Traditional Forest-Related Knowledge and Sustainable Forest Management in Africa

Papers
From the conference held in Accra, Ghana
From 15-17 October, 2008

Jointly organized by
IUFRO Task Force on Traditional Forest Knowledge
IUFRO Special Programme for Developing Countries (IUFRO-SPDC)
Council for Scientific and Industrial Research of Ghana (CSIR)

Editors
John A. Parrotta
Alfred Oteng-Yeboah
Joseph Cobbinah

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Introduction and Meeting Report

Traditional Forest-Related Knowledge in the African Context

Traditional knowledge and practices have sustained the livelihoods, cultures and the forest and agricultural resources of local and indigenous communities throughout Africa for millennia. This knowledge is tightly interwoven with traditional religious beliefs, customs, folklore, land-use practices and community-level decision-making processes, and have historically been dynamic, responding to changing environmental, social, economic and political conditions to ensure that forest resources continue to provide tangible (foods, medicines, wood and other non-timber forest products, water and fertile soils) and intangible (spiritual, social and psychological health) benefits for present and future generations.

Despite their importance and contributions to sustainable rural livelihoods, traditional forest-related knowledge and practices are under pressure in most African countries (as elsewhere in the world) for a number of reasons. These include imbalanced power relations between State forest management authorities and local and indigenous communities whose traditional governance systems and customary laws are often at odds with those of the State; the erosion of traditional knowledge and practices, government policies and regulations within and outside of the forest sector restricting access and traditional use of forest resources, and a general erosion of traditional culture and of traditional land and forest management knowledge and practices, and declining interest in traditional wisdom, knowledge, and lifestyles among younger generations. The negative implications of this loss of TFK on livelihoods, cultural and biological diversity, and the capacity of forested landscapes to provide environmental goods and services remain poorly understood, largely unappreciated, and undervalued by policy-makers and the general public in most countries.

The Conference

The International Conference on Traditional Forest-related Knowledge and Sustainable Forest Management in Africa was held in Accra, Ghana on October 15-17th 2008. The meeting was jointly organized by Ghana's Council for Scientific and Industrial Research (CSIR) in association with the IUFRO's Task Force on Traditional Forest Knowledge and the Special Programme for Developing Countries (IUFRO-SPDC). For the IUFRO Task Force on Traditional Forest Knowledge, this meeting was the fourth in a series of regional conferences held since 2006.

The conference was attended by approximately 40 participants from 13 countries in Africa plus delegates from Europe and North America. Delegates included researchers from numerous biophysical and social science disciplines, academicians and teachers, students, representatives of community-based NGOs, national forest management agencies. Also among the delegates were several representatives of local and indigenous communities involved in the studies and projects presented and discussed at the conference. The opening session of the conference included presentations by several senior Ghanaian officials and decision-makers, including Dr. A.B. Salifu (Director-General, Council for Scientific and Industrial Research), Prof. N.A. Kotey (Chief Executive, Forestry Commission) and Mr. Adjei Yeboah (Deputy Minister, Ministry of Lands, Forestry, and Mines). Their participation in the conference was an indication of the value which the conference host, the Government of Ghana, places on the issues under discussion during the conference.

Associated with this event were two pre-conference meetings organized by IUFRO's Special Programme for Developing Countries (IUFRO-SPDC): (1) a meeting of the Directors of major African national forest research organizations (the FORNESSA network) entitled "Strengthening Institutional Cooperation for Forest Research in Sub-Saharan Africa"; and (2) a training workshop on science-policy interfacing "Enhancing Contributions of Forest Science and Traditional Forest-related Knowledge (TFRK) to the Conservation and Sustainable Use of Forest Resources in Africa". Many of the conference participants supported by the grant from the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management were also involved in the science-policy training course.

Major Topics and Findings

The principal topics explored during the conference included:

- Societal perspectives on African forests in relation to livelihoods, culture, and conservation policies;
- The contribution of traditional forest-related knowledge to sustainable forest management, traditional agricultural production systems, and poverty reduction goals;
- The roles of traditional knowledge and management practices in sustaining cultural identity and rural livelihoods;
- Application of traditional knowledge in management of forest and agricultural ecosystems for food, forest products and environmental services;
- Non-timber forest products, ethnobiology and utilization of forest plants and animals in nutrition, traditional health care, and cultural expression;
- Conflicts between local and indigenous forest management practices and forest governance systems (traditional/local vs State) and efforts to resolve them;
- Challenges and opportunities for the study, preservation and enhancement of traditional knowledge to contribute to sustainable rural livelihoods and diverse forest management objectives;
- Policy issues and processes affecting the preservation and development of traditional forest knowledge.

A total of 25 papers were presented on these topics during the two days of formal sessions[1]. Presentations covered a wide range of local case studies, historical analyses, and multi-site study syntheses based on research and grass-roots development work in Cote d'Ivoire, Burkina Faso, Ghana, Togo, Benin, Nigeria, Cameroon, Ethiopia, Uganda and Kenya, as well as two presentations from Europe (see Annex II: Conference Program). These presentations are available on the IUFRO Traditional Forest Knowledge Task Force website at: http://www.iufro.org/science/task-forces/traditional-forest-knowledge/activities/accra08/.

The diversity of scientific disciplines, cultural perspectives, backgrounds, experiences and philosophies of the participants made for rich, dynamic and thought-provoking discussion during the conference. From these presentations and discussions, several topics and issues emerged that appear to be common to most countries in the region regarding the cultural, economic, and ecological importance of traditional forest knowledge, and challenges faced by local and indigenous communities to strengthen and preserve their traditional knowledge and lifestyles.

Among the issues highlighted during the conference is the general lack of recognition of the importance of traditional forest-related knowledge for livelihood security (including sustainable agricultural production and health care) by decision-makers at the national level, including those responsible for policies and management decisions about forests and woodlands which have been under traditional management by local and indigenous communities long before the establishment of state-level forest management agencies. The need to foster greater awareness of traditional knowledge and practices among policy makers, planners and the general public was highlighted, as was the need for greater involvement of forest-dependent people in forestry and agricultural policies, planning and management.

Also discussed were the shortcomings (and some failures) of many biodiversity conservation efforts in countries where establishment and management of protected areas have failed to recognize and respect the customary use rights and the roles of traditional use practices (and traditional forest governance systems) in maintaining these ecosystems and sustaining the physical, social, and spiritual well-being of forest-dependent communities.

The continued rapid erosion of traditional forest-related knowledge was an issue that received considerable attention during the conference. Strengthening the intergenerational linkages that are critical to preserving and further developing this knowledge, requires a recognition of the changing social, economic, and governance conditions arising both from within these communities and impinging on them from the broader, urbanized, or even globalised society. As in other regions of the world, these forces include the expansion of market economies, the powerful effects of popular

[1] The conference program also included a full-day field trip to the Kakum National Forest.

cultural values and lifestyle expectations via the mass media, and economic, agricultural, and forest policies that restrict traditional forms of agricultural and forest management, undermine traditional communal decision-making institutions, and limit market access to forest products based on traditional practices.

On the other hand, the conference highlighted a number of encouraging local and national examples and strategies for reversing these trends. Partnerships with NGOs, universities and research organizations and others have helped in some cases to preserve or restore traditional use rights and access for forest-dependent communities, yielded effective joint forest management arrangements, and enhanced the profile and prestige of traditional forest-related knowledge within and outside of local and indigenous communities.

The role of forest science

The actual and potential importance of forest science to helping protect and realize the full potential of traditional forest-related knowledge was discussed during the conference. Among the major points echoed throughout the conference by the participants were the importance of multi-disciplinary, participatory, research (both biophysical and social sciences); the critical issue of trust and respect (for communities, their cultures, beliefs and practices) in research on traditional knowledge, and the need for such research to help solve immediate, practical problems faced by the communities in which they work.

Working with local and indigenous communities, the forest science community can contribute to the revitalization of traditional forest-related knowledge in several important ways, including:

- Documentation of TFK in close partnership with holders and users of this knowledge, respecting the rights of local communities with regards to intellectual property protection and equitable sharing of benefits arising from the possible use of this knowledge;
- Research on traditional forest management practices and uses of forest biodiversity that help to elucidate the ecological underpinnings of traditional knowledge, and enhance possibilities for effective integration of scientific and traditional knowledge for improved forest resource management;
- Integration of TFK into forestry curricula, and partnership with the holders and users of traditional knowledge for education of the general public and decision-makers on the livelihood and environmental values of TFK.

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The organizers of this conference – the Council for Scientific and Industrial Research (CSIR) – Ghana, IUFRO's Task Force on Traditional Forest Knowledge and the IUFRO Special Programme for Developing Countries (IUFRO-SPDC) - wish to thank the following organizations for their generous financial support for this conference: the Korea Forest Research Institute, the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, U.S. Forest Service (Research and Development branch), the Swedish International Development Cooperation Agency (Sida), and the Ministry of Foreign Affairs of Finland.

PRESENTED PAPERS

BOTANICAL GARDENS AS A TOOL FOR PRESERVING PLANT DIVERSITY, THREATENTED RELIC FOREST AND INDIGENOUS KNOWLEDGE ON TRADITIONAL MEDICINE IN BENIN

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Abstract

Considering the level of degradation of natural resources in Benin and the need of local communities to preserve traditional medicine practices, 41 traditional botanical gardens have been created. Traditional botanical gardens in Benin play many roles but have been designed to reflect society's priorities, to contribute to well-being, education and research. This form of conservation constitutes a new approach which involves local communities and could contribute to the global conservation of biodiversity in Benin. Many stakeholders are involved in the creation of botanical gardens and this constitutes a great opportunity for the development of this initiative. However, many challenges have to be considered for a sustainable development of traditional botanical gardens in Benin.

Background

Human well-being is considered as an important goal by many international policies, conventions, strategies and dependent targets relevant to conservation of natural resources. This is especially true for more recent policies, which recognize how biodiversity conservation and socio-economic development can be interlinked (Waylen, 2006). The 1992 Convention on Biological Diversity (CBD) mandates that contracting Parties, to preserve and maintain knowledge, innovations and practices of indigenous peoples and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovation and practices and encourage the equitable sharing of benefits arising from the utilization of such knowledge, innovations and practices. Traditional Knowledge in the fields of medicine, healing and biodiversity conservation are well known and the need for protection of this traditional knowledge is a cross-cutting issue. Traditional approaches of conservation often assumed that nature must be protected through the promotion of the sustainable use of the resources by humans. Although, this has been useful in some situations, it has not enabled us to effectively prevent the widespread degradation of our natural resources. The loss of biodiversity is increasing. Tens of thousands of plant species are threatened with extinction (IUCN 2004, Walter & Gillett, 1998) and today we are seeing the greatest rate of species extinction in Earth's history (Wilson, 1992, Millennium Ecosystem Assessment, 2005). With the loss of biodiversity through human depredations, many traditionally utilized medicinal plants have disappeared, preventing their use by those who discovered them, as well as by the rest of humanity. In that context, botanical gardens occur as a major force for the conservation of plants around the world and have the skills and expertise to study and manage plants in cultivation, and in the wild, as a major contribution to ecological and human well-being (Waylen, 2006).

What justifies the creation of botanical gardens in Benin?

In developing countries, human activities (farming, grazing, logging, and bushfires) largely contribute to the deforestation of thousands of hectares of forests and natural vegetation each year (Sogbohossou and Akpona, 2006; 2007). This deforestation is one of the major factors of loss of biodiversity and desertification especially in dry and subhumid savannas regions. In Benin, rural populations rely on the uses of medicinal plants for their health. Unfortunately most of concerned species are disappearing due to overexploitation. As a consequence, in 1999 an international workshop was held by IPGRI to establish a national priority list of endangered medicinal tree species (Eyog Matig et al., 2001). The disappearance of these species that are always used by populations will be a great problem not only for biodiversity conservation but for population health and food. The conservation of threatened medicinal and food species will help to preserve and restore biodiversity, to fight against starvation and reduce poverty in local populations that rely for life on those resources. It is now generally admitted that people are less likely to have an incentive to conserve natural resources if they do not appreciate their value (Adams *et al*., 2004). Conservation actions which take into account the sustainable use is likely to be most effective and avoid negative impacts on local communities, which in the past has been unfortunate victims of the "protectionist" approach to conservation (Colchester, 2002). If conservation is to succeed, it should take into account of human needs. To contribute to the conservation of biological diversity traditional botanical gardens have been created by different agencies (NGOs, public ministers, forests department, etc.). This new concept has been adopted by local communities which are increasingly requesting help with the establishment of their own gardens.

Objectives of botanical gardens in Benin

The aims of botanical gardens in Benin are the following (Sogbohossou & Akpona, 2006; Krohmer et al., 2006; Houngnihin, 2008).

- Conserve phytodiversity: through botanical inventory and monitoring; protection of threatened species, including the possibility to reintroduce rare or locally extinct species.
- Conserve traditional knowledge by documenting of all kinds of traditional plant uses, especially medical and ethnoveterinary uses.
- Use of the garden as a tool and a resource for environmental education, i.e. for school children, students, non-governmental organisations (NGO), local, national and international public.
- Protect of natural resources by sustainable production of the plants used in traditional medicine.
- Create sources of new income for the local populations through nurseries and ecotourism activities.
- Establish permanent sites for research on sustainable use methods and the reintroduction of threatened species, at the same time raise awareness amongst the population.
- Create and develop a research database on traditional pharmacopoeia.
- Assure the availability of high qualities and less expensive traditional medicines in the national health system.
- Reinforce and build capacities on traditional medicine.

Establishment and management of botanical gardens

Fourty two botanical gardens have been established in Benin from 2001 to 2007. Among them, seven have been created by research institute, laboratory and NGOs and 35 established by the national program of pharmacopoeia of the Ministry of Health.

The Botanical Garden of Papatia

The Botanic Garden of Papatia was the first garden which has been established in Northern Benin in 2001 (Krohmer et al., 2006). A species-rich savannah area which had not been cultivated for many years due to its poor soil has been protected from all further human impact. This area has been donated to the newly created garden committee in perpetuity by the local king. The garden contains more than a hundred woody plants and several hundreds of herbaceous species. It is composed of a totally protected core zone (about 5 ha), surrounded by a 10 m wide fire break and a thorny Acacia hedge to prevent the intrusion of cattle. The core zone includes various ecological sites, such as a young fallow, sandy, rocky, lateritic, moist and loamy areas. Wood-cutting, pasture, hunting and bush-fires are now forbidden in this core zone, in order to enable natural growth without any human influence. In the surrounding 9 ha buffer zone, moderate pasture is allowed and annual early fires (at the end of the rainy season) are lit as a protection measure. They help to avoid the more destructive accidental bush fires in the late dry season.

The garden features the necessary educational infrastructure (nature trail, information centre, herbarium, trained guides) to facilitate field visits and permit the sensitisation of visitors (pupils, students, tourists, villagers). Already in the year following the foundation, educational workshops about environmental issues and traditional medicine have been held. These facilities have been set up by the members of the garden committee themselves, the (surprisingly low) costs being covered by a project of the University of Frankfurt and a private donor. In 2002, a nearby gallery-forest could be added to the garden: The biodiversity of such water-accompanying formations is particularly high and nowadays particularly threatened. In the same year, a tree-nursery was created in order to multiply rare species for distribution and to reintroduce them into the garden. Permanent plots in the core zone have been established for a long term monitoring of vegetation dynamics under such protected conditions.

In 2005, with the financial assistance of the IUCN, the project “Ecole Baobab” was initiated, which enabled the foundation of an environmental education centre aiming at the ecological sensitization of the whole region’s population. Since the support ended 2006, the garden committee is looking for new funding to ensure that the actual achievements will persist and continue to progress. At present, the garden receipts are far from being sufficiently high to finance the educational activities.

Additional garden activities:

- tree nursery: multiplying threatened local species, but also selling highly demanded exotic fruit trees like cashew nut and mango tree. This is an important source of additional income for the population, just as the
- beekeeping in the garden core zone for honey production, the
- creation of a traditional pharmacy and the
- foundation of a women’s group for market orientated vegetable gardening, made possible be a new well.
- Eco-tourism is planned to be integrated in the garden programme in the future.

These additional income possibilities appeared to be a very important, if not essential condition for a long term garden-existence.

Gusõn botanical garden

The example of Papatia strengthened an association of traditional healers at Gusõn in the region of Pehunco, who were also worried about the ongoing decline of traditional medicinal plant species, in their idea to create their own botanical garden: They put a 40 ha territory under permanent protection, located on two hills and therefore not agriculturally used. Its main aim is to guarantee the continuity of the local traditional medicine, by the protection of the used plant species and the knowledge linked to them (Krohmer et al., 2006). To achieve this aim, an action programme quite similar to that of Papatia is currently put into practice. As an additional and very effective instrument for environmental sensitization, the Gusõn garden committee produces radio transmissions that focus on traditional knowledge, biodiversity, ecology and so on, which are broadcasted twice a week and reach a wide audience in the region.

Botanical gardens of Dakérérou, Nassou, Gnaro and Koungarou

From 2006 to 2008, four other protected areas in different implementation states joined the network: the Botanic Garden of Kouandé, the sacred forest of Nassou, the municipal forest of Dakererou and the protected areas of Koungarou and Gnaro (Sogbohossou & Akpona, 2006; 2007).

Identification of gardens sites

Possible villages of implantation of botanical gardens were identified by the Laboratory of Applied Ecology (LEA) and BIOTA (Biodiversity Analysis and Transect Monitoring in West Africa). Those sites were prospected by a team of CERGET NGO and meetings were organised with local communities and districts authorities of each pre-selected sites. During those meetings, it appeared that the local populations are aware of the degradation of their resources and the disappearance of many useful species, and they expressed a need to overcome resources degradation. Together with those village dwellers, the concept of several traditional botanical gardens was developed as a way to conserve species diversity as well as the traditional knowledge linked to numerous threatened species. To achieve this goal, populations identified some areas where such gardens could be set up and the team had prospected those sites.

Creation of village botanical gardens committees

In order to have a group which will be in permanent contact with the NGO staff and will have the responsibility of taking care of the garden, we organized in each selected village, a meeting with all stakeholders (healers, farmers, and stockbreeders) and genders. During this meeting local populations identified resource persons which could help for the gardens maintenance. The committee was composed of a president, a secretary, an accountant, two wise persons of each ethnic group and two guards. Gender issues were considered in the committee' establishment.

Identification and production of plants in nursery.

We identified with communities, using a participatory approach, the main species they want to promote according to the extinction risks and their needs for traditional medicine. To this list, the project adds other species from the national priority list of endangered medicinal tree species established by Eyog Matig et al., (2001). We delineated and estimated with the committee the area in which reforestation need to be done for the current year. According to the area, the need in seedlings per garden was estimated annually. A contract was signed with a central nursery in Pehunco district before the rainy season. This nursery was monitored and plants species were produced and bought by the project. To build local capacities in nurseries in each village where the botanical gardens sites were identified, we asked each committee to identify a volunteer to be trained by the responsible of the Pehunco nursery about techniques of production of plants in nursery. After the training, seeds were given to each committee to create their own nursery in each village. Three tree-nurseries were created in order to produce rare species for distribution and to reintroduce them into the garden (Figures 1a, 1b, 1c).

Management of gardens and private plantations .

After the production in nursery, the project facilitates the transport of seedlings from the nurseries to the botanical gardens. During the reforestation, the committee got support from many other villagers to help with the plantation. We delineated the edge of each garden with fast growing species such as *Gmelina arborea, Acacia polyacantha, Eucalyptus camaldulensis* and *Azadirachta indica (*Figure 2). In the gardens, threatened medicinal species were planted: *Khaya senegalensis, Kigelia africana, Afzelia africana, Afraegle paniculata, Vitex doniana, Strophantus sarmentosus* and *Moringa oleifera*. Moreover we promoted private plantations by giving seedlings to villagers who were interested in creating their own plantations in their compounds or farms. This support was given especially to some healers and breeders who expressed the need. The national day of tree was celebrated each 1st of June in Benin.

Figure 1. Plant production in nurseries. A. *Eucalyptus camaldulensis*; B. *Afraegle paniculata*; C. *Kigelia africana*.

Figure 2. Delimitation of Niaro garden with *Gmelina arborea* (2nd year of plantation)

Moreover we promoted private plantations by giving seedlings to villagers who were interested in creating their own plantations in their compounds or farms. This support was given especially to some healers and breeders who expressed the need. The national day of tree was celebrated each 1st of June in Benin. The project availed itself of this opportunity to support the district authorities by giving them some seedlings for reforestation where they chose to celebrate this event.

Local committees are in charge of the protection of gardens against late bush fires. Before the dry season communities take care of the edge of gardens by establishing 2-3 meters firebreaks around the gardens (Figure 3). Annual early fires (at the end of the rainy season) were lit as a protection measure and help to avoid the destructive accidental bush fires in the late dry season.

Figure 3. Fire break in Dakererou garden (Pehunco district)

Awareness and promotion of gardens

The promotion of botanical gardens consisted in the realisation of boards for identification of gardens, for orientation and public awareness about “no fires, no pasture” (Figure 4a, 4b) and for identification

of main species in the gardens. We identified and built in each garden trails to facilitate the visit of gardens. Moreover, the project builds in 2007 one chair for tourists in each garden (Figure 5). Many leaflets were edited to promote the new concept of botanical gardens in the region.

Figure 4. Plant production in nurseries. Left: identification signs; B. sensitisation boards

Figure 5. A chair built in a garden for tourists and for rest

The project signed a contract with a local radio called NaanЄ Ouassa FM to raise awareness. As an additional and very effective tool for environmental sensitization, the association of healers in collaboration with gardens committees produced radio talk shows that focus on traditional knowledge, biodiversity and ecology, the importance of gardens which are broadcasted twice a week and reach a wide audience in the region.

Creation of district associations of healers

An association of healers exists before the beginning of this project in Ouassa district. This association was established with BIOTA and the Laboratory of Applied Ecology and was in charge of the management of one of the first's botanical gardens in the district: The garden of Guson. This association had been reinforced and help in the creation of a similar association in Sinendé district. Those associations will be trained and traditional pharmacy will be created to improve traditional medicinal knowledge.

Research

Many gardens put a strong emphasis on research relevant to the development of useful plants, especially in the fields of agriculture and healthcare (Waylen, 2006). Many research activities are planned to be implement in the gardens. In 2007, an MSc student investigated the importance of those gardens in the preservation of most important ethno veterinary plants in the region. This topic was defended in last August 2008.

Botanical gardens installed by the ministry of health

The national programme of pharmacopoeia and traditional medicine had been created in 1996. In 1999, the program had inventoried medicinal plants of Benin and also Traditional Medicine Patricians (TMP). After that step, the programme establishes with the participation of healers, 35 gardens in all the department of the country from 2002 to 2007. The creation of such garden is based on the needs to assure the availability of plants for traditional medicine and at lower costs. The botanical gardens have an area which varies from 1.5 to 10ha and are managed annually by a garden committee. The programme proceeds annually to the training of TMP on some current diseases such as malaria and

HIV. The ministry of health aims through this programme to create an environment (technical, legislation, etc.) for the application of traditional medicine and pharmacopoeia in Benin. For that purpose, the programme created a national day of traditional medicine and pharmacopoeia (each 12 of June) and a national council for traditional medicine in Benin.

Cooperation between the network member gardens

The network gardens already exchange management know-how and their experiences concerning education and sensitisation methods. All gardens will soon benefit from the possibility of exchanging plant and seed materials, to enrich their local collections and to reintroduce species that may have been already extinguished locally, but have important medical properties. A regional traditional healer's network will allow its members to exchange knowledge and remedies to help the traditional medicine compete better with the modern medical system. An increasing esteem for traditional medicine can already be noticed in the places where the first gardens had been implemented.

Many examples were taken from the experience of the first village botanical gardens in the region: The Botanical Garden of Papatia established in 2001. An exchange visit of members of Ouassa and Sinendé gardens management committees to Papatia botanical garden was arranged in 2006 to share and train participants in new packaging, processing, and marketing methods.

Difficulties and challenges for sustainable development traditional of botanical gardens?

Botanical gardens are a major force for the conservation of plants around the world and are a major contribution to ecological and human well-being (Waylen, 2006). Village botanical gardens are a recent strategy to conserve medicinal and threatened plants in Benin. It has the same advantages of preservation of the genetic resources for therapeutic, phytochemical and pharmacological studies (Vieira, 1999). The concept differs from classic botanical gardens which are a form of *ex situ* conservation contrary to the traditional botanical gardens which are a form of *circa situ* conservation (Hamilton, 2002).

In the case of Benin, we followed plants production in nurseries to enrich spaces with original medicinal species which abundance was reduced in the past. As a result we obtained a stable and an improved form of botanical gardens considering that species are planted in their natural habitat. Botanical gardens are also a strategy to fight against desertification and to preserve medicinal plants from extinction. They are managed by local communities for the promotion of traditional medicine and ecotourism and could further generate new incomes (Sogbohossou & Akpona, 2006; 2007).

The sustainability of botanical gardens in Benin context is affected by many difficulties and some challenges have to be considered:

Agriculture. Some farmers plot at the edge of the gardens and this can especially facilitate the propagation of late fires to the gardens. To assure the sustainability of gardens, we need to create a buffer zone between the gardens and the fields which could be used for nurseries and other activities related to the conservation of natural resources.

Cattle breeding. Gardens shelter permanent water sources which attract cattle. Cattle herders often prune the fodder trees to feed their animals. The consequence is drastic because the fodder plants are the same with the same threatened trees used for traditional medicine. The involvement of cattle breeders in the gardens committees will help to mitigate such conflicts. The management of the gardens by the populations even makes them more responsible and it is noticed that they exert a good monitoring on their resources and do not hesitate to denounce destruction actions.

Fire management. Some gardens have been destroyed annually by late fire. This is due generally to the lack of training of committees (especially those established by the ministry of health) on fire management.

Social considerations. Generally when a new concept occur in a village, all the community can not be agree with the innovation. It is necessary to implement the innovation for a first phase (called pilot phase) and to show the direct positive impact on the livelihoods of those who had been involved. It is necessary to proceed to awareness in order to have the participation of those who reject the project during the pilot phase. In addition to the ecological and geographical requirements necessary for the

creation of such a botanic garden, the following social conditions proved to be necessary to guarantee the long-term existence:

- Integration of all local stakeholder groups in the garden-planning, especially the different ethnic groups present in the region and all those who may eventually be affected by the protection measures, in order to avoid local conflicts.
- Integration of traditional (e.g. council of the elders) and modern authorities.
- Sensitisation, by means of workshops, excursions etc., of all villagers affected directly by exploitation restrictions.
- Community-elaborated code of conduct, the protection measures being agreed by all members of the local community.
- Consider the necessity to develop income generating activities for the population which are closely linked to the garden; so each and everyone will be eager to contribute to its long term success.

Creation of synergy and functional network. Many institutions work on botanical gardens in Benin and each of them develop its own strategy. No guide, no synergy and no policy exist in that area. It is important to create that synergy in order to be able to act with the same methodology in botanic gardens development. Moreover, we have to promote many exchanges between actors at all level in order to share experiences on garden management and also on traditional medicine. The innovation of the ministry of health could be an interesting opportunity to created a forum and discuss about the existing information and about new challenges we have to face.

Integrate genetic aspects into botanical gardens development. Little is known and investigated about seeds quality for nursery establishment and for genetic diversity. Botanical gardens development have to consider the preservation of the existing genetic diversity as potential for adaptation and evolution, and, therefore, to ensure that the adaptation and evolutionary potential of important regional tree species are maintained.

Create a link between botanical gardens development and policy making process. Traditional botanical gardens in the context of Benin constitute a great opportunity for nature conservation, traditional medicine development, research and human well being. The combinations of those roles generate good information which could be used to influence decision making process. It is important to capitalize annually the existing information and to think about how that knowledge could be more efficient or could be easily transformed into useable information for problem-solving and decision-making. This could allow governmental institutions to integrate this new concept in their priority and promote village botanical gardens in each village as a national conservation strategy which integrate directly communities.

Sustainable development of botanical gardens in Benin. Village botanical gardens are the most recent strategy we have to develop when we consider the implication of local communities in the management of such gardens. Many projects involve themselves in the management of existing forests (classified forests, reserves, etc) on which the state have authority. Those projects need lot of financial and technical resources to be implementing. And after the end of the project, local populations started to degrade the forests which have been managed with their participation. To change that tendency, botanical gardens have many opportunities.

Firstly, areas which are converted in botanical gardens are the property of the communities and are supposed to be more protected in a sustainable way. In a second way, those areas will provide traditional healers an opportunity to implement their daily activities without great difficulties. Moreover, if correctly managed, gardens could provide money for populations through tourism. Considering the lack of permanent funding process, we have to give attention to 3 major principles (Krohmer et al., 2006):

- ***Have a close look***: In many places, people already preserve their environment: Look for sites like holy groves, sacred forest, fetish places and other traditionally protected sites, as well as for sites that are not or little used for agriculture as starting point for such activities. They may be especially well-suited as starting-points for local botanic gardens.
- ***Go to the roots*****:** Ask the local populations about their perceptions of environmental changes and discuss with them their ideas of remedies and measures to be taken: you will admire their creativity and energy and realize that you are preaching to the already converted.

- ***Don't think too big*:** In countries like Benin, small projects often reveal to be more efficient than big ones; with little money, a lot can be done.

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CONTRIBUTION OF TRADITIONAL KNOWLEDGE DEVELOPED BY FARMERS TO CONTROL PESTS AND DISEASES IN COCOA AGROFORESTS IN SOUTHERN CAMEROON

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Abstract

Introduced in Cameroon some decades ago, cocoa trees are mainly grown under partially cleared forest shade. While technical requirements for cocoa trees are well-known and taught to farmers, associated forest trees are generally retained and managed without advice and technologies from extension/forest services to provide shade to cocoa and meet specific household needs (food, medicine, etc…). Depending on the type and density of associated trees inside cocoa agroforests, cocoa can be either attacked by black pod disease (when the shade is heavy) or capsids (light shade). With the support of the state which was providing pesticides, farmers in their daily practices succeeded to find "stable" situations where associated trees are maintained to allow the growing and production of introduced cocoa trees. Under the context of worldwide economic liberalization and structural adjustment policies, the government withdrew from pesticide imports and distribution and suppress subsidies to inputs. These new policies have generated a set of new constraints including access to pesticide. The previous "stable" situation (where cocoa trees received regularly chemical pesticide applications) was disrupted by the reduction of pesticide applications. This reduction led to the increase of pest and diseases with the consequent reduction in the productivity of the cocoa trees. The current paper describes farmer knowledge developed and adapted to local conditions to overcome major pests and diseases in cocoa agroforests. These farmers knowledge are generally based on plant/trees extracts that are mixed with synthetic chemical pesticides. Constraints related to the application of this farmer knowledge are also described and discussed.

Introduction

Small holder forestry activities are the future of forestry outside primary/secondary forest stands on the fringe of the Congo Basin. In the case of Cameroon, cocoa agroforests are the most important small holder forestry settings. Apart from home-gardens, fallows and crop fields, cocoa agroforests generally host forest trees that are associated with exotic cocoa trees and crops in the same land. They present a good opportunity to combine products and services provided by crops and forest on the same land. Because it hosts cocoa trees whose products are sold on the international market, cocoa agroforest management and composition are influenced by international trade and related changes. These trends/changes impact on the way farmers manage their cocoa plantation and as such they need to be reviewed constantly to update cocoa agroforest management systems and take advantage of new opportunities. The current study aims at assessing the indigenous knowledge acquired by farmers in the cocoa agroforestry area following structural adjustment policies (lower subsidies) and liberalized input and product markets including cocoa by the World Bank and the International Monetary Funds. The paper presents (1) The importance of the cocoa agroforestry systems, (2) Pest constraint management in cocoa agroforestry, (3) Ecology of pest management, (4) Indigenous pest management developed by farmers and (5) Perspectives associated with this new farmer knowledge in cocoa agroforests of Cameroon.

Importance of cocoa agroforestry systems

Since its introduction in West Africa, cocoa trees have been grown either in open sun or under shade trees. We generally have cocoa orchard with less/no trees and cocoa agroforests characterized by a combination of cocoa with shade trees. Cocoa agroforest fields are generally established by felling part of the forest trees and introducing cocoa trees under remnant forest. After felling of forest trees, farmers establish a crop field—generally an *essep* field (*Egussi melong*)— the year before young cocoa trees are introduced in the field. Banana plants are also introduced in the field to provide early shade to young cocoa plants. As the young cocoa trees are growing, forest trees are retained and additional exotic trees are introduced gradually in the system towards establishing the shade system of the cocoa plantations. The result, a few years later, is a multistrata system which is a mixture of cocoa, forest and exotic trees. Associated plants (mainly forest and exotic trees) contribute to providing shade to cocoa trees and allowing their development. Cocoa orchard follows the same development except that after the felling of forest trees, banana plants are introduced to provide early shade, and cocoa trees are later maintained without shade neither from forest or introduced. This was generally encouraged in Ghana and Cote d'Ivoire.

Depending upon availability of shaded trees cocoa production may vary. A cocoa plantation under shade is known to be less productive but can survive longer than cocoa orchard. Because of the absence of shade a cocoa tree can produce only for around 15 years, while a shaded cocoa, like the ones in Cameroon, can still produce after 40 years. In the study of cocoa production in Southern Cameroon, Sonwa (2004) obtained a production of 6 to 17 pods per tree, which is significantly lower than the 25 to 70 in Côte d'Ivoire (Lachenaud & Mosu, 1985) and 12.7 to 48.6 in Ghana (Hurd & Cunningham, 1961 cited by Wessel & Gerritsma, 1993).. This difference is partly attributed to no-shade production option in these two countries. In an experiment in Cameroon, a shaded system with pesticide applications could produce 768 Kg /Ha compared with 464 Kg in a heavy shaded system (Sonwa, 2004). So the non-shaded system in this environment is producing 65% more than the shaded system. The general advice from extension services to farmers is to retain trees so that they allow 60% of the light to pass through to the cocoa canopy for the good development of cocoa trees. But farmers generally do not apply this recommendation and based on their knowledge of trees, they build an ecosystem where forest trees, exotic trees and crops are intimately associated with cocoa trees. A total of 201 plant species were found to be associated with cocoa farms in southern Cameroon (Sonwa et al., 2007). This also contributes to diversifying the income of cocoa agroforest.

The sale of cocoa beans is supposedly the main source of income for cocoa farmers. In the late 80s when the cocoa sector was supported by the state, cocoa provided the main income to rural farmers in Cameroon. Around this period, a cocoa farmer in southern Cameroon, mainly in the Lekie division, could earn 230 000 Fr CFA by selling cocoa beans per year (Losch et al., 1991). Globalization and liberalization led to the restructuring of the government parastatal in charge of regulations, input and product marketing in Cameroon..With their dependence on the international market and its accompanying fluctuating prices, farmers now started to think of managing the associated trees available in their field. Based on their previous knowledge of the management of indigenous trees in forests or villages and the will to diversify their income, they tried to manage diverse trees inside the cocoa plantation for the purpose of household consumption and market. In view of understanding farmers' farm management modules, Sonwa et al. (2007) found that, in each of the cocoa plantation, of the 21 plant species found, 6 are edible, 2 are medicinal, 6 are timber and 6 others had minor use. For southern Cameroon, of the 201 plant species, 17% of the tree species associated with cocoa had edible products, 11% produced low value timber, 11% produced high value timber, and 8% had mainly medicinal uses (Sonwa et al., 2007). Few studies have tried to quantify the total amount of what is extracted from the cocoa farm. Nevertheless, an evaluation from Gockowski et al. (2004), shows that with an investment of 46 000 CFA, ($US 102; i.e. 450 Fr CFA = 1 $US) with a 300Kg/ha of cocoa production, a farmer in southern Cameroon could earn 164 000 Fr CFA ($US 364) in 2002/2003. These authors also observed that African plum (*Dacryodes edulis*), 'Ndjanssang' (*Ricinodendron heudelotii*), palm oil (*Elaeis guineensis*), palm wine (*Elaeis guineensis*), avocado (*Persea Americana*), orange (*Citrus sinensis*) and mandarin (*Citrus reticula*) from cocoa agroforest could provide a net return of 96 913 Fr CFA ($US 215); 20,939 Fr CFA ($US 47); 4,771 Fr CFA ($US 11); 13,250 Fr CFA ($US 29); 2,795 Fr CFA ($US 6); 16,698 Fr CFA ($US 37); 62,700 Fr CFA ($US 139) respectively. Managing trees in association with cocoa can thus be useful for small holder cocoa farmers. .

Besides the socio-economic importance associated with the trees that are found in the cocoa farm, managing these trees with cocoa in the same field provides opportunities for cocoa to play an important ecological role. In Cameroon, shade agroforests are recognized to provide habitat for local faunal (Gartlan, 1989; Weinbaum et al., 2007). Cocoa agroforests also store carbon of potential interest to the development of Clean Development Mechanism (CDM) and Reduction of Emission through Deforestation and Degradation (REDD). Within the UNFCC, these contribute to climate change mitigation while at the same time potentially generating some income through the sale of carbon stock to the international community. It is also expected that cocoa agroforests can play a role in watershed management (Sonwa et al., 2007).

Pest constraints in cocoa agroforests

The main pest constraints in cocoa production are black pod disease and mirid attack (Sonwa et al., 2005). Black pod is caused by *Phytophtora megakaria*, a fungus that is found in the cocoa plantation. It spreads in the system and attacks mainly cocoa pods. The fungus spreads on the pod and then the beans are affected by becoming "powder" and useless for chocolate manufacturing. This can cause a loss of cocoa beans up to 60%. Mirid attacks and kills the branches of cocoa trees, and reduces the transmission of sap. Capsid attacks can reduce cocoa production by about 75% (PAN, 2001). A workshop of African cocoa scientists in Ghana some years ago mentioned the fact that black pod disease and capsid attacks were the main constraints of cocoa production in West and Central Africa (Vos & Neuenschwander, 2002).

The use of pesticides such as copper-based fungicides (10 times a year or every 21 days) is recommended by extension workers to control black pod disease. Without this application, black pod incidence could be more than 60% (Sonwa, 2004). To control capsids, fumigation is recommended every 28 days. Pesticide application in Cameroon was previously managed by SODECAO, a para-statal. There was a cocoa board in charge of buying and fixing of cocoa prices so that a fixed price was guaranteed to farmers. Following IMF and World Bank's intervention, Cameroon, under the pretext of liberalization of its economy, stopped the subvention of the cocoa sector. The private sector, which was ill prepared at the time, was asked to take over the role the State had been playing (Matteson et al., 1995). In the mid 1980s, over 30 million fungicide packets were acquired, transported and distributed freely to farmers. By 1993, following the liberalization of the sector, only 3 millions packets were purchased by private suppliers (Varlet & Berry, 1997). Sonwa et al., (2008) found that only 21% of farmers buy their pesticides in the village market. Of the10 fungicide application recommended each year, very few farmers are able to apply 5 per year. Pest and diseases became the main constraint faced by cocoa farmers in southern Cameroon (Sonwa et al., 2005).

Micro-ecology of cocoa agroforests and pest management

Micro-ecology of the cocoa field depends on the density of plants (cocoa and non-cocoa) and the type of management applied in cocoa plantations. Cocoa, which is originally an under-storey plant originated from the forest of Amazon. For its proper development, the cocoa tree needs certain micro-ecological conditions without which the plant becomes stressed and susceptible to pest and diseases. The micro-ecological conditions for instance mean a temperature of 18ºC-32ºC, 70-100% humidity and 50-100% light (Mossu, 1990). Temperature, light and humidity around cocoa trees, are thus important factors influencing the development of cocoa trees and cocoa pod production. These factors and soil conditions can be influenced by the nature and density of other plant species existing on cocoa farms.

The micro-ecological conditions of the cocoa agroforest also determine the level and type of pest on cocoa farms. *Phytophtora megakaria*, the agent of black pod disease develops well in humid conditions. The spores of the fungus are stored in the soil during the dry season and emerge under humid conditions to infest cocoa pods (Norgrove, 2007). Consequently, high density of forest trees translates into high humidity thereby creating a favorable environment for diseases on cocoa farms. Capsids on the other hand are mainly active under open cocoa systems like those in West Africa. The more forest trees in the system, the less probability of capsid attacks. Given the two scenarios in which the 2 diseases prevail especially in Cameroon, farmers need to find a good equilibrium when introducing and managing trees inside cocoa agroforests. This is also important since having forest trees on cocoa farms is also contribute socio-economic and ecological services.

It is generally accepted that 60% light is ideal for cocoa to thrive because it allows good development of cocoa and prevents pest and disease with the rational use of pesticides. Some trees are seen as susceptible to pests and facilitate the spreading of the disease in cocoa plantations. A recent investigation in Cameroon suggested that *Irvingia* was the host of *Phytophtora megakaria* (Holmes et al., 2003). In Cameroon, it is recommended to retain the following trees when converting forest to cocoa plantation: *Terminalia* spp, *Millicia excelsa, Albizia* spp, *Alstonia boonei, Ficus volgeliana, Ficus exasperata, Entandrofragma* spp, *Antrocaryon* spp, *Pycnanthus angolensis, Canarium schweinfurthii* and *Epathodea campanulata* (Braudeau, 1969). *Ceiba pentandra* are also suitable for the cocoa plantations. *Cola* species on the other hand are not suitable because of their ability to host capsid that can attack cocoa trees. Despite these recommendations, the maintenance of trees in cocoa plantation is generally the result of a balance between socio-economic and ecological/agronomic/sylvicultural considerations. It is thus not surprising to see that farmers are still maintaining some other plant species on their cocoa farms to sell for cash. This was also observed in Nigeria. Scientists generally advice forest trees (and mainly timber species) to be associated with cocoa. Farmers, for their part, are preoccupied with the planting of other tress that can provide basic needs along side the production of cocoa. Sonwa (2004) observed that each cocoa farmer in southern Cameroon intentionally introduced 7 species (4 fruit and 3 non-fruit) in their cocoa farm. For the region, it was observed that 23 fruit species and 68 non-fruit species were introduced. The purpose was for farmers to diversify their income and thus balance the fluctuation of cocoa prices, but also complement what is lost as a result of non/low application of pesticides. The combination of trees in the cocoa farms led to a multistrata cocoa agroforest that offered diverse types of micro-climate and reflected the various perspectives in smallholder cocoa agorest management. Sonwa (2004) found that in the instance where pesticides are not available, a cocoa system with less cocoa trees but associated with other plants produced more cocoa than a system with high cocoa density. In the system with high cocoa density with fewer shade trees *Phytophtora* movement was probably easier from one cocoa tree to another. This suggests that farmers' knowledge about the maintenance of trees in the system could influence the management of cocoa production.

New indigenous knowledge developed by cocoa farmers.

Non-availability and non-affordability of conventional pesticides have led cocoa farmers of southern Cameroon to develop alternative local pesticides to treat their cocoa plantations. Coulibaly et al. (2002) provided more details on these uses: plant extracts are either used alone, mixed with other plant extracts, or mixed with synthetic pesticides. The plant generally cited by farmers was hemp (*Cannabis sativa*), locally call "*chanvre indien*" or "*Banga*" in local language. Active ingredients of the plant are extracted by boiling, drying or pounding of hemp leaves that are mixed with other plant extracts and/or combined with synthetic products. According to farmers, hemp plants in cocoa plantation can help to repel some insects. The sustainability of plant extracts derived from hemp is threatened by the fact that hemp is recognized as a drug and its use prohibited. Farmers thus hide the use of the plants and generally crop it far inside the forest. Besides hemp, other local plants used to control cocoa pest (black pod and capsid) are *Erythrophleum ivorense*, *Guiobourtia tessmannii*, *Ceiba pentandra, Pachyelasma tessmannii, Carica papaya,* and *Nicotiana tabacum*. Parts of the plant used are roots, barks or leaves. They are used alone, mixed with other tree extracts or mixed with hemp. All these mixtures are used to threat black pod diseases and capsid. The effectiveness/efficacy of these uses depends on the mixture of different plants species. According to farmers, the more diverse the mixture is, the more effective it becomes. Farmers develop these local mixtures based on their previous use of the plants. The use of the plant extracts thus depends on the toxicity from previous use. *Erythrophleum ivorense* is reported to be toxic to human, while *G. Tessmannii* and hemp are none toxic when boiled and are thus commonly used as medicine for malaria, stomachache, headache, etc.. Apart from hemp and *Nicotiana tabacum*, trees used by farmers to develop local pesticides are found inside cocoa plantations. Chemical pesticides used by farmers generally include locally available products such as cuprous oxide, cuprous hydroxide, chlorpyrifosethyl and endosulfan as active agents. Coulibaly et al. (2002) noted that other relatively cheap chemicals mixed with plant extracts and used as insecticide are products such as kerosene, crezyl (a sanitary cleaning product), kanfa or naphthalene (a cockroach insecticide used for clothing), powder from burned old tires, etc… Although these are perceived as dangerous for cocoa fruit and leaves, farmers use them because of lack of alternative pesticides.

In southern Cameroon, more than half of cocoa farmers know about the existence of these traditional methods (Sonwa et al., 2002) used against cocoa pest and diseases. Because hemp use is prohibited, not all farmers claim knowledge of its usage for fear of being reported to the police. Nevertheless, more than half of those who are aware of the existence of these traditional methods know and/or use one of these methods. For cocoa farmers, the constraints related to the new techniques developed locally are the ban of hemp by law (24% of cocoa farmers), some ingredients are hard to find (9%), the methods are dangerous for health (5%), the methods are time consuming (4%), etc. Despite the emergence of these new local methods, 21% of farmers expressed their need to use the "modern" method, while 30% preferred using both traditional and modern method.

Farmers' indigenous knowledge of preventing or reducing black pod disease and capsid attacks is mainly based on their previous knowledge of the plant being used. Plants that are perceived to be dangerous to humans or germs are use to overcome pest and diseases of cocoa. Consequently, farmers combine their knowledge of the plants used for the local production of pesticides with what they know about the management of tree density on cocoa plantations.

Perspective

The indigenous knowledge to treat pest and diseases was developed by farmers in the context of non affordability and non-availability of pesticides. Sonwa et al., (2007) noticed that only 20% of farmers in southern Cameroon were buying their pesticides in local markets. The will to use modern pesticides that are well packaged is still there, and farmers will be ready to use them if they are available. But the new initiative of farmers in using local tree/pants extract offers an opportunity to assess their effectiveness in reducing the negative effect of pests and diseases. In the case of hemp, it will be good to identify the main active ingredients and see how it can be manufactured in an acceptable method for use. The use of tree bark poses a problem of sustainability.

Other indigenous knowledge is mainly linked with the management of associated trees inside cocoa plantations. On the issue of tree density, farmers are aware of the fact that some trees can attack or limit the development of pests. A report of IRA (1988) reveals that achae caterpillars, responsible for the defoliation of cocoa trees survive in *Piptadeniastrum africanum, Margaritaria discoides, Petersianthus macrocarpus, Clhorophora excelsa, Terminalia superba, Entandrophragma utile, and Pycnanthus angolensis*. Despite this, farmers still keeping these trees on their cocoa plantation probably because of the benefit they provide. Some farmers will prefer to maintain some trees in the field because they favor the development of cocoa and make the cocoa tree less susceptible to pest attack. (Bidzanga, 2005). The result of a balance between which trees to maintain or remove is the indigenous cocoa agroforest system comprising of a mixture of forest and exotic trees. As this agroforest is playing a good ecological role, farmers' knowledge needs to be combined with modern recommendation in order to design an appropriate integrated approach. The Sustainable Tree Crops Program is trying to develop this through network of farmer field school (David et al., 2007). However, focus needs to be placed on the management of forest trees alongside the production of good cocoa yields. To have sustainable cocoa agroforestry systems where forest trees are associated with cocoa, local knowledge needs to be combined with modern sylvicultural practices.

Multidisciplinary research around forest trees and its link to cocoa farming needs to be promoted (Sonwa et al., 2005). This needs to take into consideration both farmers' experience/knowledge and the outcome of formal research.

Conclusion

The indigenous knowledge developed by farmers to controlpest and disease problems is based on plant extracts and mixtures of these extracts and/or synthetic pesticides. The knowledge developed by farmers is based on their previous perception of the nature of the products they use. These new methods are also combined with previous practices of farmers to find a balance between forest and exotic tree density in the system so that the combination does not favor black pods or capsid attacks. Although current efforts in developing integrated pest management practices are still centered around cocoa, there is a need to also take in consideration sylvivulture of forest trees. Indigenous knowledge of farmers can thus be useful when developing tools for the management of small-holder forestry systems containing cocoa and companion trees (exotic and forest).

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TRADITIONAL AGROFORESTRY SYSTEMS IN TOGO: VARIABILITY ACCORDING TO LATITUDE AND LOCAL COMMUNITIES

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Abstract

The presence of trees in agrosystems is a fundamental property of agrarian landscape in tropical Africa. This study aims to define the typology of traditional agroforestry systems and show the variability of their structure in Togo. Forest inventory and ethnobotanic investigations were carried out in several sites across the country. In each site trees inventory was done in plots of 50 m x 50 m, completed by queries on the uses of species conserved in farms. Three types of traditional agroforestry systems were identified: home garden and farm parkland extended across the study area, and « multistage farms » practice in cocoa and coffee plantations in southwest of Togo. The structure of these agrosystems varied according to latitudinal gradient and practices of local communities. Some agroforestry species like *Parkia biglobosa, Vitellaria paradoxa, Vitex doniana* have a large distribution spectrum, and others were restricted to specific climatic region. The diversity index of Shannon increased from 0.51 bits in the north to 3.27 bits in the southwest region. There is a relationship between plant diversity of parkland and selectivity of species conserved in agrosystems by local communities. Wherever this selectivity is high, the parklands are monospecific. Tree density on farms decreased from forest area to north sudanian zone. Tree species conserved in farms provide many non-timber products such as food (leaves, fruits, flowers), forage, medicinal plants, fuel wood, material for construction and craft. They are also a major source of economic income in rural areas.

Introduction

The agrarian landscape in tropical Africa has particular physiognomy according to the presence of trees conserved and keep up by the farmers. This particular physiognomy is characteristic of traditional agroforestry systems, the most widespread systems in sub-Saharan Africa, where farmers grow annual crops in fields with scattered trees, (Teklehaimanot, 2003). Ecological, socio-economical and cultural interactions existed between trees and the others components of the system (Maranz & Wiesma, 2003; Wala et al., 2005; Djossa et al., 2008). These agrosystems are mostly dominated by tree species that are useful for the local population like *Vitellaria paradoxa, Parkia biglobosa, Elaeis guineensis, Vitex doniana,* etc. (Boffa, 1999; Lovett & Haq, 2000).

In Togo, several studies were carried out on these farming systems (Guelly et al., 1999; Guelly, 2000, Wala et al., 2005, Padakale , Houngbédji, 2008), but there is not a synthesis showing their variability. The latitudinal extension of the country on several climatic zones covers diversity of vegetation, soil, geology, hydrographic, and local communities. This diversity of landscape and culture match with differences in farming systems across the country. The question to answer is to know if differences of climate, local communities and farming systems influence the composition and the structure of those agrosystems. This paper is a synthesis on traditional agroforestry systems which aims to show their variability in Togo following latitudinal gradient and local communities' practices.

Methodology

Study area

Togo is a small country of West Africa, about 56,600 km², limited by Ghana in the west, Benin in the east, Burkina Faso in the north and the ocean Atlantic in the south. Togo is crossed by Atakora

mountain chain from the south western to the north eastern and is located in the Dahomey gap which represents an interruption of the West African tropical forest at the level of the gulf of Guinea (IUCN, 1992). Ern (1979) had subdivided the country into five ecological zones (fig. 1). Except the mountain semi-deciduous forests of southwest (Akpagana, 1992), the country is mainly covered by sudano-guinean and sudanian savannas and dry forests. Climate is sub-equatorial in southern, and tropical in northern. There is a geographic gradient of climate characteristics (precipitation, temperature, relative humidity). Rainfall and relative humidity increased from northern sudanian zone to forest zone but the temperature decreases from northern sudanian zone to forest zone. As illustration, annual precipitation ranges between 1000 and 1350 mm/year in the northern while in the southern it ranges between 800 and 1600 mm annual precipitation ranges between 1200 and 1350 mm/year. The population of Togo was estimated in 2006 about 5,337,000 inhabitants with a density about 94 inhabitants/km^2. There is a high diversity of ethnic groups (40) with agriculture and breeding as the major economic activities.

Data collection and analysis

Surveys were carried out in several sites selected within four ecological zones (fig. 1). In each sites, the composition and the structure of the agrosystems were analyzed trough trees inventory in farms and fallows in 10 plots of 50 m x 50 m. Diameter at breast height (DBH) of stems, was measured at 1.30 m above ground. To understand agroforestry practices, ethnobotanic inquiries were done at farmers level. The questions concerned the age of farms, the duration of fallows, the origin and uses of trees conserved in farms and the principal crops.

Floristic data were quantitatively analyzed for abundance, density and frequency. Trees were considered to be individuals of dbh (diameter at breast height) >10 cm and sapling of dbh < 10 cm. The assessment of tree species diversity encompasses the calculation of species richness (R), diversity index (Shannon index H), evenness of Pielou (E) (Maguran, 1988). Stands were described by density and species chorology following White (1986) was analyzed.

Results

Three types of traditional agroforestry systems were identified: home garden, farm parkland, and « multistage farms » (agroforest) practice in cocoa and coffee plantations in forest zone of Togo.

Home garden

They are agroforestry systems located around home met across the study area but their species composition has been studied at Niamtougou (9°50'). The species richness vary from 5 to 52 species. Numerous introduced fruit-trees are planted: *Mangifera indica, Citrus spp, Carica papaya, Annona muricata, Cocos nucifera, Psidium guajava,* etc. Local fruit-trees like *Blighia sapida, Hyphaene thebaica, Borassus aethiopum, Zanha golungensis* are also conserved in the home gardens. Another species in the home gardens are trees that organs (leaves, seeds, flowers) are used like legumes (*Adansonia digitata, Ceiba pentandra, Moringa oleifera, Vernonia amygdalina, Bombax costatum*, etc.) or used for forage (*Ficus thonningii, F. polita, Celtis integrifolia*). In the sudanian zone there are numerous fetish-trees in home garden. At Niamtougou for example we can cite *Milicia excelsa, Antiaris africana, Voacanga africana, Holarrhena floribunda, Oncoba spinosa, Dracaena arborea, A. digitata, Hyphaene thebaica* and *Borassus aethiopum*. Most of these species and others are maintained as medicinal and ornamental plants in home gardens.

Agroforestry parkland

They are met across the study area but their structure has been studied in the sudanian zone (Niamtougou and Dapaong) and in the coastal zone.

In the sudanian zone, the species richness failed from 25 species in the southern zone to 18 species in the northern. The Shannon diversity index is low and varies also between the two zones. In the southern, it is about 1.97 at Niamtougou, but in the northern sudanian zone, it is about 0.51 at Dapaong site. The evenness of tree species decreases from 0.77 at Niamtougou to 0.19 at Dapaong. The parklands are denser in south sudanian zone, (32 to 65 trees/ha) than those of northern sudanian zone with 15 to 26 trees/ha.

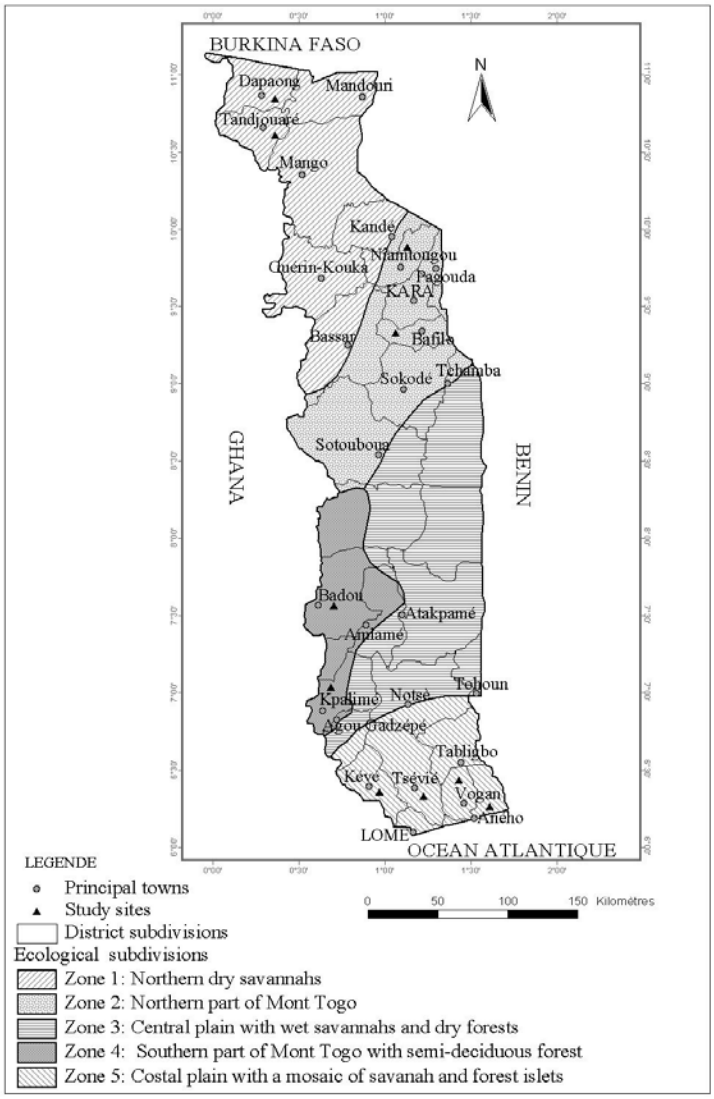


Figure 1. Study area

Three multipurpose trees dominate the parklands in these areas: *Vitellaria paradoxa, Parkia biglobosa* and *Adansonia digitata* which distribution area extended to sudano-guinean and sudanian zones. Some particular conditions (rainfall and socio-economic interest) could favor the development of another kind of parklands. That is the case of the sub-natural palm-grove of Niamtougou. This palm-grove is much dense and counts up to 135 trees/ha with 95.4% of palm trees. The Shannon diversity index is very low (0.34) showing so the dominance of palm trees in these parklands.

In the coastal region, the parklands are dominated by *Dialium guineensis, Elaeis guneensis, Cocos nucifera*, *Adansonia digitata, and Borassus aethiopum. D. guineensis* parlands had about 20 to 35 trees/ha while in the palmgroves, density varied from 578 to 643 trees/ha.

Nowadays, forest degradation in the zone IV, modify landscape into parklands where under tree species like *Elaeis guineensis*, *Khaya grandifoliola, Albizia adianthifolia, Alstonia boonei, Cola nitida, Persea Americana, Ceiba pentandra* and *Mangifera indica* farmers grow annual crops (*Zea mays, Manihot esculenta, Dioscorea cayenensis, Xanthosoma maffafa,* etc.).

Multistage farms

Introduction of heliophile varieties of coffee and cocoa in the southwest forest zone of Togo has accelerated the forest degradation. Whenever the farmers established that without tree-shade, the coffee plants died out with a decline of production. Then they used to return to their old practice: the multistage farm system. It consists to preserve in the cash crop plantations some natural tall trees, which will give their shade to coffee and cocoa plants. Farmers, always select shady trees for their multipurpose services. Shannon diversity index is about 3.47 bits but tree species evenness is medium (0.69). The density is about 260 to 500 trees/ha. Three groups of species constituted these agroforestry systems:

- The fruit-trees planted for their income: coffee (*Coffea spp.*) and cocoa (*Theobroma cacao*), *Persea americana, Citrus spp., Cola nitida, Elaeis guineensis, Xylopia aethiopica , Psidium guajava, Musa sapientum, Citrus sinensis, Spondias mombin, Mangifera indica, Carica papaya, Irvengia gabonensis, Pentadesma butyracea, Vitex doniana,* etc.
- Trees which are preserved at land cleaning time: *Milicia excelsa, Antiaris africana, Parinari glabra, P. excelsa, Erythrophleum suaveolens, Khaya grandifoliola, Alstonia boonei, Ceiba pentandra, Aubrevillea kerstingii, Piptadeniastrum africanum, Dialium guineense*, etc.
- Those that appear after land cleaning: there are pioneers like *Albizia adiantifolia, A. ferruginea, A. glaberrima, A. zygia, Macaranga barteri, Harungana madagascariensis, Margaritaria discoidea,* etc.

Floristic and phytogeographic affinities of study sites

The floristic composition of the agrosystems varies according to their geographic situation.

The cluster analysis shows at 60% of dissemblance three groups of sites: the forest zone and the costal zone (Kévé) form two separate groups while the third group is formed by Niamtougou and Dapaong sites (fig. 2). That explains difference in species composition of agroforestry systems between the different ecological zones.

Agrosystems in forest zone (plateau) and costal region are dominated by guineo-cogolian species (68% and 35% respectively) while in sudanian zones, they are dominated by sudano-zambesian species with respectively 57.85% at Niamtougou an 38% at Dapaong (fig. 3). At Niamtougou, some guineo-cogolian species are present in the agrosystems certainly in home gardens.

Discussion

Existence of the described traditional agroforestry systems indicate the needs of local communities to grow diverse plants species. The fundaments of this practice are numerous advantages (Nair, 1984; Wala, 2001) of trees conserved in farms. Effectively, these advantages explain the functional typology of parklands (Seignobos, 1982): alimentary parkland dominated by *Parkia biglobosa, Adansonia digitata, Ceiba pentandra, Bombax costatum* which organs (leaves, flowers, seeds) are eaten; oleaginous plants parkland dominated by *Vitellaria paradoxa* and *Elaeis guineensis*; fire-wood parkland with *Anogeissus leiocarpa and Crossopteryx febrifuga.*

We can add forage parkland with *Pterocapus erinaceus, Khaya senegalensis, Ficus spp.,* and *Afzelia africana* in the northern Benin (Wala et al., 2006). These types of parklands are not isolated according to their function but at farm level, a parkland share several of these functions. Farmers controlling trees density preserved several species with numerous uses, which constitute incomes for rural populations.

Another advantage of agroforestry systems is role of trees in soil improving in farms. Litter of trees constitutes fertilizer for crops. This role is well played by leguminous trees like *Albizia spp.* in the forest zone (Guelly, 2000). Also in the sahelian zone, leguminous trees like *Acacia albida* are conserved in parklands to improve the soil quality (Depommier et al., 1993).

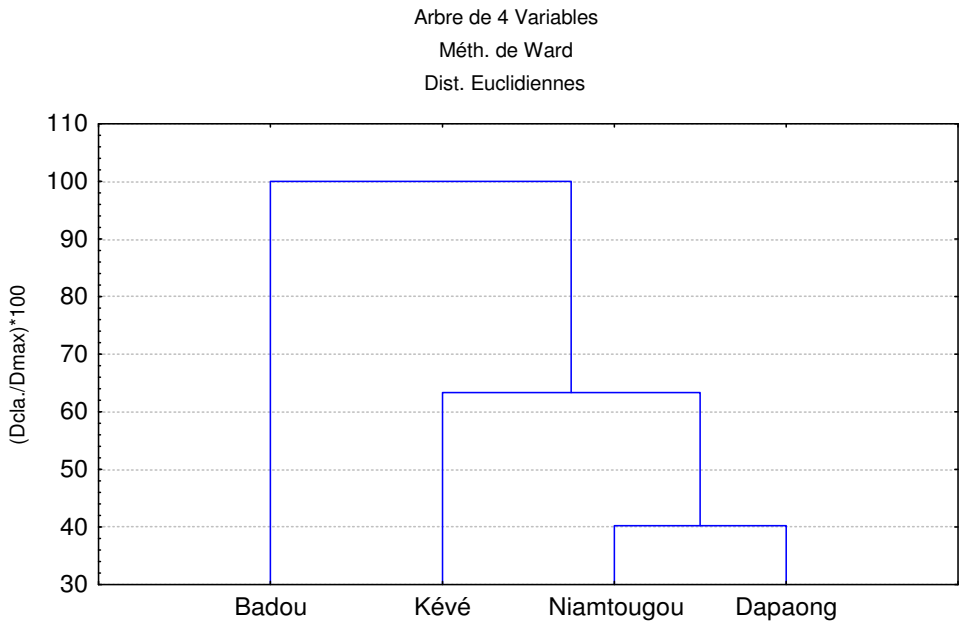
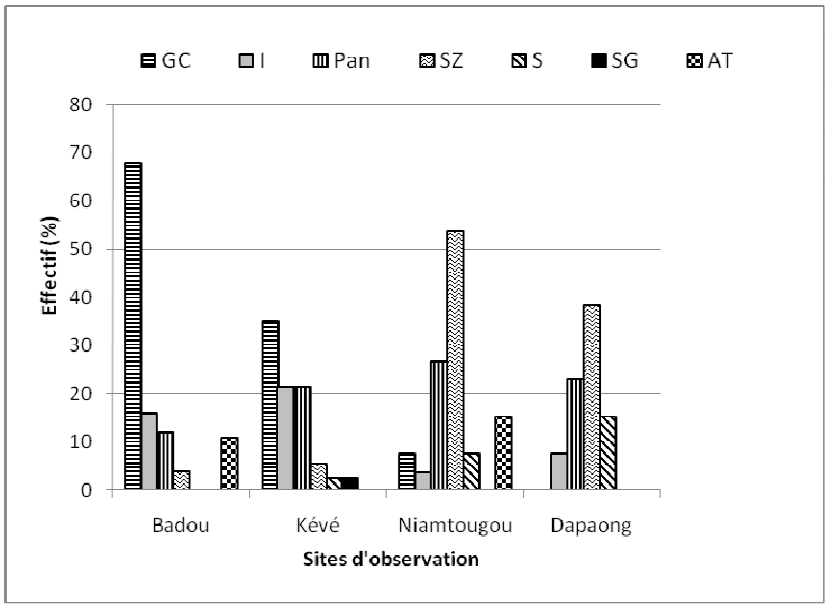


Figure 2. Study sites' hierarchical classification dendrogram



Key:

GC: guineo-congolian species
I: introduced species
SZ: sudano-zambesian species
S: sudanian species
Pan: pantropical species
SG: Sudano-guinean species
AT: afro-tropical species

Figure 3. Phytogeographical species spectrum of study sites

The management of trees in agroforestry systems contributes to maintain a more or less dense vegetation cover in the farming space. That has an important ecological advantage by protecting soil against erosion and favoring fast reforestation of fallows. In the forest zone among species conserved, there are pioneers (*Albizia spp., Harungana madagascariensis, Margaritaria discoidea, Trema orientalis* etc.), and forest trees that are seed producers (Guelly et al., 1999). Agroforestry systems are widely dominated by phytogeographical species that are typical to climatic zone. In the forest zone guineo-cogolian species dominate the multistage farms when in sudanian zone, parklands are dominated by sudano-zambesian species. In Sahelian zone, parklands are dominated by spine trees like *Acacia alibida* associated with other local species (Depommier et al., 1993). Some species

like *Albizia spp. Cassia spectabilis, Pycnanthus angolensis,* etc. are widely distributed and conserved in various forest phytogeographical regions as in Burundi in coffee and cocoa systems (Depommier, 1988). In Latin America, shady trees in cocoa plantations are dominated by local species like *Cocos nucifera, Persea americana, Cedrela odorata, Cordia alliodora, Ficus spp, Tabejuga spp. Gliricidia sepium, Erythrina spp., Albizia spp.,* etc. (Alpizar et al., 1986). These examples show that agroforestry systems can differ in floristic composition according to local climax mainly controlled by climate and soil conditions. This proves that local communities identify useful species in their surrounding environment and then conserve and protect them in *situ*. Multistage farms practice occurs mainly in guineo-cogolian forest region. That system is not practiced in the sudanian zone because of water stress that not allows high density in plant community. Meanwhile, some introduced fruit-species like *Mangifera indica, Citrus spp., Carica papaya, Annona spp.,* etc. have a widely distribution spectrum.

Different species can be used for the same purpose in different climatic zone. For example in the forest zone, palm trees produce oil. In the sudanian zone where palm is rare, the local people rely on Sheanut tree (*Vitellaria paradoxa*) that constitutes their main source of oil. Also in the forest zone timber trees are *Milicia excelsa, Khaya grandifoliola, Erythrophleum suaveolens, Antiaria africana,* when in the sudanian zone, they are *Khaya senegalensis, Afzelia africana, Pterocarpus erinaceus, Diopyros mespiliformis* used for the same purpose.

Difference between species composition and density of parklands in southern and northern sudanian zone could also be explained by difference in rainfall. The less density of parklands in northern is related to the low rainfall in this area. Numerous studies show that the density of parklands increases from southern to northern latitude in tropical Africa in the same manner as aridity increased. That is the case, in the sudano-guinean at Bassila (9°00′ N) where Schrekenberg (1996) counted 63 trees/ha and in Ghana where tree density in farm parklands is 83 trees/ha (Hall et al., 1986). In the sudanian zone, Wala et al. (2005) counted on average 60 trees/ha at Niamtougou (9°50′ N) when Boffa (1995) counted 27 trees/ha in the south of Burkina Faso. These data show that differences in farm parklands tree species and density are due first to climax vegetation density as explained by latitudinal rainfall, and secondly by local farmer practices through a particular zone.

Conclusions

Results obtained show differences of traditional agrosystems structure according to rainfall gradient and local community practices. So far, the forest zone is characterized by multistage farms in which forest multipurpose trees are preserved. In the sudanian zone there are agroforestry parklands dominated by *Vitellaria paradoxa* and *Parkia biglobosa*. They still defer in their density and floristic composition according to climate and local community uses. The traditional farming systems described vary widely also within a region. The different species conserved usually have multiple uses (food, fruit, firewood, timber, windbreaks, etc.). Considering high rate of population in rural areas and land scarcity, the agroforestry systems are a good alternative for land management. Agroforestry improvement will contribute to have an adequate tree cover in farmland, and to assure food security and revenues in rural areas in the tropics.

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DANS L'OUEST-CAMEROUN, LES PAYSANS ONT PRÉSERVÉ LES ARBRES DANS LEURS CHAMPS, PENDANT QUE L'ETAT LAISSAIT BRÛLER CEUX QU'IL AVAIT PLANTÉS DANS SES RÉSERVES

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IN WEST CAMEROON, FARMERS HAVE LOOKED AFTER THE TREES IN THEIR FIELDS, WHILE THE STATE ALLOWED THOSE THAT IT HAD PLANTED IN ITS RESERVES TO BURN

Summary

The sub humid hills of the West Cameroon were formerly covered with semi-deciduous forests. The Bamileke and Bamoun tribes, which colonized them, mainly cleared them. Starting from the second half of the twentieth century, the forest administration worried about the disappearance of the last scraps of natural vegetation as well as about the lack of construction timber and fuel wood for the local population. Forest reserves were created and plantations carried out, mostly with exotic species, for the production of sawlog (pines), pole and fuel wood (eucalyptus) and for shade in coffee plantations (leucaena).

The farmers, for their part, enclosed their fields using live-fences, where they installed various locally raised or shrubby species, which were easy to propagate by cutting or by pricking out. Within their crops and around their dwellings, they preserved or planted multi-purpose species coming from the natural forest or nurseries. Half a century on, it is noted that the afforestation carried out by the State and the forest reserves were generally destroyed by fire or slashed and burned by the population. On the other hand, in cultivated areas, one finds a patchwork of forest or agroforest formations made up for the most part by a great number of tree species taken in the original forest. For example, one can find live-fences of *Polyscias fulva*, species used for sculpture. Close to houses, *Canarium schweinfurthii* are mixed with oil palm trees and all kinds of local or exotic fruit trees. In the hollows, the raffia palm stands (raphiales) were preserved and are intensively used for the manufacture of various objects (movables, ceilings, crates, etc.) and the production of raffia wine. More surprisingly, one finds in certain farms sawlog-tree species plantations like *Entandrophragma* sp.p. and *Podocarpus milanjianus*.

Among the exotic species, pine was not adopted by farmers, because of the poor quality of its wood, its little resistance to funguses and insects in such a hot and wet climate. The eucalyptus experienced a very beautiful development in country landscaping because of its rusticity, speed of growth, coppicing capacity, fire resistance and its multiple uses (firewood, poles, posts, sawing and pharmacopeia). Leucaena practically disappeared with the coffee-plantations and their interest for nitrogen fixing was not charged for by farmers who prefer to use manure or to associate their crop with edible herbaceous leguminous plants (beans, peas and cowpeas). It is thus noted that the farmers of this area developed their own strategy as regards conservation of forest resources in a very independent manner compared to the recommendations or to the orders of the forest administration and research organizations. In fact, one can say that they have a very utilitarian and pragmatic vision of the forest: each one preserves or reconstitutes, on its grounds, an agro-ecosystem that satisfies as much as possible within its strategy, its various possibilities and needs. The single and stereotyped message of the administration and different projects, often bearing an ideology (to save the forest, to fight against it turning into a desert, to protect water and the grounds, to preserve biodiversity, to fix carbon, etc.), clearly cannot be appropriate in each case and for everyone. It

should, however, be noticed that individual farmer initiatives are not often supported by the administration and that their diffusion is often blocked by badly adapted (or interpreted) protectionist laws. For example, a farmer can freely exploit the exotic species (eucalyptus, pines) he planted but not local species (*Entandrophragma* or *Canarium)* for which he has to obtain a cutting license, which requires cumbersome and expensive steps. Certain agroforest fruit-bearing species are even completely protected and cannot even be pruned without consents which are mostly very difficult to obtain. It is the same situation in the other parts of the country, as for *Acacia albida* and *Vitellaria paradoxa* in the Sudanese zone or for *Irvingia gabonensis* in the Guinean zone.

To conclude it would appear that, as a matter of priority, states should adapt their legislative and tax environment to the realities of the conservationist practices of local populations, understand their way of thinking and support their initiatives - instead of imposing simplistic techniques on a large scale or responding to problems that do not really relate to them directly. On the other hand, NGOs should help communities to market Non Timber Forest Products (NTFP), by means of certification of the "organic farming" type or "ethical and ecological products", and to be given international appropriations for the conservation of biodiversity and storage carbon-storage.

Résumé

Les collines Subhumides de l'Ouest Cameroun étaient autrefois couvertes de forêts semi-décidues. Les peuples Bamiléké et Bamoun qui les ont colonisées, les ont en grande partie défrichées. À partir de la moitié du XXe siècle, l'administration forestière s'est inquiétée de la disparition des derniers lambeaux de végétation naturelle ainsi que du manque de bois de feu et de construction pour les populations. Des réserves forestières ont été crées et des plantations réalisées, en majorité avec des espèces exotiques, pour la production de bois d'œuvre (pins), de perches et de bois de feu (eucalyptus) et pour l'ombrage des plantations de café (leucaena).

Les paysans ont, pour leur part, clôturé leurs champs à l'aide de haies-vives, où ils ont installé différentes espèces arborées ou arbustives locales faciles à bouturer ou à repiquer. À l'intérieur de leurs cultures et autour de leurs habitations, ils ont conservé ou planté des espèces à usages multiples provenant des forêts naturelles ou de pépinière. Un demi-siècle plus tard, on constate que les reboisements effectués par l'État et les réserves forestières ont le plus souvent été détruits par le feu ou défrichés par la population. Par contre, dans l'espace cultivé, on trouve un patchwork de formations forestières ou agroforestières constituées en majorité d'un grand nombre d'espèces prélevées dans la forêt originelle. On peut par exemple, trouver des haies-vives de *Polyscias fulva*, espèce utilisée pour la sculpture. Près des maisons les *Canarium schweinfurthii* sont mélangés aux palmiers à huile et à toutes sortes de fruitiers locaux ou exotiques. Dans les bas-fonds, les raphiales ont été conservées et sont intensivement utilisés pour la fabrication d'objets divers (meubles, plafonds, cageots etc.) et la production du vin de raphia. Plus étonnant encore, on trouve chez certains agriculteurs des plantations d'espèces de bois d'œuvre comme *Entandrophragma sp.p.* et *Podocarpus milanjianus*.

Parmi les espèces exotiques, le pin n'a pas été adopté par les agriculteurs, en raison de la médiocre qualité de son bois, peu résistant aux champignons et aux insectes dans ce climat chaud et humide. L'eucalyptus a connu un très beau développement en milieu paysan, en raison de sa rusticité, de sa vitesse de croissance, de sa capacité de rejet, de sa résistance au feu et de ses usages multiples (bois de feu, perches, poteaux, sciages, pharmacopée). Les *Leucaena* ont pratiquement disparu avec les caféières et leur intérêt pour la fixation d'azote n'a pas été perçu par les paysans qui préfèrent utiliser de l'engrais ou associer leur culture avec des légumineuses herbacées comestibles (haricots, pois, niébé). On constate donc que les agriculteurs de cette région ont développé leur propre stratégie en matière de conservation des ressources végétales forestières de façon très indépendante par rapport aux recommandations ou aux ordres de l'administration forestière et des organismes de recherche. En fait, on peut dire qu'ils ont une vision très utilitaire et très pragmatique de la forêt : chacun conserve ou reconstitue, sur ses terrains, un agro-écosystème qui satisfait au mieux à sa stratégie, à ses possibilités et à ses besoins. Le message unique et stéréotypé de l'administration et des projets, souvent porteur d'une idéologie (sauver la forêt, lutter contre la désertification, protéger l'eau et les sols, conserver la biodiversité, fixer le carbone, etc.), ne peut convenir à tout le monde.

Il faut cependant remarquer que les initiatives paysannes individuelles ne sont pas souvent soutenues par l'administration et que leur diffusion est souvent bloquée par des lois protectionnistes mal adaptées ou mal interprétées. Par exemple, un agriculteur peut exploiter librement les eucalyptus qu'il

a plantés mais pas les Entandrophragma ou les Canarium pour lesquels il devrait obtenir un permis d'abattage, après de lourdes et coûteuses démarches. Certaines espèces fruitières agroforestières sont même intégralement protégées et ne peuvent même pas être émondées sans autorisations très difficiles à obtenir. Il en est de même dans les autres parties du pays, comme pour *Faidherbia albida* et *Vitellaria paradoxa* en zone soudanienne ou pour *Irvingia gabonensis* en zone guinéenne.

En conclusion, il apparait que les états devraient en priorité adapter leur environnement législatif et fiscal aux réalités des pratiques conservationnistes des populations, comprendre leur logique et appuyer leurs initiatives, au lieu d'imposer des techniques simplistes à grande échelle, répondant à des problèmes qui ne les concernent pas directement. D'autre part, les ONGs devraient aider les communautés à commercialiser les Produits Forestiers Non Ligneux, par le biais de certifications de types « agriculture biologique » ou « produit éthique et écologique », et à bénéficier de crédits internationaux pour la conservation de la biodiversité et le stockage de carbone.

Introduction

Les traditions orales de l'Ouest Cameroun évoquent, très fréquemment, l'existence de très anciennes formations forestières qui ont été progressivement défrichées, lors de l'installation des premiers occupants. D'origines diverses, ceux-ci ont créé de véritables « trouées » qui sont devenues de nombreux villages ou chefferies (Njoukam, 1995). Pour se nourrir, se vêtir, se construire et fabriquer des objets fonctionnels, les villageois se sont constamment tournés vers les ressources forestières, provoquant à la longue une pénurie ligneuse de plus en plus accentuée. Face à cette situation, l'Etat a délimité à partir des années 30 des aires protégées qui se sont transformées en périmètres de reboisement. L'objectif initial de ces forêts de plantations était de reconstituer le patrimoine forestier, afin de satisfaire, de façon soutenue, les besoins des populations et de lutter contre l'érosion sur les terrains pentus. Plusieurs essences (locales et exotiques) ont été expérimentées. Certaines espèces, notamment les exotiques, ont connu du succès et ont fait l'objet de vastes plantations, grâce à la maîtrise de la technique sylvicole. L'écrémage du bois dans la région a poussé les populations à exercer de fortes pressions sur ces réserves forestières par des intrusions fréquentes, conduisant aux coupes frauduleuses, aux feux de brousse incontrôlés, aux pratiques de cultures, etc.

Par ailleurs, pendant que ces plantations étatiques étaient ainsi dévastées, faute de moyens de contrôle et de gestion, le paysan a su forger son propre itinéraire technique en adoptant très vite les essences exotiques à rémunération précoce. C'est ainsi qu'il exploite rationnellement son terroir, soit en intégrant les arbres dans les cultures, soit en pratiquant une sylviculture « unilinéaire » pour matérialiser les limites de sa concession.
Cette communication vise donc à relever les différentes péripéties traversées par les plantations forestières étatiques et à apprécier l'ingéniosité du paysan dans l'intégration et la gestion des arbres (exotiques et locales) dans son milieu.

Présentation de la zone d'étude

La partie ouest du Cameroun appartient à la région des savanes humides, d'altitude comprise entre 900 et 1200 m, surmontée de grands massifs tels que le Mont Oku (3110 m), les Bamboutos (2740 m), le Mbam (2335 m), le Nkogam (2263 m) et le Mbapit (1989 m). Les sols sont en général ferrallitiques, dérivés du socle basaltique. Il existe également des sols fertiles provenant du volcanisme récent. Le climat est équatorial, du type « camerounien de montagne » avec 4 mois de saison sèche (Letouzey, 1968). Les précipitations annuelles varient de 1500 à 2000 mm. La température moyenne annuelle est de l'ordre de 20 °C.

La végétation actuelle est du type « savanes humides d'altitude » appartenant au secteur guinéo-soudanienne des savanes périforestières. Ces savanes sont très hétérogènes du point de vue phytogéographique. On y distingue des savanes arborées et arbustives d'une part à *Terminalia glaucescens* et *Annona sengalensis* (Donga Mantung, Menchum et Noun) et d'autre part à *Daniellia oliveri* et *Lophira lanceolata* (Ndé et vallée du Noun) ; la savane boisée à *Burkea africana*, *Daniellia oliveri* et *Borasus aethiopum* (sud du Département du Noun et au Nord de la Menchum) et la savane herbeuse à *Imperata cylindrica* (faible superficie dans le département du Noun).

Cette végétation actuelle est la conséquence de l'action anthropique qui est à l'origine de la disparition du paysage d'autrefois composé d'une forêt dense semi-décidue de moyenne altitude,

d'une savane périforestière et d'une formation montagnarde. Devant cette situation de déforestation à outrance, l'Etat a décidé de réaliser des plantations forestières dans le but entre autres de réduire la pression anthropique sur les formations naturelles.

Les plantations forestières

Le rêve des premiers forestiers était de transformer le paysage de savane en terrains boisés. C'est ainsi que l'Etat a créé une trentaine de réserves forestières d'une superficie totale d'environ 125 550 ha. Les premiers essais de plantation utilisent des essences locales représentées dans les galeries forestières ou dans les forêts de montagne voisines (Faure, 1986). Parmi ces essences on peut citer : *Khaya grandifoliola* (acajou d'Afrique), *Lovoa trichilioïdes* (dibetou), *Milicia excelsa* (iroko), *Pycnanthus angolensis* (ilomba), etc. Ces plantations se sont soldées par un échec, ces essences ne résistant pas au milieu ouvert qu'est la savane. Des espèces exotiques tropicales furent alors introduites à l'instar des pins (une quinzaine d'espèces) et des eucalyptus (une trentaine d'espèces). Des genres tels que *Cupressus*, *Callitris*, *Widdringtonia*, etc. ont été aussi plantés.

Les succès

Toutes les espèces introduites n'ont pas connu du succès. Le reboisement s'est poursuivi avec celles qui se sont mieux adaptées. Une étude de croissance réalisée récemment dans les plantations réussies de la réserve forestière de Melap donne les résultats suivants :

Les pins (tableau I).

Tableau I. Croissance dans les plantations de pins

Espèce	**Age (ans)**	**Aam (m^3 ha^{-1} an^{-1})**
P. kesiya	47	20 - 25
P. caribaea var *caribaea*	55	
P. caribaea var *hondurensis*	47	
P. oocarpa var *ochoterrenaï*	33	
P. merkusii	48	
P. douglasiana	49	15
P. leiophylla	51	
P. patula	51	9 - 20

Cette performance dans la première catégorie des pins explique l'engouement de l'ex-ONADEF (Office National de Développement des Forêts) dans l'utilisation de *P. kesiya, P. caribaea* et de *P. oocarpa* dans le reboisement. *P. patula* pousse beaucoup mieux (20 m^3 ha^{-1} an^{-1}) en altitude plus élevée (> 1 500 m). *P. douglasiana* et *P. leiophylla* ont été proscrits du reboisement à cause de leur croissance relativement faible. Essences assez frugales, les pins ont été plantés notamment sur des sols pauvres avec affleurement des concrétions ferrallitiques.

Les eucalyptus

E. saligna et *E. grandis* se sont parfaitement acclimatés et ont occupé de grandes surfaces. A partir des espèces introduites, des hybrides (notamment *E. grandis* x *E. saligna*) se sont naturellement créés et s'adaptent également dans la région. La productivité des eucalyptus varie de 15 à 20 m^3 ha^{-1} an^{-1}.

Les eucalyptus et les pins ont été pendant longtemps les principales essences de reboisement dans les réserves de l'Etat. Dans les périmètres de reboisement peu perturbés, ces essences exotiques ont fini par créer, d'après Faure (1986), une « ambiance forestière » avec pour conséquence l'installation d'espèces locales. Achoundong (1988) considère ce phénomène comme étant une dynamique possible vers une forêt naturelle, en l'absence des pressions anthropiques. Cette évolution se déroulerait en trois étapes : *i*) les pionniers regroupant les espèces héliophiles : *Alchornea cordifolia, Bridelia micrantha, Rutidea sp* etc.; *ii*) la forêt secondaire : *Albizia adianthifolia,*

Ficus exasperata, etc.; *iii*) la forêt mésophile : *Canarium schweinfurthii, Markhamia lutea, Pseudospondias microcarpa* etc.

Les échecs

Les plantations forestières étatiques ont connus beaucoup d'écueils, notamment à travers les feux de brousse et les intrusions de toutes sortes par les populations environnantes.

Les feux de brousse

Les feux de brousse constituent une menace sérieuse pour les formations végétales naturelles en général et les plantations forestières en particulier. Ces feux sont de pratiques courantes et il faut en tenir compte dans un programme de reboisement. Ils sont souvent allumés pour défricher les terres agricoles ou pour régénérer les pâturages. Les mégots non éteints des fumeurs peuvent embraser plusieurs hectares. Certains feux émanent des braconniers de moindre effort en quête du gibier ou des personnes astucieuses qui cherchent à provoquer d'abord la mort des arbres afin de justifier ultérieurement leur abattage.

Ces feux ont un impact négatif sur les ressources naturelles. Au niveau du sol, ils sont à l'origine des pertes des éléments minéraux. Il y a certes apports de cendres qui ne constituent en fait qu'une richesse éphémère, car elles disparaissent rapidement par lessivage (Gillon, 1990). Sur la végétation, les feux dégradent les écosystèmes en favorisant uniquement les espèces pyro-résistantes. A partir de l'âge de 10 ans, les pins commencent à résister aux feux à cause de leur écorce épaisse. Les eucalyptus sont vulnérables durant toute la vie du peuplement. Le recépage de ces arbres est conseillé en cas de passage d'un feu dévastateur, afin de favoriser la pousse des rejets sur les souches encore vivantes.

Sur tout un autre plan, les feux de brousse génèrent dans l'atmosphère des gaz à effet de serre (CO_2, CH_4 et N_2O) responsables du réchauffement de la planète et du changement climatique (Riedacker, 2004).

Les intrusions diverses

L'organisme chargé du reboisement a toujours privilégié l'extension des superficies boisées au détriment des soins culturaux. L'absence d'une gestion permanente permettant entre autres de mettre les produits ligneux à la disposition des populations est à déplorer. Celles-ci ne se sont pas faites prier pour assaillir régulièrement les réserves forestières dans le but de satisfaire leurs besoins en produits ligneux (bois-énergie, bois de service, bois artisanal et bois d'œuvre) et non ligneux (plantes médicinales, vin de raphia, etc.). De nos jours, la plupart de ces réserves sont pratiquement occupées par des champs vivriers et même par des maisons d'habitation.

Une récente « découverte » de certains petits exploitants frauduleux, dont beaucoup d'enfants, a été de mutiler les pins sur pied au niveau d'environ 50 cm du sol, en prélevant à la machette des fragments de bois destinés à allumer le feu de bois dans les ménages. Ces fragments de bois, riches en résine, constituent à cet effet un succédané parfait du pétrole lampant dont le prix n'est plus à la portée de toutes les bourses. Les chablis provoqués ultérieurement par ces mutilations sont récupérés et transformés *in situ*, soit en bois de feu par les petits vendeurs, soit sous forme d'ébauches de statue par les artisans.

Les pratiques paysannes

Parallèlement au triste sort qu'ont connu les réserves forestières étatiques, faute de plans d'aménagement ou même de l'application de ceux qui ont existé à l'instar du plan d'aménagement de la réserve forestière de Melap rédigé par Faure (1986), le paysan a su développer sa propre stratégie pour mieux intégrer les ressources végétales forestières dans son terroir. Cette intégration varie en fonction de la nature des essences.

Essences exotiques

Les pins et les cyprès, considérés depuis longtemps comme des arbres ornementaux, ont été quelques fois plantés uniquement pour délimiter les concessions. Leur bois de médiocre qualité s'avère peu résistant aux attaques des champignons et des insectes, surtout s'il est exposé aux intempéries. Depuis un certain temps, des tentatives timorées de production de lambris avec le bois

de pin se font de plus en plus par quelques personnes averties pour fabriquer les plafonds ou pour recouvrir les murs des maisons.

Introduits au Cameroun dans les années 20, les eucalyptus font actuellement partie intégrante du paysage de l'Ouest et du Nord-Ouest du Cameroun (Tchanou, 1993). Le paysan a fini par l'adopter et n'arrive toujours pas à trouver une essence de remplacement réunissant les mêmes caractéristiques (croissance rapide, multi-usages : bois de feu, perches, poteaux, sciages et pharmacopée).

Pour adopter complètement les eucalyptus, le paysan a fini par forger son propre itinéraire technique guidé par des contraintes foncières et financières.

Récolte de graines: Elle s'effectue sur les semenciers isolés ou en peuplement, sans aucun souci d'une sélection massale.

Germoir : Les semences sont mélangées à la cendre pour permettre leur meilleure répartition sur le germoir et assurer également une bonne fertilisation.

Fabrication des pots de repiquage : Faute de moyens financiers pour l'achat des sachets en polyéthylène, le paysan fabrique lui-même les pots de repiquage des semis en feuille de *Dracaena arborea* ou en gaine sèche de bananier ou encore en chaume de graminées. Ce matériel local est certes biodégradable mais ne résiste pas longtemps. Le fond des pots pourrit rapidement et laisse traverser tout le système radiculaire qui favorise l'ancrage du plant non seulement dans la terre du pot mais aussi et surtout dans le sol ferme.

Mise en place : La densité des peuplements purs est souvent très élevée et frise parfois plus de 20 000 tiges à l'hectare, faisant ainsi fi de la capacité du sol à subvenir (sans aucun apport supplémentaire) aux besoins en nutriments de cette importante biomasse végétale à forte densité.

Les plantations d'eucalyptus sont parfois associées aux cultures vivrières pour mieux assurer les entretiens des jeunes ligneux. Avec la patate douce, plusieurs campagnes peuvent être pratiquées avant la fermeture du couvert des arbres.

La durée du cycle du manioc s'étalant sur deux ans, le paysan ne réalise qu'une ou deux campagnes avant de partir définitivement du peuplement. Nous avons assisté à la récolte de la 2ème et dernière campagne du manioc sous eucalyptus âgé de 4 ans. L'estimation rapide des rendements obtenus à partir de trois tiges choisies sous eucalyptus et de trois autres déterrées hors eucalyptus donne respectivement 18 et 29 kg de poids frais.

Dans les plantations d'eucalyptus plus âgées, l'intuition a amené des paysans à y installer des cultures diverses (maïs, ignames, colocases - *macabo*, bananiers etc.), utilisant parfois des fientes de poules pour fertiliser ces sols cultivés sous forêt. De pareilles initiatives audacieuses méritent tout de même une attention particulière des Chercheurs pour l'étude du fonctionnement d'un tel agro-système. Quoiqu'il en soit, la majorité des planteurs d'eucalyptus des hautes terres sub-humides de l'Ouest-Cameroun ne perçoit pas l'effet appauvrissant et desséchant du sol des eucalyptus, tant dénoncé dans de nombreux organismes de développement, et en particulier par les ONGs.

Essences locales

Les haies vives ont toujours représenté une importante réserve de produits ligneux, alimentaires et médicinaux pour le paysan (Torquebiau, 2007). Ces haies jouent également un rôle anti-érosif et permettent la mise en défens des champs vis à vis du bétail et d'autres animaux domestiques en divagation (Depommier, 1983). Parmi les nombreuses essences qui enrichissent les haies, *Canarium schweinfurthi*, *Polyscias fulva* et *Entandrophragma candollei*, *Podocarpus milanjianus* ont fait l'objet de quelques observations de part leurs valeurs socio-économiques non négligeables.

Canarium schweinfurthii

Appartenant à la famille des Burseracées, l'arbre aux fruits noirs ou l'aiélé est une espèce fruitière forestière dioïque qui pousse à l'état isolé en savane humide, notamment dans les différents systèmes agroforestiers. Dans l'Ouest-Cameroun, l'intérêt de l'arbre réside surtout dans sa production de fruits, mais l'aiélé est aussi exploité pour son bois (Njoukam et Peltier, 2002). Les fruits font l'objet d'un commerce florissant. D'après Tchouamo et al (2000), les fruits de l'aiélé ont rapporté aux seuls marchés des villages du département Bamboutos une rondelette somme de 27 millions de francs CFA en une saison de production. Il n'existe pas une véritable tradition de plantation de

l'espèce chez le paysan. Ce dernier protège les sauvageons qui poussent spontanément et les transplante aux endroits de son choix. L'absence quasi totale de techniques de sa propagation nous a conduit à entreprendre les travaux de sa domestication.

Production des plants : Le prétraitement qui a donné les meilleurs résultats (taux moyen de levée : 95% en trois mois) a consisté en un dépulpage des « fruits noirs » après trempage dans l'eau chaude (40 à 50 °C). Ce même traitement est d'ailleurs utilisé comme mode de cuisson des fruits avant leur consommation (Njoukam et Peltier, 2002).

Etude de croissance de l'aiélé en plantation : Après un séjour d'environ 6 mois en pépinière, les jeunes plants ont été transplantés dans une parcelle expérimentale. Le rythme de croissance a ainsi été suivi pendant 14 ans et la courbe de celle-ci est tracée à la figure 1.

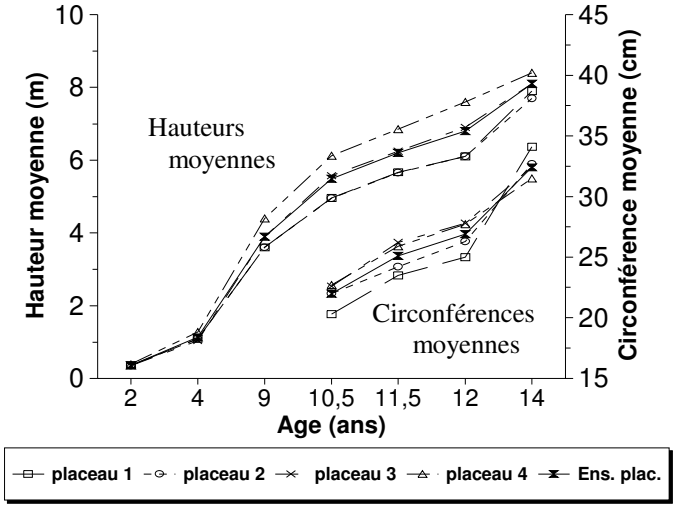

Figure 1. Evolution de la hauteur moyenne et de la circonférence moyenne des arbres de quatre placeaux (120 tiges par placeau) d'un peuplement expérimental de *Canarium schweinfurthii*.

Après 14 ans de croissance, la circonférence moyenne des arbres (à hauteur de poitrine) observée pendant les quatre dernières années de mesures est de 32,7 ± 1,1 cm, soit 10,4 ± 0,3 cm de diamètre. La circonférence moyenne dominante mesure 54,0 ± 3,1 cm, soit un diamètre moyen de 17,2 ± 1,0 cm. La hauteur moyenne des tiges atteint 8,0 ± 0,3 m et la hauteur dominante, 12,4 ± 0,6 m.

Fructification : Les individus mâles ne portent pas de fruits et les arbres femelles, même après floraison, ne fructifient pas automatiquement. Le fruit est une drupe ellipsoïdale qui devient violacée à maturité.

Autres usages : Les noyaux extraits des fruits sont calcinés et utilisés dans le traitement de l'angine chez l'homme et de la coccidiose chez la volaille (Tchoumboue et al., 2000). Séchée et broyée grossièrement, la résine remplace efficacement l'encens importé qui est brûlé lors des grandes cérémonies de certaines confessions religieuses.

Polyscias fulva

C'est un arbre de taille moyenne de la famille des Araliacées, à tronc lisse grisâtre surmonté de branches rayonnantes courbées vers le haut et portant des bouquets de grandes feuilles imparipennées (Letouzey, 1983). Il se retrouve également dans les haies vives. Son bois n'est pas de bonne qualité. Mais, il est tendre, facile à travailler et prisé par les artisans-sculpteurs qui produisent des masques de forme allongée, en particulier à Foumban appelée couramment la « citée de l'art » (Njoukam *et al*., 2008). Actuellement, ces derniers parcourent des distances de plus en plus longues (plusieurs vingtaines de kilomètres) à la recherche de cet arbre devenu pratiquement rare. Il est

abattu, tronçonné *in situ* (à la dimension requise) et ramené dans les ateliers de sculpture situés en général dans les villages limitrophes de la ville.

Mesures effectuées dans une haie vive de polyscias âgés de 20 ans: Dans le village Nessah (près de Bangangté) situé à près de 120 km de Foumban, des mesures ont été effectuées sur les polyscias âgés de 20 ans qui avaient été plantés sous forme d'une haie vive d'environ 80 m. Il convient de signaler que contrairement à la région de Foumban où l'espèce est pratiquement surexploitée, ces arbres poussent tranquillement ici, loin de toute pression humaine. La figure 2 ci-après présente la répartition du nombre d'arbres mesurés dans la haie en fonction des classes de diamètres.

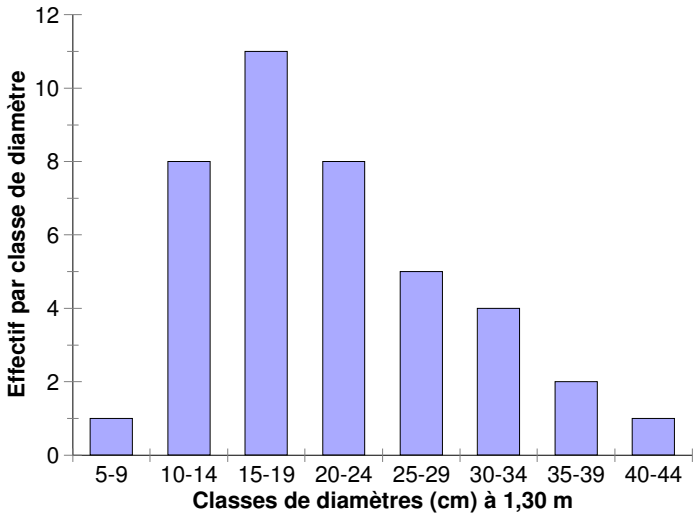

Figure 2. Distribution des polyscias âgés de 20 ans par catégorie de grosseur dans une haie vive à Nessah près de Bangangté.

68% d'individus se recrutent dans les trois classes suivantes: 10-14, 15-19 et 20-24. Les 32% sont répartis dans les autres classes, avec une seule tige dans la première et la dernière classe. Contrairement au secteur de transformation de bois qui aurait dû être fasciné surtout par les classes des plus gros bois, les sculpteurs s'intéresseraient à toutes les classes, notamment à celles relatives aux dimensions des objets dont la demande est habituellement élevée.

Essai de plantation du polyscias: Au niveau de la pépinière, seules les graines obtenues après dépulpage ont germé avec un taux de germination d'environ 60%). Le maintien de la pulpe (traitements T_1 et T_2) lors du semis aurait un effet inhibiteur sur la germination. L'eau bouillante utilisée dans le but de hâter la germination a été plutôt nocive pour les graines. Le début de levée a eu lieu 1 mois 10 jours après semis.

Les plants ont été mis en place et les mensurations périodiques ont démarré dans la parcelle deux mois plus tard. La courbe de croissance est indiquée à la figure 3.

A travers cette figure, on observe une croissance régulière dans la parcelle. La courbe de la hauteur en fonction des dates de mesures ne présente pas encore un palier qui traduirait ainsi un ralentissement dans la croissance des arbres. Les observations se poursuivent et détermineront à partir de quel âge cette essence peut être exploitée pour la fabrication des objets d'art.

Autres usages: l'écorce, les feuilles et les drupes du polyscias sont utilisées en pharmacopée.

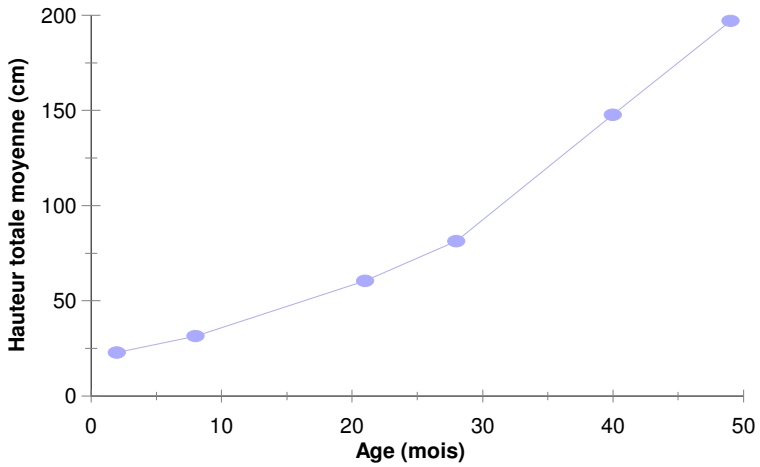

Figure 3. Croissance des arbres dans la parcelle expérimentale de *Polyscias fulva*

Entandrophragma candollei

A l'Ouest-Cameroun, *Entandrophragma candollei* (une Méliacée) a été introduit dans le village Bayangam par un notable du nom de Sa'a Nuetsa il y a plus d'un siècle. Depuis lors, l'essence a été plantée notamment dans les haies vives et en bordure des aires de danses traditionnelles. De très beaux fûts, droits et cylindriques, se dressent dans plusieurs concessions de ce village. En cas de besoin, le propriétaire choisit un ou plusieurs arbres qui sont abattus et sciés grossièrement à la tronçonneuse pour produire des lattes et des chevrons utilisés dans la construction des maisons.

Nous avons pensé que les recherches forestières devaient s'intéresser à cette sylviculture « unilinéaire » inventée par le savoir-faire paysan sans doute à cause de la forte densité humaine qui prévaut dans cette région. C'est une sylviculture à promouvoir chez les paysans qui désirent planter les arbres et qui n'ont pas suffisamment d'espace pour créer des boisements.

L'ingéniosité du paysan se poursuit jusqu'au sciage des arbres qui, une fois abattus, séjournent au sol pendant près d'un an pour un séchage naturelle à l'air libre. Les débités issus de ce sciage tardif subiraient un retrait moins important et se déformeraient très peu. Nous avons observé en juin 2008 dans la concession pionnière de Sa'a Nuetsa un superbe entandrophragma ($D_{1,30\ m}$ = 1,38 m) abattu en septembre 2007 qui attend d'être débité un an après (en septembre 2008 ?).

A partir de l'essai de germination que nous avons conduit, il ressort que la période de latence a duré 18 jours avant le début de germination. Au bout de 46 jours d'observations, les taux de levée varient de 46 à 70% dans les différents lots. Ce taux est estimé à 54% sur le total des 200 graines semées. On note que le pouvoir germinatif des graines baisse pratiquement de moitié, 3 semaines à un mois après récolte. Les graines conservées pendant 8 mois à température ambiante n'ont du tout pas germé. Il faut aussi noter que les graines en maturité sont souvent attaquées depuis leurs capsules ligneuses par des insectes. Ce qui est préjudiciable au pouvoir germinatif qui déjà ne semble pas se conserver pendant longtemps. Une fois récoltées, il serait prudent de trier rapidement les semences saines pour les semer immédiatement ou pour les conserver au réfrigérateur en attendant la période de semis.

Podocarpus milanjianus

C'est une espèce endémique au Mont Oku (Province du Nord-Ouest) notamment entre 2 400 et 2 900 m d'altitude et l'une des seules espèces endémiques de conifères en Afrique, au sud du Sahara. Le podocarpus est fréquemment planté (de même qu'une espèce voisine *P. mannii*) en alignements purs et très serrés sur 1 ou 2 lignes pour délimiter les champs et les concessions dans les départements du Haut-Nkam et de la Menoua. Les paysans récoltent les graines qui sont semées en saison sèche dans les endroits marécageux. Les jeunes plants sont transplantés en saison des pluies.

C'est un arbre à croissance moins rapide que l'eucalyptus, au fut rectiligne et au houppier étroit. Il fournit également des perches et son bois dense et résistant est débité (comme celui de l'eucalyptus) pour la production des lattes et des chevrons.

Conclusion

Cette étude nous a permis de mettre en exergue deux types de ligniculture : les plantations forestières étatiques à grande échelle d'une part et l'intégration ou le maintien des ligneux à l'échelle paysanne dans l'espace cultivé d'autre part. Les plantations forestières étatiques ont connu certes des succès au point de vue introductions d'essences avec la maîtrise des techniques sylvicoles qui en découlent. Mais avec du recul, on peut relever aujourd'hui que la conception initiale du reboisement a été jonchée de lacunes qui plus tard ont constitué les germes de la destruction de ces plantations. Plusieurs projets de reboisement ont été imposés à l'époque pour (mais sans) les populations. Celles-ci n'ont pas été parfaitement sensibilisées et se sont vues exproprier des périmètres à reboiser, le plus souvent sans indemnisations consistantes ni encadrement dans le nouveau village ainsi créé. Ces populations, installées non loin des réserves se sont progressivement érigées en saboteuses, pratiquant les coupes frauduleuses et allumant les feux de brousse. Par ailleurs, l'organisme chargé du reboisement a toujours privilégié l'extension des superficies plantées au détriment des soins à apporter aux arbres sur pied. Les plantations, apparemment abandonnées à elles-mêmes, subissent par conséquent la pression des populations environnantes.

Le modèle paysan, bien que développé à petite échelle, est plus durable et perturbe moins l'environnement. Le paysan obéit à son intuition et demeure très indépendant face aux recommandations ou aux ordres de l'administration forestière et des organismes de recherche qui, le plus souvent, lui donnent plutôt un surcroît de travail, à côté de son calendrier déjà chargé. Il faut cependant remarquer que les initiatives paysannes individuelles ne sont pas souvent soutenues par l'administration et que leur diffusion est souvent bloquée par des lois protectionnistes mal adaptées ou mal interprétées. Par exemple, un agriculteur peut exploiter librement les eucalyptus qu'il a planté mais pas les *Entandrophragma* ou les *Canarium* pour lesquels il devrait obtenir un permis d'abattage, après de lourdes et coûteuses démarches. Certaines espèces fruitières agroforestières sont même intégralement protégées et ne peuvent même pas être émondées sans autorisations très difficiles à obtenir.

Il en est de même dans les autres parties du pays, comme pour *Faidherbia albida* et *Vitellaria paradoxa* en zone soudanienne ou pour *Irvingia gabonensis* en zone guinéenne (Smektala et al., 2005).

Il apparaît donc que les états devraient en priorité adapter leur environnement législatif et fiscal aux réalités des pratiques conservationnistes des populations, comprendre leur logique et appuyer leurs initiatives, au lieu d'imposer des techniques simplistes à grande échelle, répondant à des problèmes qui ne les concernent pas directement.

D'autre part, les ONGs devraient aider les communautés à commercialiser les Produits Forestiers Ligneux ou Non Ligneux, issus de plantations ou de gestion durable d'espèces locales en danger d'extinction, par le biais de certifications de types « produits de l'agriculture biologique » ou « produit éthique et écologique » et à bénéficier de crédits internationaux pour la conservation de la biodiversité et le stockage de carbone (Peltier et Dauffy, 2008).

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ASSESSING INDIGENOUS KNOWLEDGE FOR EVALUATION, PROPAGATION AND CONSERVATION OF INDIGENOUS MULTIPURPOSE FODDER TREES TOWARDS ENHANCING CLIMATE CHANGE ADAPTATION IN NORTHERN ETHIOPIA

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Abstract

Recognizing that northern Ethiopia will be exceptionally susceptible to climate change and its associated potential impacts as observable from years of repeated cycles of drought, a study of indigenous methods for Evaluation, Propagation and Conservation of indigenous multipurpose fodder-trees (IMFTs) was conducted to assess the role of traditional knowledge in fostering climate change adaptation in a sensitive and fragile agro-ecological system upon which livelihoods depend. An intensive study of communities and forests was accomplished using Ecological surveys and Rapid Rural Appraisal methods to document indigenous strategies for evaluation, propagation, conservation, current forest stock and health, while creating awareness of global climate change impacts and adaptation measures. Analysis of accumulated data was accomplished using SPSS 14.0. Results indicate that some communities of northern Ethiopia living in mountainous dryland landscapes have a rich indigenous knowledge handed down over generations and have been cultivating IMFTs for diverse positive values (cultural, medicinal, fuel, fibre, environmental and livestock feed). Feed value of IMFTs was ranked first, followed by timber quality, biomass production, fencing value, soil and water conservation, ever-greenness and spiritual value, drought resistance and absence of allelopathic effects on under storey plants and agricultural crops. In comparing its multipurpose consumptive qualities, Ficus thonningii scored 8.39, out of 10, followed by Cordia africana (7.03), Eucalyptus cameldulensis (6.85), and Acacia ethabica (6.71). Appreciating these immense values and threats from changing environment, natives intensified propagation F. thoningii to averages of 5-10 cuttings per household per year and have perfected an indigenous protocol for evaluation, propagation and conservation, including care at different stages of growth. This practice has created a forested island and wildlife habitat in the midst of a highly denuded dryland landscape. IMFTs conservation has increased environmental resilience of the area by giving it increased carbon sequestration and adaptability to climatic forces. Therefore, preferred IMFTs should be recognized as main-stream fodder plants and keystone species and adopted in agrosilvopastoral systems for enhancing opportunities offered by indigenous people towards adaptation and mitigation (carbon sequestration) in vulnerable regions.

Introduction

Global climate change poses particular risks to poor farmers in developing countries. The northern Ethiopian region has been severely affected by repeated droughts and associated famines for the past quite few decades. Death of oxen used for plowing land is the worst impact of droughts in Ethiopia. Adaptation to climatic change (repeated droughts) in northern Ethiopia has focused on increasing or at least maintaining feed availability even in the driest years. This has resulted in the incorporation of new set of evaluation criteria for forage and fodder plants by local farmers. Through experience and co-evolving with recurrent drought, farmers in northern Ethiopia and, Ahferom woreda

(the study area) in particular have developed indigenous criteria for selection and evaluation of indigenous fodder trees and shrubs (IFTS) and have also perfected protocol for propagation and effective conservation of such species. Increased utilization of these IFTS selected by farmers as a means of adaptation to recurrent droughts and thus avoiding famines necessitates the need to understand the perceptions of natives, their preferences, and indigenous criteria of selection, exploitation, propagation and conservation.

Many interventions generated by research with the aim of improving the quality of life of traditional people, nutritional status of their livestock etc, in developing countries have failed to realize their apparent potentials when implemented on ad hoc basis. It is now widely accepted that this is because unlike the research generated technologies, farmers try to meet a wide range of indigenous objectives in feeding their animals (Throne et al.,1999) and adapting to existing agro-climatic changes in their localities. Relatively recently, however, it has become more widely appreciated that indigenous people need to balance a complex array of conflicting, multiple objectives and may have access to a sophisticated indigenous knowledge base of their own to live in harmony with nature and that indigenous people are not unknowledgeable about the eco-climatic changes that are taking place in their niches. Farming communities instead, take several sophisticated and interrelated measures for adapting to existing global and local climatic changes.

While work is underway in many places to develop varieties of staple food crops that can adapt to existing climatic changes (Rosergant, 2006), identification and selection of adaptable forage options still remains mainly an indigenous practice. Studying and exposing such indigenous adaptation mechanisms to the scientific arena is therefore a pre-requsite for stronger and adapting future. Several studies in indigenous African and Asian communities have shown that there are diverse array of indigenous criteria and strategies for evaluation, utilization and conservation of IFTS. While these criteria are intriguingly consistent in their nature, are also geared towards, adaptation needs of each agro ecology (Jimenez-Ferrer et al., 2007). While in a number of instances the laboratory nutritive value of IFTS has been found to correlate positively with their value according to indigenous evaluation criteria (Roothaert & Franzel, 2001), there are cases for some species where laboratory nutritive value does not correlate or even correlate negatively with the value of the plant according to indigenous criteria for example *Ficus thonningii* in Ethiopia (Mekoya, 2008), indicating that farmers, in their quest for adaptation, give less emphasis to conventional criteria (e.g. nutritive value), than survival. Therefore, plants that were ones not even in the list of fodder species could now be the best preferred by local communities.

Generally speaking therefore, since there are many sites specific and traditional indigenous knowledge used by local people for selecting adaptable species, such knowledge that have to be considered and integrated with scientific and conventional criteria of evaluation for better results in identification and promotion of best IFTS that can help farmers all over the world to effectively adapt to global and local eco-climatic changes. This is therefore why this study was made Ahferom district in central Tigray, northern Ethiopia to investigate indigenous peoples' knowledge on adaptable indigenous fodder trees.

Methodology

The study was conducted among indigenous Tigrigna speaking people in Ahferom woreda central Tigray, Northern Ethiopia. The geographical location of the study area is 14 ^{o} 7'00" to 14^{o}38'30" North and 38 ^{o} 56'0" East.The surveyed indigenous people have resided in a typically dry mountainous highland area with altitude range of 2300-3200 masl (meters above sea level) for over 1000 years. The area experiences unimodal rainfall pattern characterized by heavy and repeated hails. The mean annual rainfall ranges between 350-650 mm (BoARD, 2008). The area is typically characterized by repeated droughts with a typical frequency of drought as ones in three years (BoARD, 2008). A reconnaissance visit was organized in Ahferom to familiarize and plan the survey. Intensive field socio-economic and ecological survey was carried out between 2007-2008 using field equipments and structured and semi-structured questionnaire administered to 120 farmers (45% of households). Besides, discussions were held with local development agents, selected knowledgeable individuals and community administrators. Separate interview was also made with selected community elders (>60 years of age) and youngsters (20-25 years of age) to see perception differences between generations and infer information about history of climatic change. Data was analyzed using simple descriptive and inferential statistics and results presented as averages and percentages in tabular forms for ease of interpretation.

Results and Discussions

Drought and the Adibre community; perception and the use of F. thonningii for adaptation

Separate interviews with the two generations of farmers in the area revealed that climatic changes (drought), has actually impacted the environment and the way by which people perceive and utilize the environment . While older respondents (> 60 years) identified 40 wildlife species, 56 IFTS, 21 herbaceous forage species, and 18 cultivated staple food crops, younger respondents (20-25) identified only 16 wildlife species, 9 IFTS (citing *F. thonningii* first in all cases), 9 herbaceous forage species and 14 cultivated staple food crops. Similarly, answering to question on how they select forage plant, while older respondents emphasized on impact on animal productivity, younger respondents considered drought tolerance and survival or hardiness as the most important factor.

Through experience and co-evolution, with climatic change (drought), farmers have from time to time changed their view of environment and thus their ways of conservation and utilization. Older respondents indicated that trees like *F. thonningii* which used to grow by them selves with no care or agronomic inputs applied to them are now the most commonly cultivated forage plants indicating that locals have actually recognized the change and are adapting to it. *F. thonningii* is preferred not only because of being adaptive plant to the recurrent droughts, but also because of its diverse benefits and services to the local community. The increased propagation and cultivation of *F. thonningii* for more than 100 years now, has changed the landscape from an inclement arid land to an ever green lush forest habitat surrounded by vast mountainous drylands. The Adibre community, the study area can be described as a green Island amidst the ocean of dry and degraded mountains in central Tigray, northern Ethiopia.

Community's perception and use of Ficus thonningii for animal feeding

Feeding of *Ficus thonningii* as a normal feed to animals started following severe feed scarcity problems commonly caused by repeated droughts and over grazing which reached alarming levels during the years 1985 and 1991. According to respondents, in the distant past , when conventional feeds; grasslands and wastelands were highly productive and feed was plenty, and *F. thonningii* was there with all its potentials, no one was interested in using it as an animal feed as it had no comparative advantage to other fodder trees and herbaceous forage plants that existed at that time according to the then working criteria (nutritive value). Only equines and small ruminants used to eat leaves whenever a tree fell by accident or due to other reasons. Currently, because of increased awareness and *Ficus thonningii* being the most readily available option, there is an increased use and propagation of *Ficus thonningii* trees in those dryland farming systems. Due to the close supervision and care paid by farmers to *F. thonningii*, the indigenous people keep track of when each stand or collection of stands were planted and thus have a clear idea of their ages.

The age structure of available *Ficus thonningii* plants is a good indicator of its sustainable conservation in the area. In all surveyed communities, the proportion of old trees (> 50 years), middle aged (5-50 years), and young (<5 years) is 12.3%, 36% and 51.7% respectively. Besides to the multipurpose benefits that it renders to the community, higher acceptance of *F. thonningii* is also because of its ability to stay green even at the driest years. Locals even have songs of praise for the drought resistance ability of the tree. A famous one is "*Dirki Halifu Sala Shibaka, Durka Tay Akure-eka* " translated as "hay or grass, you can't claim pride, it is the *F. thonningii* that saved our lives (during drought)." Its ability to shed its leaves during the driest seasons of the year may also contribute to its drought resistance. It has a characteristic succulence because it holds large amounts of water in almost all its parts and the stem is particularly watery with milky exudate. However, this higher drought tolerance characteristic is ironical to the fact that *F. thonningii* has got a shallow root system which ordinarily should not allow it to utilize deep lying ground water. Respondents also indicated that *Ficus thonningii* does not infiltrate or exhaust ground water as it anchors its roots only in the upper 1-3m of the soil. This short root system, according to respondents is said to be advantageous as compared to other trees mainly *Eucalypetus cameldulensis* which is known for exhausting underground water and create water deficiencies for many other purposes.

It is also important to note that, it is not only that the proportion of *F. thonningii* is increasing, but that the proportion of other introduced exotic species is decreasing even with the advantage of government promotion. Figures 1 and 2 show the trend in number of planted and survived respectively of *F. thonningii* and three other exotic and promoted species.

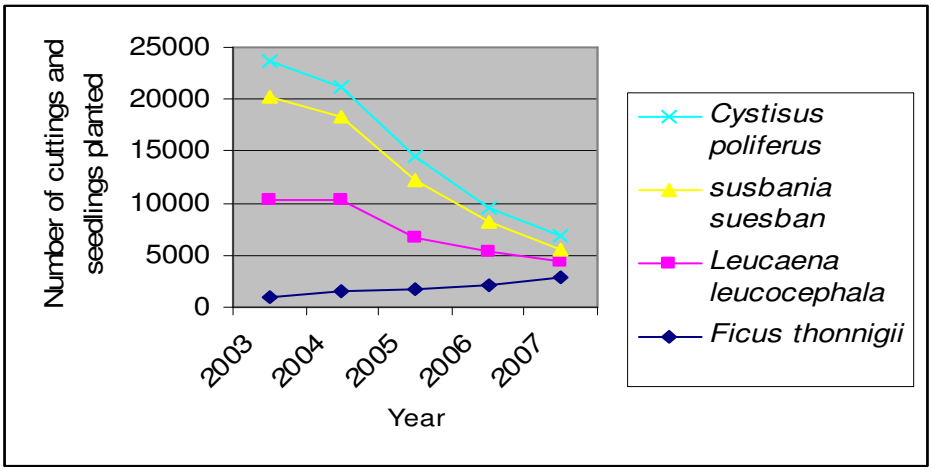

Figure 1. Trend of the number of different fodder trees planted in the backyards of the farmers of Adibre community for the last five years.

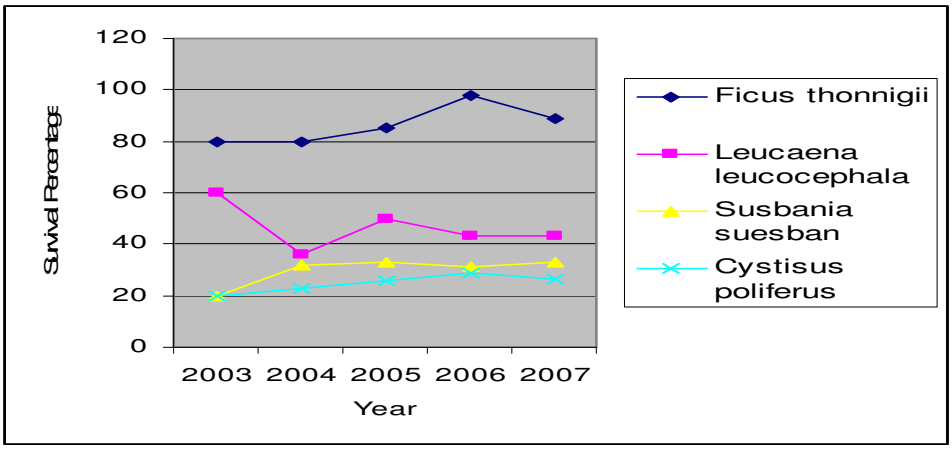

Figure 2. Trends in the survival percentage of three exotic fodder species as compared to *F. thonningii* for the last five years

Indigenous criteria for evaluation, selection, propagation and conservation of Ficus thonningii

Multipurpose values of Ficus thonningii

The qualities and criteria of selection for *Ficus thonningii* used by farmers are similar to the general primary indigenous selection criteria for other forage plants; such as ease of establishment, fast growth and regeneration, palatability to animals, persistence (Gabunada, 2000 as cited in Sullivan, 2001) and biomass production, adaptability, ease of propagation, growth potential, multifunction, life span and compatibility with crops (Mekoya, 2008). Table 1 shows indigenous people's ranking of the different positive attributes of *Ficus thonningii* in terms of their importance. The other indigenous criteria indicated in table 1 are also similar to indigenous selection criteria of IFTS described by Throne et al., (1999) and Roothaert (2000). Multipurpose merits of *F. thonningii* are also shown in Figure 3. According to the respondents' ranking based on composite criteria, *Ficus thonningii* was the most important tree followed by *Cordia africana, Acacia nilotica, Rhus natalensis and Eucalypetus cameldulensis* (Table 2). *Ficus thonningii* besides its other qualities discussed in the previous sections, is also appreciated for being very simple to propagate by stem cuttings which is also reported by Mekoya (2008), in other parts of northern Ethiopia. It performs well in soils of poor fertility status and marginal lands (Figure 4).

Table 1. Respondent's ranking of multipurpose qualities of *Ficus thonningii**

Qualities	Ranks									Average rank
	1	2	3	4	5	6	7	8	9	
Feed value	120	0	0	0	0	0	0	0	0	**1**
Timber quality	0	112	6	2	0	0	0	0	0	**2.08**
Biomass production	0	21	21	50	9	8	11	0	0	**3.95**
Fencing value	0	0	21	21	50	28	0	0	0	**4.7**
Soil and Water Conservation	0	0	29	16	15	70	0	0	0	**5.38**
Ever greenness	21	0	0	0	0	0	91	0	8	**6.08**
Drought resistance	0	0	0	0	21	14	28	57	0	**7**
Soil fertility improvement	0	0	0	7	6	6	11	49	41	**7.76**
Free of shading and alelopathic effect		0	0	6	6	6	7	7	88	**8.23**

* The ranks are averages of ranks given to each quality by each of the 120 indigenous people, for instance the average rank for timber quality is (0*1+112*2+6*3+2*4+0*5 etc.)/ 120 = 2.08

Figure 3. Common local multipurpose uses of *Ficus thonningii* - timber (wooden door), soil and water conservation, feed and live fencing.

Figure 4. Common niches where *Ficus thonningii* is planted in the study area - communal wastelands, farm boundaries, with conservation structures (earthen trenchs), and village foot path boundaries.

Indigenous practices of propagation and conservation of Ficus thonningii

While long ago, *F. thonningii* was not a fodder tree of interest, today it is being deliberately planted by farmers for the purpose of producing fodder for livestock, aforementioned benefits and other salient uses of its bark and leaves for traditional medicines, healthcare delivery and tools. The indigenous people are now planting between 5-10 cuttings per year per household. This indigenous conservation strategy using *F. thonningii* as "keystone" species is a laudable innovation that is worthy of further research, development and duplication in other areas especially in an era when global climate change and its associated adverse impacts poses increasing threats to local communities livelihoods and biodiversity conservation. Through experience, the local community has developed and perfected indigenous procedures and protocols for successful propagation of the plant (Table 3).

The use of Ficus thonningii for feeding of animals

The feed value of *F. thonningii* has also been appreciated by other researchers. For instance Smith (1992), rated *Ficus thonningii* as fodder tree of high value in humid tropical Africa. In Central Tigray, Northern Ethiopia, (REST & NORAGRIC, 1995) also reported that *shibaka* (the local name of *Ficus thonningii*), is one of the trees used as a fodder plant by livestock herders in the highlands of central Tigray. With regard to indigenous use of *Ficus thonningii* as a fodder tree, Roothaert, (2000) indicated that it is one of the top ten selected IFTS in two zones of Kenya. Even if all types of animals eat the plant well (Figure 3), the degree of preference is higher in equines followed by small ruminants and then cattle.

Indigenous people practice deliberate feeding to small ruminants than the other livestock because in all of Ethiopia, there are no cultures of preparing ration or stored feed for small ruminants, thus small ruminants are usually fed the readily available feed, e.g. *Ficus thonningii*. Intensive feeding is practiced when conventional feed reserves (hay and straw) are exhausted. While most farmers (74.3%) own at least 10 trees for feeding their animals, others (20.4%) indicated that they have bought *F. thonningii* fodder at some time for feeding their animals, at a prices of 30-70 ETB (Ethiopian Birr) (1 USD = 9.6 ETB), which indicates the valuing of the plant by farmers. For cattle, *F. thonningii* is only considered a supplement to the conventional feeds. So, it is usually fed after cattle eat straw or

hay but to small ruminants, camel and equines it is fed as a basal diet (it is considered a basal diet because there is almost no grazing land resource available for these animals in this specific area). It is wilted when fed to cattle while it is usually fresh when fed to small ruminants, camel and equines. Feeding fresh to cattle in poor body condition is said to cause esophageal blockage during swallowing and causes inability to breathe, drink eat and finally death of animal. Esophageal blockage is probably caused by over swallowing large amounts of material without proper chewing as the plant is very soft and slippery.

Table 2. Average scores and overall ranking of multipurpose qualities of *Ficus thonningii* as compared to other local trees

Scientific name	local name	Feed	fuel wood and charcoal	fencing	shading	soil and water conservation	Source of cash	Timber	overall average score
Ficus thonningii	Shibaka	10.0	7.6	8.2	9.0	7.9	8.0	8.0	**8.39**
Cordia Africana	Awhi	8.0	7.6	1.3	7.7	7.4	8.6	8.7	**7.03**
Acacia nilotica	Chea	7.6	8.0	8.5	5.5	8.0	2.1	1.4	**5.87**
Rhus natalensis	Mengi	5.0	8.2	7.7	7.3	3.2	8.2	7.7	**6.76**
Eucalypetus cameldulensis	Kelamitos	0.8	6.9	7.8	7.0	8.4	10.0	7.1	**6.85**
Coroton macrostachyus	Tambuk	8.1	6.5	2.2	7.4	6.8	3.0	5.5	**5.64**
Accacia ethabica	Seraw	8.6	10.0	8.3	3.2	5.4	8.8	2.6	**6.71**
Olia europiana	Awlie	1.1	8.0	1.0	7.4	6.5	8.3	5.5	**5.39**
Mytenus senegalensis	Argudi	2.2	8.0	7.0	1.1	4.1	1.0	0.7	**3.44**
Carrisa edulis	Agam	4.7	8.5	8.0	7.0	4.5	1.4	2.4	**5.21**

Table 3. Indigenous procedures and requirements for successful propagation of *Ficus thonningii*. information on the propagation techniques collected from group discussions and individual interviews.

Requirement	Measurement / indicator	explanation
Age of mother plant	> 2 years	Depends on the size and maturity
Average length and width of branch for cutting	Width 10-30cm, and length <4m	long cutting easily shaken by wind
Season for cutting	March-May and end of August	Wet but not waterlogged land
Care during cutting	Avoid peeling barks, level cutting, and don't leave the cut part in the host plant shaded by leaves as this will cause drying of the branch.	All branches cut at ones to avoid shading.
Incubation time between cutting and planting	About 1-2 months for those cut March-May, <1 month for those cut at the end of August.	this is to make cuttings loose some moisture
Care between cutting and planting (Incubation time)	Protection from bark damage and peeling. Covering the over all cutting with dung to repel animals.	Avoid peeling barks as it is detrimental
Depth and width of planting pit	50 cm depth and 20 cm width	Adjusted to fit the cutting. Pit has to be well compacted to protect shaking.

Watering frequency after planting	May not need watering	Survive on water stored in the stem
Best soil type for planting	Good in all soil types	Water logged soil is bad, so adapts well in sandy soil, firm clay soil is good for holding the cutting tight.
Care after planting	Complete protection form animals by dipping the whole cutting in dung to repel animals, attaching the planted cutting to a tree or a stationary peg or stone to avoid shaking.	Shaking hinders root development and thus survival of the plant

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TRADITIONAL KNOWLEDGE ON TREE CHARACTERISTICS AND USES FOR AGROFORESTRY IN GHANA

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Abstract

Traditional method of farming has been the shifting cultivation. Some tree species are deliberately left on farms to serve different functions. The farmers, through constant association with the trees, have observed field behaviours and influences of the tree species on the environment. Importance of the tree-crop associations has been known through long history of farming systems and the knowledge handed over to later generations. Farmers' wealth of knowledge about tree-crop associations are crucial for the development of agroforestry systems. Trees left on farms are normally selected based on several factors including; Tree characteristics and habit, tree canopy architecture, structure, texture, extent, etc in combination with crops, Ecological, biological and engineering functions, Traditional uses; subsistence and commercial, the value of the tree parts e.g. medicines, housing, food, fuelwood, religious, etc. Hence, local names of plants and tree species are derived from functions, attributes, uses, other special characteristics and history of their discovery. Tree species and their local names are used for identifications and information on their renaissance must be documented. Local names in different languages may have similar meanings and are useful for tree species identification, nomenclature and uses.

ENDOGENOUS KNOWLEDGE ON NON-TIMBER FOREST PRODUCTS IN NORTHERN BENIN

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Natural ecosystems have historically been managed independently, or sometimes in collaboration with government agencies. Traditional forest knowledge and innovative forest management practices developed over centuries have contributed significantly to Africa's natural and cultural heritage, while helping to sustain production of multiple goods and services that enhance livelihood security and quality of life. This study assessed Non Timber Forest Product utilization in surrounding villages of W National Park (northern Benin). The aim of the study was to document their importance in local communities' livelihood in order to built sustainable strategies of conservation and utilization. The data were obtained using semi-structured interviewed and questionnaires. The random number tables were used to select 148 households among those who engage in NTFP extraction. Data was collected (for the year 2007) through personal interviews using individual questionnaires for the different stakeholders identified as those who gain utilitarian value from plants. Analyses have been made using EXCEL ordination statistical packages. This work showed that 172 species of tree are used and played an important role in local communities' livelihoods. Those plants are valued for economic income, cultural reasons, non-monetary utilitarian purposes (food, firewood and medicine) and traditional industry. This study also indicates that all the households in the sample extract mainly 4 products such as fuelwood (*Anogeissus leiocarpus* and *Crossopteryx febrifuga*), kernels of *Vitellaria paradoxa*, fruits of *Parkia biglobosa* and leave of *Adansonia digitata.* Those plants should be taken into account as far as defining community priorities for scientific study in relation to forest resources management.

UTILISATION AND LOCAL KNOWLEDGE OF *SCLEROCARYA BIRREA* (ANACARDIACEAE) BY THE RURAL POPULATION AROUND THE W NATIONAL PARK IN KARIMAMA DISTRICT (BENIN)

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Abstract

The harvesting and consumption of plant products from natural forests is known to account for a large proportion of the livelihood of people living close to such habitats. The purpose of this study was to assess local knowledge on *S. birrea* (A.Rich) Hochst, a wild edible plant, and analyse the species population viability in relation with the local uses and land uses practices. An ethnobotanical survey was carried out with a total of 159 respondents randomly selected in all socio-cultural and professional groups with respect to gender in Karimama district. The mains rubrics of the survey form were related to the part of the species used, the ways it is used and what it is used for. Results showed that *S. birrea* is maintained by farmers in an agroforestry situation. About 73% of 159 respondents have each at least one *Sclerocarya birrea* tree on their farm. The socio-economical importance of S. *birrea* species results in supplying the local population needs in food and medicine scopes. All parts of the species (bark, fruits, kernel, leaves, root and wood) are used by local population. About ten diverse illnesses are treated with *S. birrea* organs particularly the bark. Apart from logging for carving and clearing for agricultural purposes and, the current use didn't appear to threaten the species' viability. We conclude that *Sclerocarya birrea* is a multipurpose uses species well integrated in the livelihood of Karimama local population. It is underutilised and deserves more attention for the improvement of this population's livelihood.

Introduction

Tropical parks have been surprisingly effective at protecting the ecosystems and species within their borders in the context of chronic under-funding and significant land-use pressure. They have been especially effective in preventing land clearing, arguably the most serious threat to biodiversity (Burner et al., 2001). However there is an increasing realization that to ensure long-term sustainability of biodiversity conservation through protected area networks in the developing tropics, the emphasis needs to shift towards significant involvement of local communities who meet their livelihood needs from forest based resources that fulfils different roles in their sustenance (Ramakrishnan et al., 2005; Ramakrishnan, 2007; Delang, 2006) . In this effort, traditional ecological knowledge generated and practiced by traditional societies over time and space along with text-book based formal knowledge has a key role to play in ensuring sustainable natural resource management (Ramakrishnan et al., 2005). Indigenous people often attempt to provide appropriate cultural responses to their environmental problems. In Africa and particularly in Benin, they use their traditional knowledge accumulated over centuries and transmitted from generation to generation to take advantage of they environment and manage it in a way that it should be sustainable (Gadgil *et al*., 1993). However, many plant species whose different parts (leaves, fruits, bark, root, wood, etc.) are daily used by rural population to meet their nutritional, cultural and medicinal needs remain unknown and then slightly documented. This is particularly important in semi-arid area of the country where people live mainly on cereals like millet and sorghum, which are known as rich in energy and poor in vitamins and proteins. These plant species provide the essential nutrients. Among them, *Sclerocarya birrea* is one of forest trees used for many purposes by local population around W National Park. Several

researches have been carried out on the species in other parts of Africa, mainly in South Africa where the subspecies *caffra* is locally known as "marula tree" (Eloff, 2001; Shackleton et al., 2002; 2003; 2005, Emanuel et al., 2005; Leakey et al., 2005), Senegal, (Soloviev et al., 2004) where it is called "bir" in ouolof and in Burkina Faso (Diallo et al., 2005). However, the species' importance for Benin rural population livelihood is slightly documented.

The main objective of this study is to contribute to the conservation of W National Park by exploring local alternatives given to residents to lessen their pressure on the protected area. More specifically, the aims of this research work were to: (1) assess knowledge on local uses of *Sclerocarya birrea* in Karimama; (2) analyse its population viability in relation to local uses and land uses.

Methodology

Study area and studied species

Field surveys were carried out in Karimama District located at the Northern part of Benin Republic between longitudes 11°50-12°25 N and latitudes 2°43-3°20 E. It covers 6,102 km^2 with an annual population growth rate of 3.18% giving a current estimation of 47757 inhabitants. The District holds the Benin part of W regional transfontier reserve. The climate is sudano-sahelian with average annual rainfall of 800 mm. The mean annual temperature recorded is ca. 28.27°C with a minimum of 17.07°C in December and a more than 40°C in April.

Sclerocarya birrea belongs to the family of Anacardiaceae (mango family) and have 2*n* = 26 chromosomes. It has been described by many authors under several names, which are *Sclerocarya caffra* Sond. (1850), *Poupartia caffra* (Sond.) H.Perrier (1944), *Poupartia birrea* (A.Rich.) Aubrév. (1950). *Sclerocarya* is a strictly African/Madagascarian genus. Three subspecies of *S. birrea* are distinguished: subsp. *birre*a, subsp. *caffra* (Sond.) Kokwaro and subsp. *multifoliolata* (Engl.) Kokwaro (Hall, 2002). *S. birrea* is a fast growing tree. Although widely described as a dioecious species, Diallo et al. (2006) has demonstrated a morphological androdioecism inside the species' population. The species occurs throughout most of sub-Saharan Africa outside the humid forest zone, from Mauritania and Senegal to Ethiopia and Eritrea, south to Namibia, Botswana, Zimbabwe, Mozambique, South Africa and Swaziland. In Benin, Adomou (2005) has noticed its occurrence in Bassila, Atacora Mountain and Mekrou-Pendjari phytogeographycal districts.

Methods

An ethnobotanical survey was carried out among local people around the protected area from July to August 2007. Structured interviews were carried out with 159 persons from different households chosen in the 18 villages of the district of Karimama. All occurring socio-cultural (Dendi, Gourmantché, Fulfulde, Hausa) and professional (farmers, traditional healers, cattle breeder, fishers, craftsmen) groups with respect to gender were included in the sample. The inquiries were focused on local identification of the species, the different parts of the species that are used and how they are harvested and finally the way those parts are used and what they are used for. In each village, 8 to 10 farmers including the village chief, added to traditional healers were interviewed. Interviews were done individually or in groups of 2 to 10 persons when possible. After analysis of survey forms, the answers rates per kind of utilisation have been expressed following Kouyaté (2005), which is as follow:

F (%) = (S/N) ×100 with S= Number of responder related to a given utilisation and N= Total number of respondants.

Results

About 73% of 159 respondents sampled have at least one *Sclerocarya birrea* tree on their farm. Farmers found the species growing on their farm or have inherited it with the farm. None has planted *S. birrea*. The importance of S. *birrea* species results in supplying the local population needs in food and medicine scopes irrespectively to the socio-cultural groups. Various names are given to the species according to cultural groups. In Dendi and Djerma, the species is called *Diney, Louley or Loulan.* It is called *Eidi or Chaïk* by Fulfuldé, *Bounama'gbou* by Gourmantché and *Denya* or *Looda* by Hausa. The different uses made of the species is summarised in table 1.

Table 1. Different uses made of *Sclerocarya birrea* organs in Karimama district

Organs	Utilisation	Associated items	Processing method	Form of use	Purpose	Response rate (n=159)
Bark	Medicine		Soak in cold water Boil in water as infusion	Drink the water or infusion Wash injured person with infusion Bathe in the infusion	Malaria; Stomach-ache, Diarrhoea and haemorrhoids treatment	37.2% 45.5%
	Medicine		Boil in water as infusion	Wash children Rinse out mouth	Enhance strength, Treat tooth-ache	10.9%
	Medicine		Dry and reduce in powder	Put the powder in wounds	Wound healing	3.1%
	Medicine		Boil in water as infusion	Drink	Blood pressure Tuberculosis Micturation facilitation	7.3%
Leaves	Food and medicine	Millet starch,	Pound leaves with millet and transform in porridge	Drink	Milk production stimulation for nursing women	40.4% (80% of women)
	Food	Mixture of dried peanut extract, red pepper, salt and other spices	Boil leaves and mix with seasoning	Eat in form of “leaf bundle”	Human care	60.0%
	Medicine		Harvest young leaves and recover the sap	Put the sap on eyes	Treat sore eyes	37.1%
	Medicine		Dry and reduce to powder, Boil in water or pound fresh	Put the powder or pounded leaves in wounds. Wash the injured person with	Human and animal wound healing	16.0 %
	Pastoral		Harvest the leaves	Give fresh leaves for cattle as forage	Cattle care	100%
Fruits	Food		Remove the flesh of the small round Extract juice	Eat or drink juice	Human and animal care	100%
	Medicine		Fresh fruit	Rub the fruit juice against the body	Stop itching or scorpion bite	7.5%
Kernels	Food		Open the pit using rocks as hammer and anvil	Eat as snack food	Human care	100%
	Care		Harvest a small stem	Use as toothpick	T eeth care	12.6%
	Firewood		Collect dried wood	Use for fire		74.5%

Organs	Utilisation	Associated items	Processing method	Form of use	Purpose	Response rate (n=159)
Wood	Agricultural tools			Use for hand tools, plough wheels		40.9 %
	Carving for cultural and home use purposes		Carving variants items	Use for making pestles, mortars, drums, stools, rosary, drums, bowls, spoons, and canoes from large trees.		71.8%
Roots	Medicine				Swelling and gonococci healing	1.9%

Beyond the above mentioned used, *Sclerocarya birrea*, services mentioned by farmers (100%) is the shade it provides for them during their rest while working on farms as the leafing phase of the species correspond to the active farming activities period. In two Dendi settlements farmers reported to bury dead persons with *S. birrea* wood because of its ability of keeping moisture for a long time. There is not particular culture and ritual associated to *S. birrea* apart from veneration when the tree appeared to be the largest or the oldest located in a village. This veneration somehow is not specific to *S. birrea* but could be consented to another species provided it is large and aged.

Discussion

Sclerocarya birrea was found to be a multipurpose use species in Karimama as revealed by literature. The fact that every part of the species is used is consistent with previous results (Shackleton et al., 2000; Shackleton et al., 2002; Shackleton et al., 2003). Formers studies have also noticed the use of the species since decades (Palmer & Pitman, 1972; Quin, 1959) and probably by the early Hominid *Australopithecus africanus* (Matt et al., 1999). *S. birrea*'s bark is widely used by the population for healing malaria. This species is proved to have an antibacterial activity, as bark and roots are also reported to be used in treatment of many bacteria-caused diseases such as stomach disorder, dysentery, diarrhoea, and wounds (Eloff, 2001).The fruit and kernels of *S. birrea* are reported to be important components of the rural people diet in several areas where the species is found (Cunningham, 1988; Shackleton *et al*., 2000) and they have a potential large economic value (Emanuel et al., 2005). Fruit are transformed in juice, alcoholic beverage (wine and beer), jam (Shackleton et al., 2002; Von Maydell, 1963; Arbonnier, 2000; Hall, 2002), but this is not yet the case in Karimama District. A nutritional analysis of the pit undertaken by Glew et al. (2004) showed that it contains many essentials fatty acid, (linoleic acid, oleic acid), protein (36,4%, the highest rate found in more than 75 edibles plant foods of the western sahel), and energy. The nutritious oil and protein rich kernels known as *kôkô* in Pedi, *eegongo* in KwaNayama Owambo and *umango* in Zulu are extracted manually from the pips using a range of techniques specific to the different parts of the plant distribution range (Shackleton et al., 2002).

Even if unfortunately the pattern of essentials amino acids in the protein fraction of *diney* pit falls far short of the World Health Organisation (WHO) standard when it comes to several essential amino acids, the arginine content of the protein fraction of *S. birrea* pit stands as one of the highest levels of arginine in any plant protein that has been reported (Glew et al., 2004). Arginine is known to play vitals roles in nutrition and metabolism. It is classified as an essential amino acid for infants and young children. It is a conditionally essential amino acid in adults at times of trauma or disease. This justifies the importance of kernels as an excellent diet complement in rural area like Karimama which belongs to areas where recommended dietary allowances are not met because of the food mainstay made essentially of cereals and frequent food shortage due to the climate hazard or risk. The nutrients in *diney* pits could be beneficial to pregnant women and children which are the very consumers of kernels.

Apart from the human consumption and utilisation, the species is also used in animal breeding. Although, *S. birrea* seed has a very low dry matter digestibility (Aganga, 2001), its leaves are mostly

used as forage in animal feeding at the beginning of the rainy season when livestock is penned in order to avoid crop damage (Shackleton et al., 2003; Aganga et al., 2001) and this situation is similar in Karimama. The ease of working the wood with simple tools, combined with its large size for a dryland tree (Hall, 2002; Shackleton et al., 2002) explains its traditional popularity for carving in the study area. The outcome of our survey corroborate previous reports by Shackleton et al. (2002) where the marula woods has been traditionally used for carving pestles and mortars, bowls, drum, beehives and stools, canoe. These findings confirm the socio-economical importance of the species and highlight its importance in food security and poverty alleviation

The use of every organ of a species (leaves, fruits, bark, woods and root) is widely reported to have negative synergistic effect on the sustainability of this species (Eloff, 2001; Hahn-Hadjali et al., 2004; Guedje et al., 2007; Gaoué et al., 2008). This is of particular importance when these organs are object of market exchange. But apart from utilisation of trunk and branches for carving mainly by carvers which is a high impediment to the population viability, the current uses don't constitute a threat for the species in Karimama. The fact that *S. birrea* is not yet the object of market exchange in the district could justify this situation. The fruits of *S. birrea* are harvested mainly for children consumption. Lombard et al. (2000) have stated that the harvest of this fruits would be out of direct environmental risks. However, further studies are needed for a better understanding since the fruit harvest for human use may indirectly impact on the potential regeneration of the species (Shackleton et al., 2002). However the fact that *S. birrea* germinates readily and can also be propagated visa stem cutting, grafting and can also sprout shoots (Soloviev et al., 2004; Bellefontaine, 2005; Shackleton et al. 2000) is an asset that can be used to promote its domestication and spreading in agroforestry systems.

Conclusion

From our fieldwork which is the first exploration on the species in Benin, it appears that *Sclerocarya birrea* is a wild edible tree that is found in the northern part of the country and is maintained by farmers in an agroforestry situation. This shows that *Sclerocarya birrea*, through its multipurpose uses by Karimama residents, is really integrated in the culture of this community. Thus, this study of how communities use this forest species, the nutritional, medicinal and cultural benefits they derive from it, is an important preliminary as to further management actions including these stakeholders.

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ENDOGENOUS KNOWLEDGE ON TAMARIND (*TAMARINDUS INDICA* L.) IN NORTHERN BENIN

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Abstract

Tropical ecosystems are full of multipurpose tree species daily used by rural communities. This study assessed knowledge on *Tamarindus indica's* in northern Benin. The aim of the study was to document its importance in local communities' livelihood in order to built sustainable strategies of conservation and utilization. Data were collected using questionnaires and semi-structured interviews. Quantitative analyses have been made using SPSS ordination statistical packages. Tamarind played an important role in local communities' livelihoods as showed by its many purposes. Most commonly the fruit (pulp) was used to make beverages, as laxative and purgative and seemed to be the only one part sold. Barks were frequently used as a medicine in hardly curable wounds treatment while leaves were used to make porridge and as antibiotic. Anthropogenic activities and practices as far as mature trees mutilating, seedling removing and fire were the principal threats to the species. Results did not support the hypothesis which assumes that tamarind trees often grow on mounds in arid ecosystems do to the species' soil requirements. This study indicates that tamarind should be taken into account as far as defining community priorities for scientific study in relation to forest resources management is concerned. More interests are called on the species' contribution to households' incomes, local economies and its ecology as far as its domestication is concerned.

Introduction

Tropical ecosystems are full of multipurpose tree species daily used by local communities. (Okafor, 1997; IPGRI, 1999). In spite of their so reported potentials, these species uses have generally been less studied (or only for a short extent) compared to their industrial counterparts (Leakey & Newton, 1994). New initiatives in agroforestry are seeking to integrate into tropical farming systems indigenous trees whose products have traditionally been gathered from natural forests (Leakey & Simons, 1998). *Tamarindus indica* is a multipurpose tree species of the Leguminoseae family. The species grows in most of the tropical countries in a wide range of habitat ranging from natural zones to anthropogenic ones. It is an important tree species with resources used for livelihoods (El-Siddig et al., 2006). Despite the widely known socio-economic and industrial uses of tamarind products, the species is still under utilized and unimproved in many countries (Meghwal, 1997; FAO, 2004). Further more, the species' utilization in many countries where it grows as well as Benin, are not yet known (FAO, 1999). In tamarind studies, a still undocumented matter is also the relation between tamarind and termite or ant as the tree is said to be commonly seen on those social insects' buildings. Hypotheses have attributed the phenomenon to the soil requirements of tamarind trees (El-Siddig et al., 2006). However these hypotheses have never been tested. Gathering information on how does local people interpret such a phenomenon could help for a better scientific understanding. Fortunately, in efforts to enhance the species' genetic conservation and utilization, Benin and other countries have recently prioritised it for conservation (Eyog Matig et al., 2002). There is therefore a need to document local people knowledge on tamarind tree in these countries, to generate information to guide the design of comprehensive intervention strategies, for the species' conservation and enhanced utilization. Thus, this study assessed knowledge on tamarind tree in northern Benin, posing the following questions:

- What are the different products and uses of tamarind?
- What are the diversity traits and principal threats to the species?
- To what do local communities attribute the relation between tamarind trees and termite mounds or ant hills to?

Methodology

Study area

This study was performed on tamarind (*T. indica*) within Karimama district (northern Benin), where the species occur in its highest density. The sampled zone is located between 11°40' to 12°23' N and 2°2' to 3°2' E. The mean Annual rainfall is about 950 mm and soils are mainly ferruginous. Karimama is the biggest district of the country with its 6,041 km² of which 83.3% is covered by the W National Park. As a result, the 39,579 inhabitants of the district are facing lack of land for agriculture as reflected by the agricultural density (80 inhabitants/ha) (LARES, 2001). The principal ethnical groups are the Dendi and related (63.8%), the Fulani (18.3%), the Gourmantché (9%) and the Haussa (about 3%) (INSAE, 2003).

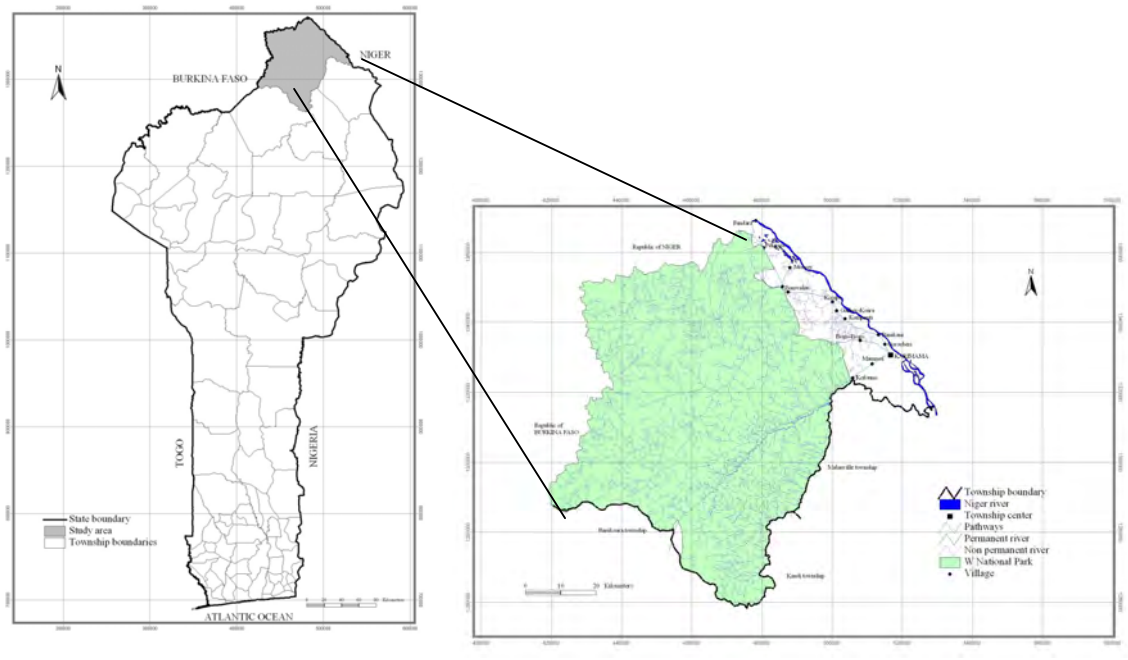

Figure 1. Map of Benin showing the study area and sampled villages

Ethnobotanical survey

A survey based on a semi structured group-interviews was realized in the 18 principal villages of Karimama district surrounding the W National Park; namely, Pékinga, Monsey, Loumbou loumbou, Bonwalou, Kompa, Garbey koara, Komponti, Bogo bogo, Torioh, Banikani, Gorou béri, Mamassi Peuhl, Mamassi Gourma, Kofonou, Kargui, Birni lafia, Gorou kambou and Karimama. This is to document the socio-cultural importance of *T. indica* in local communities' livelihoods. Informants' selection was done in collaboration with village leaders. The sample was based on the ethnical groups and their related percentage in the district. In each village, groups of the same sex of not more than five persons were interviewed together. This gave a total of 171 informants of which 63.16% Dendi and related, 16.96 % Fulfuldé, 16.96 % Gourmantché and 2.92 % Haussa. Interviews have focused on (i) the knowledge of local communities on the species' products and utilizations, (ii) variability in the species, (iii) factors which threaten the species and (iv) relation between the species and termite mounds/ ant hills. Quantitative analyses have been made using SPSS ordination statistical packages. Thus, the response rate per information has been calculated using the following formula:

$$F = 100 \times \frac{S}{N}$$ (a) Kouyaté (2005),

Where S is the number of persons which have given a response related to given information and N, the total number of persons interviewed.

To correlate informants responses related to tamarind-mounds association with field observations, an inventory has been made in the species' major habitats (gallery forests savannah woodlands and farmlands). 130 trees have been surveyed per habitat type meaning a total of 390. Data related to presence/absence of termite mound or ant hill under each recorded tamarind tree have been collected.

Results and discussion

Tamarind utilization

All of the informants know and usually use different part of tamarind. The local names of the tree are: Bôbosséi or Bôsséi in Dendi, Djêtami in Fulfuldé, Bu pug bu in Gourmantché and Tsamia in Haussa. Tamarind played an important role in local communities' livelihoods as showed by its many uses (table 1). Domains of it use cover traditherapy, nutrition, occultism and pastoralism. About 75% of the recorded uses are shared by the surveyed ethnical groups. Most commonly the fruit (pulp) is used to make beverages, to treat malaria, as laxative and purgative and seemed to be the only one part sold. The bark is most frequently use as a medicine in hardly curable wounds treatment while the leaves are used to make porridge and as antibiotic. The wood is used to make agricultural tools. Some of the uses as far as that of the wood for cultural flagellation and in young cows weaning are restricted to Fulani's ethnical groups.

The recorded uses of tamarind overlap with results obtained later (Arbonnier, 2002; El-Siddig et al., 2006). In spite of those uses, the species is still underexploited. Many studies have documented the nutritive potential of tamarind. Tamarind seeds are a cheap source of proteins that could be used to alleviate protein malnutrition in children. Industrially, the seeds are established to have the potential to substitute 30 % of cereals in livestock rations and leaves are used in pharmacology (Nordeide et al., 1996; Kawasaki et al., 1999). Tamarind seeds have been proven to be 2 and 15 time rich in protein than maize and cassava, two common crops in tamarind occurrence zones (Kilungu, 2005). Tamarind fruit pulps are also good source of proteins, lipids and carbohydrate (Jama et al., 2007). In Karimama district where children are facing severe malnutrition (LARES, 2001) a better valorisation of tamarind products could help to overcome the issue. Tamarind is also a tree with significant potential to international trade, and so could be used to increase revenues at both household and national scale in developing countries. In 1995 for instance, the exportation price of tamarind from Indonesia has reached 0.6 US$, above 360 CFA. Tamarind trees will begin bearing by the fourth years if they have been vegetatively propagated and have a pod yield of 40 kg/tree (El-Siddig et al., 2006). Basing estimates on 90 trees per hectare, 3.6 tons of tamarind fresh fruit could be then harvested from a one hectare parcel for a total income of 1.296 million CFA. This is at least 6 times better than what can be earned nowadays from a one hectare parcel of cotton, the most important marketed crop in sub-Saharan countries. These performances will more than double when the plantation will reached ten years old (El-Siddig et al., 2006). The above analyses provide strong evidence of the potential of tamarind as a key species in poverty alleviation and less developed state's economy empowerment. Nonetheless, more information on the species' contribution to households' incomes and local economies are needed.

Perception of diversity traits and threats

According to all of the respondents, there are no particular tree-to-tree traits used to classify tamarind individuals. However, a high diversity in seeds colour, size and shape and the cracked aspect of tamarind trunk in open ecosystems in contrast with that of gallery forests have been mentioned.

Gourmantché informants (16.7% of respondents) have also indicated a slight difference between gallery forest trees' pulp taste (less sour) and that of savannah woodlands and farmlands (sour). Tamarind mature individuals were feared and sacred in all of the surveyed ethnical groups and sometime chosen as privileged places for occult ceremonies. This long ago has protected the species from systematic logging when farmers cleaned lands for agricultural purposes. Unfortunately, nowadays, Karimama district's inhabitants are facing a chronic lack of cultivable lands. Thus, tamarind individuals are not anymore systematically spared.

Table 1. Local knowledge on tamarind utilization

Organs	Uses	Preparation	Related percentage of respondent (%)
Fresh leaves	Mumps treatments	Pound, mix with water and apply on jowls	100
	Antibiotic in circumcision or current wounds' treatments	Boil to 100°c and clean wounds with the obtained solution	100
	Accouchement facilitation in caprine and ovine	Triturate in water, filter and administrate the filtrate orally	22
	Overhead fodder for caprine and ovine		100
	Used instead of the fermented solution for local porridge brewing	Triturate in water, filter, boil and mix with fermented millet or sorghum substrata	100
Fresh bark	Purgative, stomach-ache treatments	Soak in fresh water for 24 hours and drink	100
	Against witchcraft	Boil in mixture with *Balanites aegyptiaca* leaves and drink	9
Dry barks	Hardly curable wounds' treatments	Pound and apply on wounds surfaces	100
	Making a body metal proof		100
Fresh fruits (pulp)	Malaria treatments, laxative, purgative	Soaked in fresh water	100
	Local porridge preparation	Mix with soft hot millet or sorghum fermented substrata	100
Wood	Calf weaning	Hang a catapult-shaped soft wood to the muzzle	17
	Yoke, shaft and nave fabrication for cow team		100
	Toothbrush		100
	Fulani's cultural feast of flagellation		100

Among anthropogenic activities and practices, mature trees mutilating for the species' diverse uses, seedling removing and, fire and knocking down when cleaning lands are the principal threats to the species. This has contributed to an extreme scarcity of the species regeneration. The negative impact of mutilations and agricultural practices on tree species long term survival has been proven (Omeja et al., 2005). Such a tree may need more interests on its ecology, diversity and domestication for its conservation and enhanced utilization.

Local perception on tamarind-social insects association

It has generally been observed under tamarind trees shadow a termite mound or ant hill alive, abandoned or being rebuilt. Above 85% of the recorded trees in farmland and savannah woodlands were found with termite mound (of which 70% with living mounds and 15% with abandoned one). In gallery forests in contrast only 24% of the recorded trees were found with social insects buildings (of which 20% living and 4% abandoned). Those observations suggest that the presence of social insect building under tamarind is more frequent in open ecosystems. According to 98.8% of the informants the building of mounds or hills generally start when the tamarind tree reaches the adult stage. This

means the presence of the tree is anterior to that of mounds. In all surveyed ethnical group it is believed that the association of tamarind and social insects has to do with a mystical relation of supernatural spirits living in both. However about 15 % of respondents (aged persons) have also attributed the phenomenon to an affinity of those social insects to tamarind trees due to the particular humidity under the tree's crown year-round. In addition, field observations have revealed that both termites and ants feed on tamarind fruits and barks. This proves a trophic relation between tamarind and termites and ants.

Tamarind-social insect association is not yet scientifically well elucidated. Some authors have reported the species to grow near ant-hills or termite mounds in Africa, due to its preference for well aerated soils (Dalziel, 1937; Eggeling & Dale, 1951; Irvine, 1961; Allen & Allen, 1981). It has been also suggested that its association with ant-hills and termitaria may be due to a preference for slight lime content in the soil (Jansen, 1981). However, up to date, these hypotheses have never been tested through a scientific research. Our results did not support them and clearly showed that the presence of tamarind trees is anterior to that of mounds. The importance of thermoregulation systems in social insects has been discussed in several studies (Starks et al.,2004; Korb & Linsenmair, 1999; 2000; Banschbach et al.,1997). It has been reported that the fungus-cultivating Macrotermitinea have elaborated thermoregulation mechanism within the nests to yield a constant nest temperature of 30°C and humidity near saturation year-round (Wood & Thomas, 1989). Further research on the auto-ecology and feeding preferences of termites or ants currently found under of tamarind trees and other trees species' shade in general could help to elucidate the phenomenon.

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ESTIMATING LOCAL VALUES OF VEGETABLE NON-TIMBER FOREST PRODUCTS TO PENDJARI BIOSPHERE RESERVE DWELLERS IN BENIN

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Abstract

This paper uses an indices method based on respondents' ranking of species to quantify use-values of Non-Timber Forest Products and the socio-economic factors that influence these values for people living around the Pendjari Biosphere Reserve in Benin. We identified 76 species with high value to people. The three most valued plant families were Bombacaceae, Mimosaceae and Sapotaceae. Species values were influenced by the nature of the species, the gender and the socio-cultural group affiliation of respondents. This variation in values was driven by the transmission of ethnobotanical knowledge within communities. The study also illustrates that women had a preference for NTFP species with high commercial and nutritional values while men preferred plants that provide construction material and medicine. Moreover, the group that hunted historically valued NTFPs more than any other group.

Introduction

Forests constitute a reservoir of biodiversity and play a fundamental role in the life of numerous households in Africa (Gopalakrishnan et al., 2005). Among the products and services provided by forests, Non Timber Forest Products (NTFPs) have huge importance. NTFPs include exudates (gums, resins and latex), canes, fruits, flowers, seeds, seed derivatives, entire plants, leaves, root or stem bark, fungi, meat and by-products from game animals, animals for the pet trade, micro-organisms, and insects (Tewari, 2000). NTFPs are also used as food and medicine and are often the only means for forest dwellers to enter the cash economy (Clark & Sunderland, 2004).

Non Timber Forest Products are considered to be of little importance, a status reflected in their designation as 'minor' forest products (Arnold & Ruiz Perez, 2001). In this fact, conservation issue was taken account timber and considered as a biological and ethno-botanical issue. Many efforts undertaken to conserve forests, based on a strictly natural science orientation and command-and-control approaches, have failed in several parts of the world (Gopalakrishnan et al., 2005). Among the many reasons for such failures in developing countries the most important is the disregard for the needs and aspirations of adjoining communities who have been utilizing forest resources for centuries (Gemedo-Dalle et al.,2005). In fact, conservation and sustainable resource use will not be successful without the full participation of indigenous peoples and the application of their ethnobotanical and ecological knowledge (Gemedo-Dalle et al.,2005). Therefore, great hopes have been placed on the potential for diverse NTFPs to support rural livelihoods in a way that makes development and conservation compatible (Arnold & Ruiz Perez, 2001).

Although many studies have assessed human–plant interactions (Shanley & Rosa, 2004; Case et al., 2005; Lozada, 2006; Müller-Schwarze, 2006) we have limited understanding of the values of plants to rural people in Africa and the factors that influence the extent to which they depend on forests.

The limited number of ethnobotanical studies in Benin has focused on a list of local plant names and uses (Adjanohoun et al.,1994; Hermans et al.,2004). We have limited knowledge of the potential of NTFPs for rural livelihoods. Sustainable forestry embraces the ecological, economic and social viability of timber and NTFPs (Kvist et al.,1995). Some of these aspects are comparatively well

understood and provide a factual basis for analysis, whereas other aspects, especially the socio-economics of NTFPs, remain contentious and difficult to quantify.

The aim of this paper was to take the first step in this direction and permit better understanding of the use-values of plants for people living around the Pendjari Biosphere Reserve (PBR) and the socio-economic and contextual factors that may influence these values. It also analyzes their association with different socio-cultural groups. The interest in knowing these values is two-fold. It will allow us to move beyond the listing of local plant names and uses to explain the attributes of plants which make them useful to people. In terms of the sustainable management of PBR, the results will permit a better integration of the needs of local people into conservation strategies.

Study area

Pendjari Biosphere Reserve is located in the north west of the Republic of Benin (10°30' to 11°30 N; 0°50' to 2°00' E) (Fig. 1). With the exception of the Atakora chain (400–513 m above sea level) in the South of the reserve, the region mostly lies between 150–200 m above sea level (Delvingt et al.,1989). The climate is Sudanian with a seven-month dry period. The mean annual rainfall is 1,000 mm. The peak of the rainfall occurs between late May and early October. The mean annual temperature is 27 °C (CENAGREF, 2005).

The vegetation is composed mostly of open shrub and tree savannahs and in some places dry or gallery forests (IUCN, 2002; Adomou, 2005). Around the periphery of the reserve the landscape is dominated by fields and fallows.

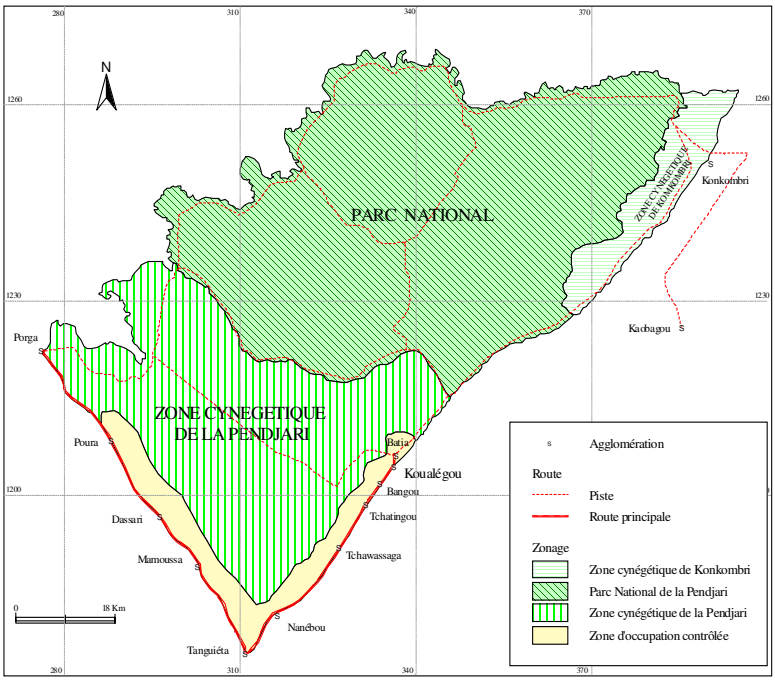

Figure 1. Map of Pendjari Biosphere Reserve

The population in the study area is estimated at 30,000 inhabitants and is composed of three main socio-cultural groups: Berba, Gourmantchés and Wama. They are spread across 20 villages (CENAGREF, 2005). The most important activity is subsistence agriculture. Cultivated crops include cotton, yams, maize, sorghum, cowpea, groundnuts and rice (CENAGREF, 2005). The savannah in the buffer zone is also used for cattle grazing and intensive collection of firewood (Sinsin et al., 2000; Lamarque, 2004).

The people surrounding the PBR still retain much of their traditional lifestyle and have extensive knowledge of the wildlife resources of the area (IUCN, 2002). They harvest useful species for their

nourishment, primary healthcare and to complement agricultural incomes. There are five main weekly markets where local people exchange their products. The most important of these market places is Tanguiéta market where collectors periodically come to exchange their products.

PBR was declared a Game Reserve in 1954, was upgraded to a National Park in 1961 and to a Biosphere Reserve in 1986 (IUCN, 2002). The current management regime attempts to give local populations more control over the management of the peripheral areas. As a biosphere reserve, it is split into three areas and human activity is banned in the core zone and the buffer zone. In these two areas, hunting, timber logging or conversion of protected lands for agriculture is not allowed. However, peripheral communities are allowed to gather forest products such as NTFPs in the buffer zone (CENAGREF, 2005).

Methods

Data collection

At the beginning of data collection (February 2006), we created focus groups in all local communities during which we invited participants to list all vegetable species used as NTFPs. Participants listed the name of all the useful plants they knew and all the uses of each plant on their list. This permitted us to identify six broad categories of uses (food, medicine, construction, ceremony, firewood and other uses).

Data collection was carried out using a quantitative and qualitative ethnographic method as described by Lawrence et al. (2005). The research sample was constituted using available demographic data (CENAGREF, 2005). In total, we worked with 185 respondents (105 men and 80 women). Each socio-cultural group was represented in proportional to their occurrence in the overall PBR population: 80 people were asked to participate as unpaid volunteers from the Berba group, 51 from the Gourmanché, 49 from the Wama and 5 from minority cultural groups (Peulh, Bariba, Dendi). Respondents' ages ranged from 16 to 90 years. We chose these as the cut-off ages because in the study area, at the age of 16, people have good knowledge about vegetable use. At the age of 90 years, people are no longer active in NTFP exploitation but their owner status of land from which species are harvested means that they have an interest in knowing the value of NTFPs.

Data were collected during six months (April, July, December 2006 and January, May, September 2007). We chose this frequency of data collection in order to reduce the contextual impact on value attributed to species through linkage to recent events or availability of NTFPs during specific periods, which could influence the value attributed by respondents.

For data collection, we asked respondents to list and rank by importance, the 10 most important species that s/he had harvested from the PBR over the last 5 years. For each species listed, respondents gave information on the uses that made that species important to him. We limited the harvest period to 5 years based on the recall ability of respondents. Species names followed the Benin Analytic Flora (Akoègninou et al., 2006).

Data analysis

As most statistical analysis relies on scores, the ranking done by respondents was first converted into a score. As each respondent rank at most 10 species, we attributed the score of 10 to the first species cited by a respondent; the second species received a score of 9, etc. If instead of 10 species, a respondent listed 5, the species that were not mentioned scored zero.

Data analysis involved two steps. Firstly, data were analyzed using a Linear Mixed Model (LMM). In this analysis model, we used the score as the dependent variable, respondents' gender, species cited, respondents' socio-cultural groups and the interaction between them (species*gender, species*socio-cultural groups) as (fixed) independent variables, and respondent as a random variable (using the procedure described by Verbeke and Molenberghs, 1998). The choice of LMM for data analysis was justified by the non-orthogonal aspect of the data. The significance of the fixed effects as predictors of score was assessed by Wald statistics.

Secondly, where LMM results revealed a significant effect of an independent variable on the value accorded to a species, we computed the values of species as described by respondents under this variable. The average value of each species was calculated as described by Lawrence et al. (2005).

For example, for a species (S), we defined its value attributed by men (m), women (w) and by men and women combined in a given socio-cultural group (g) and in PBR (r) as as:

(1) $V_{Smg} = \sum \frac{S_m}{n_m}$ (2) $V_{Swg} = \sum \frac{S_w}{n_w}$

(3) $V_{Sg} = \frac{1}{2}\left(\sum \frac{S_m}{n_m} + \sum \frac{S_w}{n_w}\right)$ (4) $V_{Sr} = \sum_{g=1}^{g=4} \frac{V_{Sg}}{s}$

Results

Effect of different uses on species values

The 97 plant species cited during free listing were followed by a total of 201 different uses while the 76 species listed in individual questionnaires had a total of 171 uses. For most categories, the number of species cited during free listing was higher than the number of species listed individually by respondents, except for species used for construction. The presence of participants who were most interested in showing the most relevant species used for house construction during free listing may explain this difference.

These results also show the multipurpose aspects of species used by inhabitants around the reserve. They also place high value on species used for medicine and diet (Table 1).

Effect of type of species, gender and socio-cultural group on importance accorded to NTFPs by local inhabitants

As presented in Table 2, the importance accorded to species used as NTFPs was significantly affected by a range of factors such as type of species, gender and the socio-cultural group of the respondent (Linear Mixed Model, Z=23.066; P<0.0001).

Table 1. Value of species used per category of use

Category of uses	***Total value of all species***	***Number of species used***
Food	43.66	48
Medicine	44.07	60
Construction	29.44	21
Ceremony	28.17	8
Firewood	37.41	30
Other uses	24.68	4

Species most valued by PBR people

The values (V*sr*) of the 76 species nominated by respondents in their top 10 ranged from 5.10^{-3} to 7.54. Figure 2 presents the distribution of species per degree of importance, divided into four classes using the Ward method with log(score) as the dependent variable. Figure 3 shows species grouped into class 1 (the most important class based on scores attributed by respondents). The three most important species used by inhabitants in the study area were *Parkia biglobosa* followed by *Adansonia digitata* and *Vittelaria paradoxa*.

The result revealed that the PBR people value trees more than herbaceous species (Student t test, d.f. = 67, *P=0.001*). In fact, the most valued herbaceous species was *Hibiscus asper* (Vsr=2.23), which was ranked seventh.

Table 2. Linear mixed model analysis of variance summary for log-transformed score.

Source	***df_N***	***df_D***	***F***
Species	75	1026.22	5.01 ****
Gender	2	1019.69	0.047^{NS}
Group	3	1127.82	26.58****
Species * Gender	34	1100.93	1.95***
Species * Group	58	1124.68	4.33****
Parameter	**Estimate**	**WaldZ**	**Sig**
Residual	0.27266	23.066	****
Respondent variance	0.00230	0.720	NS

Notes: F-tests for fixed effects constructed by SPSS MIXED procedure, with numerator denominator degrees of freedom (df_N and df_D). Significance of random effects (indicated by [Z]) determined by Restricted Maximum Likelihood ratio tests.
*NS; P > 0.05, ***P<0.001, ****P<0.0001*
Dependent Variable: log(*Score*)

The values attributed to species were related to their botanic family. Thirty-six families were represented, the most valued plant family in terms of species scores being Bombacaceae, followed by Mimosaceae and Sapotaceae. The values of these families were increased by the fact that they contained the most valued species: *A. digitata*, *P. biglobosa* and *V. paradoxa* respectively. The most important family in terms of number of species named was Caesalpiniaceae, with seven species cited.

Gender effect on species values

Men and women valued useful species differently (Linear Mixed Model, F=1.95; P<0.001). Species such as *Diospyros mespiliformis*, *Khaya senegalensis* and *Lannea microcarpa* are used preferentially as construction material and medicine and had significantly higher values for men, while species mainly used in the diet and cooking had significantly higher values for women (*Bombax costatum*, *Hibiscus asper*, *Melochia corchorifolia* and *Sesamum indicum*). *B. costatum* flowers, *H. asper*, *M. corchorifolia* and *S. indicum* leaves are used by women to make sauces. They also trade these species in markets when available. This explains why women mentioned more highly commercialised species in their top 10 than men (T=3.3575; P=0.0046).

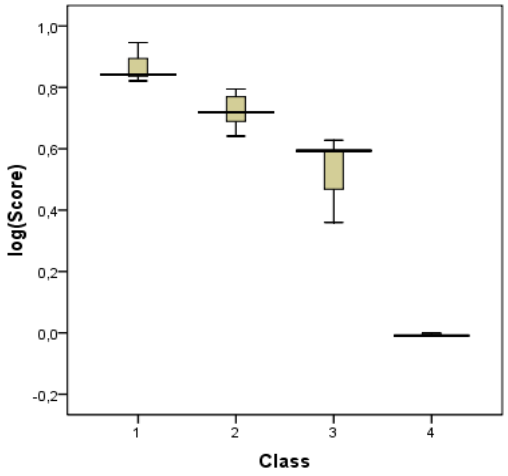

Figure 2. Division of species in classes using Ward method.

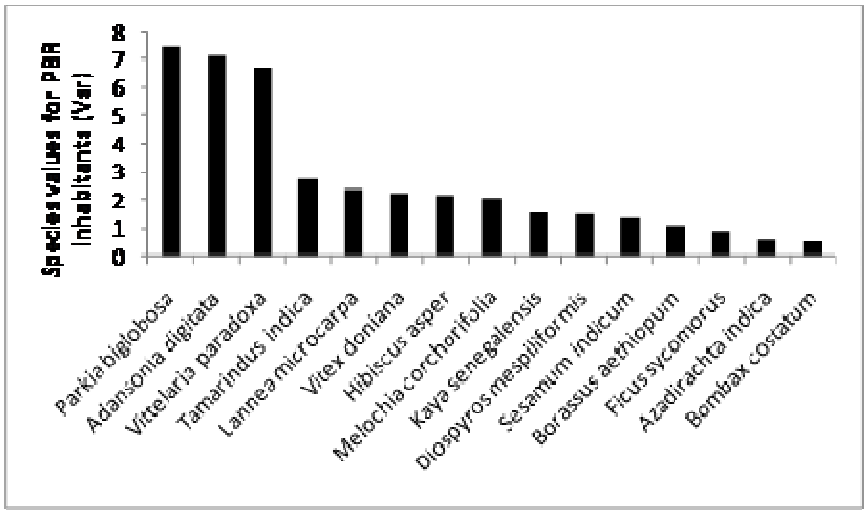

Figure 3. Relative values of most important species to inhabitants surrounding the PBR

Socio-cultural groups and species values

The value accorded to different species varied according to socio-cultural group affiliation (Linear Mixed Model, F=4.33; P<0.001). *A. digitata, Ficus sycomorus* and *H. asper* had significantly higher values for Berba while *B. costatum, K. senegalensis, P. biglobosa, Tamarindus indica* and *V. paradoxa* were more important for Gourmanché. People in the Wama socio-cultural group accorded more importance to *D. mespiliformis*. In general, there was a tendency for Gourmanché people to value NTFP species more than other socio-cultural groups. This is reinforced by the frequency with which they cited "marketing" of species' products as a reason for the importance accorded to them.

Effect of markets on species values

To assess the effect of markets on values attributed to species by respondents, we compared the average value to species marketability. The latter was measured by the frequency with which respondents mentioned "sale" as the reason that motivated them to assign the level of importance accorded to the species. As presented in Figure 4, there was strong relation between values attributed to species and the frequency with which respondents mentioned marketability as a reason for their ranking. This relation is also perceptible in Figure 5, in which *P. biglobosa* is the most important species in PBR and also the most marketed species.

To test the possibility that species values are more strongly determined by commercialization when the respondents' village is closer to the markets, we compared species values in two villages – one with relatively easy access to markets (Tanongou) and one further away (Batia). We found no difference in values accorded to species by respondents from these two villages.

Discussion

Relationships between Pendjari *Biosphere Reserve dwellers and NTFP use*

The inventories of existing NTFP resources and their present use reported in this paper give a broad view of NTFPs used by PBR dwellers. In total we found that people living around the PBR use 97 different plant species, of which 76 were identified as very important.

The most evident reasons for the local communities' relationships with NTFPs are the high degree of poverty in the area and their proximity to the reserve. The Atakora province where we carried out the study is one of the most disadvantaged areas in Benin. The western part of the province houses the largest number of poor people or people vulnerable to poverty in Benin, and furthermore the poor people in this region are still very poor (Adégbidi et al., 1999; Martin, 2000; FIDA, 2006). They have difficulties finding funds for treatment in the modern health center and they also have difficulties stocking up with foodstuffs to bridge the gap during the dry season, so these people rely on NTFPs.

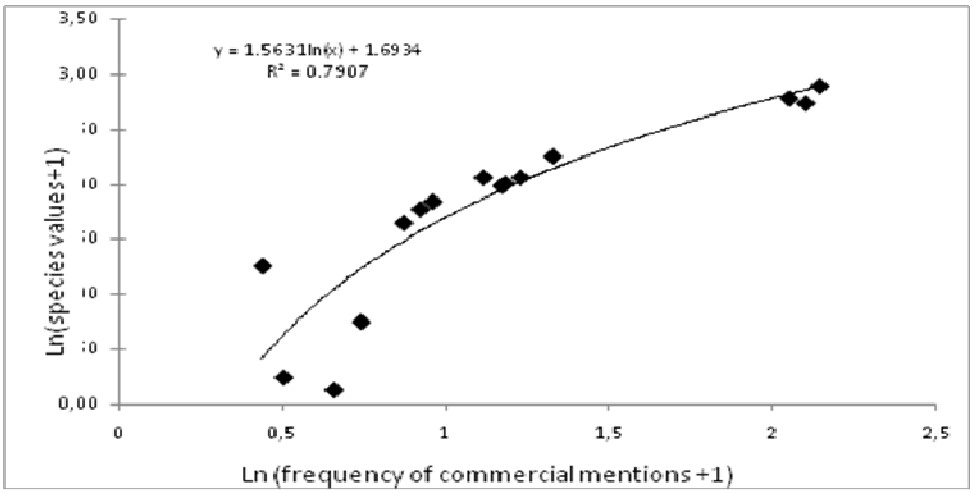

Figure 4. Relation between species values and frequency with which respondents cited marketability for species as the reason for the importance accorded to them

Based on the list of species used, people accord more value to wood than herbs. This difference can be partly explained by the seasonality observed in herb species use. Herb species used by respondents grow during the rainy season (June–October) and the population has the opportunity to use them during this period. In contrast, timber species are often multi use species and their products are available all year round. Thus, for PBR dwellers, the more they can exploit products from a species the more important this species is for them. This result is consistent with those obtained by Gemedo-Dalle et al. (2005) who found that half the species used by the Borana pastoralists have multiple purposes.

Factors affecting values attributed to useful species by Pendjari *Biosphere Reserve dwellers*

The results showed the relationship between gender, socio-cultural group of respondents and values accorded to NTFPs. In this study, we consider gender at the level of relation between men and women because it'sthe more striking gender aspect in the study area. The differences between values assigned to useful species by men and women are driven by reasons such as the type of products obtained from a species and the saleable potential of species products. In general, women valued species used for food more than men whose interest relates to species used as construction material and medicine. The most likely reason for this may be found in the social sharing of household spending. Women are in charge of household nutrition while men are responsible for household building. Thus women have the responsibility for finding seasonings for cooking food. As stated by women in our research sample, with the poverty situation of people in the study area, the part of income given by men for food is rarely sufficient. They therefore have difficulty buying all seasonings at the market. NTFPs play an important role in helping them to solve these food issues. Women also consistently ranked species that they can sell at markets. Indeed, as shown in many previous studies, women are the main actors in the harvest and sale on NTFPs (Lawrence et al.,2005; Belcher & Schreckenberg, 2007).

Concerning the impact of socio-cultural groups on NTFP values, all groups in the PBR are equally concerned with the number of useful species listed but there are patterns of difference in species prioritized by the different groups. The Gourmanché valued NTFPs more highly than any other group. This tendency can be partly explained by the geographical situation of the Gourmanché's villages, between the protected area of the National Park of Pendjari and the Atakora chain. Conversion of land in the protected area for agriculture is not allowed, while land in the Atakora chain is stony and unfit for agriculture. In this situation, the Gourmanché farmers do not have enough land to extend their fields. Thus, they harvest NTFPs to secure their well-being (CENAGREF, 2005). This may also explain the fact that the Gourmanché cited higher marketability of species as the principal reason

motivating them to value a species. NTFP harvest is the principal activity that permits them to increase their income. Also historically, the Gourmanché were hunters so their prolonged contact with vegetation has permitted to them to know more about plants and therefore use them more than other socio-cultural groups. This is consistent with reports from Adhikari et al. (2004) who found that land unavailability, livestock holdings, caste, education of family members and household economic status are factors that determine the degree of dependence on forest resources.

The results also show that markets affect the value accorded to species by respondents and species that are more commercialized are also the most valued species (*P. biglobosa*). This finding explains the strong relation between frequency of marketability and species values. It reinforces those of Mahapatra and Mitchell (1997) and Godoy et al. (2002) who found that markets have a positive effect on values accorded to species by people. Around the PBR, people rely on NTFPs, which they trade in return for money. However, NTFP commercialization is not very important in markets in the study area. It is a secondary activity for women who sell these products to supplement their household budget. This may explain in part the lack of significant difference between villages close to markets and those far from markets in terms of values accorded to species.

Determination of values assigned to species by people surrounding the Biosphere Reserve

The values assigned to NTFPs by people in the Pendjari Biosphere Reserve are influenced by the type of species, the gender and the socio-cultural group of the respondents. Previous studies have reported that ethnobotanical knowledge is influenced by important differences across sectors such as gender, age, subclass and habitation locality (Case et al., 2005; Gemedo-Dalle et al., 2005). Other authors (Berkes & Folke, 2002; Müller-Schwarze, 2006; Lozada et al.,2006) have argued that the differences may be explained by the ethnobotanical knowledge acquisition process. Local ecological knowledge is acquired from long-term observations of ecological processes and variation in knowledge within and among user groups can be a result of variation in the exposure of each user group to the knowledge. Shepard (2002) and Dafni and Lev (2002) explain the choice of useful species, mainly medicinal plants, by the Doctrine Of Signature. They suggest that the physical characteristics of species should explain the value attributed to them.

In this study, variation in values attributed to species could be explained by the transmission of ethnobotanical knowledge in the Pendjari Biosphere Reserve communities. Almost all respondents in the study area are illiterate. They acquired, learned and taught species use by doing. Knowledge is acquired by means of imitation and advice while collecting and using species. As revealed by Lozada et al. (2006), in the PBR area this knowledge is also transmitted vertically through family dissemination. This may explain why the Gourmanché, who are historically hunters, rely more on natural resources such as NTFPs for their livelihoods.

Conclusion

This study used quantitative and qualitative methods to obtain a better understanding of NTFP use-values to people living in a remote rural area around a protected area. It gives information on values given to harvested plant species by different socio-cultural groups living around the PBR. Although these people have access to a wide range of species, we found that only a few species are highly valued. NTFPs are used in a wide range of categories, which indicates the close links between livelihoods and natural resources in the area. Women have at least as much diversity of knowledge as men and show that they are also important stakeholders and merit consideration in reserve biodiversity conservation.

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ARBRES ET LIANES SPONTANÉES ALIMENTAIRES DE LA ZONE DE FORÊT SEMI-DÉCIDUE (CENTRE-OUEST DE LA CÔTE D'IVOIRE) : FLORE DES ESPÈCES RENCONTRÉES, ORGANES CONSOMMÉS, VALEURS ALIMENTAIRES

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FOOD TREES AND SPONTANEOUS LIANAS OF THE ZONE OF SEMI DECIDIUS FOREST (CENTER-WEST OF CÔTE D'IVOIRE): FLORE OF THE SPECIES MET, CONSUMED ORGANS AND FOOD VALUES.

Summary

An ethnobotanic survey was carried out beside the rural populations to count the food trees and lianas spontaneous still present in the Western Center of the Côte d'Ivoire in zone of semi decidius forest. Before the actuel ethnobotanic investigations, prospections were carried out in the plantations and the residual vegetation. The investigations were carried out with the small fermers of 9 villages retained according to the distance separating them: 10 to 30 kilometers. Peoples were randomly selected without taking account of the sex and the age to be interviewed. Samples of consumed organs and organs for identification were collected. Fifty (50) species were listed, shared in forty three (43) genus and thirty two (32) families. The trees represent 60%, the lianas 34% and the palm trees 6%. Sterculiaceae, Arecaceae and Solanaceae are the families best represented. In forest, 32 species were listed, that make 64% of the taxons. The species ubiquists represent 21,9% and the species of fallow 12,5%. The most known species formed by *Irvingia robur, Beilschmiedia mannii, Ricinodendron heudelotii* and *Myrianthus arboreus* are maintained by the smalls farmers in the plantations cocoa-trees and coffee-trees, like in the fallow. Generally, fruits are the most consumed organs. They represent 34 species (seeds, cotyledons and almonds), that make 68% of the listed plants. The leave represent 38%. As for the other organs (barks, stalks, tubers stems etc), they relate to 16% of the listed species. The leave are organs present on the plants almost throughout the year, which makes them available to any period in the making of the family meals. The importance of the trees and spontaneous lianas in the food of the population deserves that one is interested in the possible nutritive contributions of these species. The biochemical analysis of the organs of six (6) consumed species highlighted significant food values of these plants until now neglected. The knowledge of the nutritional values of these products will contribute, certainly, with a larger awakening to lead to their safeguarding. These investigations showed that the prospected area still abounds a high number of trees and food spontaneous lianas in spite of erosion of the biodiversity which affects the whole forest of the country.

Résumé

Une enquête ethnobotanique a été menée auprès des populations rurales pour recenser les arbres et lianes alimentaires spontanés encore présents dans le Centre Ouest de la Côte d'Ivoire en zone de forêt semi décidue. Avant les enquêtes ethnobotaniques proprement dites, des prospections ont été réalisées dans les plantations et la végétation résiduelle. Les enquêtes ont été effectuées avec les paysans de 9 villages retenus en fonction de la distance les séparant : entre 10 à 30 kilomètres. Des personnes ont été choisies au hasard sans tenir compte du sexe et de l'âge pour être interviewées.

Des échantillons d'organes consommés et de parties aériennes ont été collectés pour identification. Cinquante (50) espèces ont été recensées, soit quarante trois (43) genres et trente deux (32) familles. Les arbres représentent 60%, les lianes 34% et les palmiers 6%. Les Sterculiaceae, les Arecaceae et les Solanaceae sont les familles les mieux représentées. En forêt, 32 espèces ont été recensées, soit 64% des taxons. Les espèces ubiquistes représentent 21,9% et les espèces de jachère 12,5%. Les espèces les plus connues *Irvingia robur, Beilschmiedia mannii, Ricinodendron heudelotii* et *Myrianthus arboreus* sont entretenues par les paysans dans les plantations de cacaoyers et de caféiers, ainsi que dans les jachères. D'une manière générale, les fruits sont les organes les plus consommés. Ils représentent 34 espèces (graines, cotylédons et amandes), soit 68% des plantes recensées. Les feuilles représentent 38%. Quant aux autres organes (écorces, pédoncules, tubercules tiges etc.), ils concernent 16% des espèces recensées. Les feuilles sont des organes présents sur les plantes presque tout au long de l'année, ce qui les rend disponible à toute période dans la confection des repas familiaux. L'importance des arbres et lianes spontanées dans l'alimentation de la population mérite que l'on s'intéresse aux éventuels apports nutritifs de ces espèces. L'analyse biochimique des organes de six (6) espèces consommées a mis en relief d'importantes valeurs nutritives de ces plantes jusque là négligées. La connaissance des valeurs nutritionnelles de ces produits contribuera, certainement, à une prise de conscience plus grande pour aboutir à leur préservation. Ces enquêtes ont montré que la Région prospectée regorge encore un nombre élevé d'arbres et de lianes spontanées alimentaires malgré l'érosion de la biodiversité qui affecte l'ensemble de la zone forestière du pays

Introduction

La dégradation de la forêt ivoirienne, qui serait passée de seize millions d'hectares à moins de deux millions en une cinquantaine d'années, pose divers problèmes écologiques auxquels s'ajoute la raréfaction des plantes spontanées utilisées pour l'alimentation humaine. Ces espèces, autrefois abondantes dans les forêts et les jachères, produisent des fruits, des feuilles et des graines, véritables sources de compléments nutritionnels et de ressources financières en milieu rural. Elles ont joué par le passé un rôle important dans la survie des populations, surtout en période de guerre, de sécheresse et d'invasion des cultures par les criquets (Gautier-Béguin, 1992).

Les plantes alimentaires autochtones faisant l'objet de cueillette ont été bien étudiées en Afrique (Burkill, 1985; Falconer, 1990; Malaisse, 1997). En Côte d'Ivoire, les recherches ont été faites, entre autres, par N'Dri (1986), Gautier-Béguin (1992), N'Guessan (1995), Ambé (2001) et Kouamé (2000). Pour freiner le phénomène de la déforestation ou pour restaurer les milieux trop dégradés, des reboisements ont été réalisés aussi bien avec espèces locales qu'exotiques. Jusqu'à récemment, les espèces exotiques étaient privilégiées dans les reboisements villageois car leur sylviculture est simple et bien maîtrisée. Mais depuis une dizaine d'années, l'intégration d'arbres indigènes est de plus en plus préconisée dans les systèmes agrosylvicoles locaux, notamment pour éviter la disparition de ces espèces locales. Pour mener à bien ce changement d'habitudes, le choix des essences à préserver et à valoriser doit être soumis aux préférences des populations locales.

Dans le centre-ouest de la Côte d'Ivoire, où l'occupation humaine est relativement dense, avec environ 79 habitants au km2, la forêt est depuis longtemps l'objet d'une importante dégradation (Guillaumet & Adjanohoun, 1971). Les défrichements aboutissent à un appauvrissement de la flore originelle et à une diminution de la fertilité des sols. Malgré cet appauvrissement, la cueillette des organes alimentaires arborés en milieu naturel est toujours pratiquée dans les villages et une partie des récoltes est commercialisée en ville. Une triple question peut se poser : quel est l'impact des modifications de milieu sur l'abondance de ces espèces ? Sont-elles menacées par une surexploitation ? Les revenus des cueilleurs sont-ils en baisse faute de plantes à récolter ?

Pour y répondre partiellement, une enquête ethnobotanique a été conduite dans la région dite du fromager, en vue d'identifier les essences qui devraient être privilégiées pour les petits reboisements ruraux ou les actions agrosylvicoles. Les espèces d'arbres et de lianes alimentaires spontanées, encore récoltées, ont ainsi été recensées en prenant soin d'identifier les organes consommés (feuilles ou bourgeons, fruits ou amandes, graines, écorces, pédoncules, tubercules, tiges, etc.) et les biotopes qui abritent ces plantes.

Materiels et Methodes

Site de l'étude: la Région du Fromager

La région du Fromager est au Centre-Ouest de la Côte d'Ivoire. Elle comprend deux départements : Gagnoa (chef lieu de Région) et d'Oumé. Le Département de Gagnoa est compris entre 5°40 et 6°10 de latitude Nord, et, entre 5°50 et 6°20 de longitude Ouest et couvre 2500 km². Il est inclus dans le bassin versant du fleuve Sassandra. Le Département de Gagnoa comprend cinq sous-préfectures : Gagnoa, Bayota, Ouragahio, Guibéroua et Gnagbodougnoa (Figure 1).

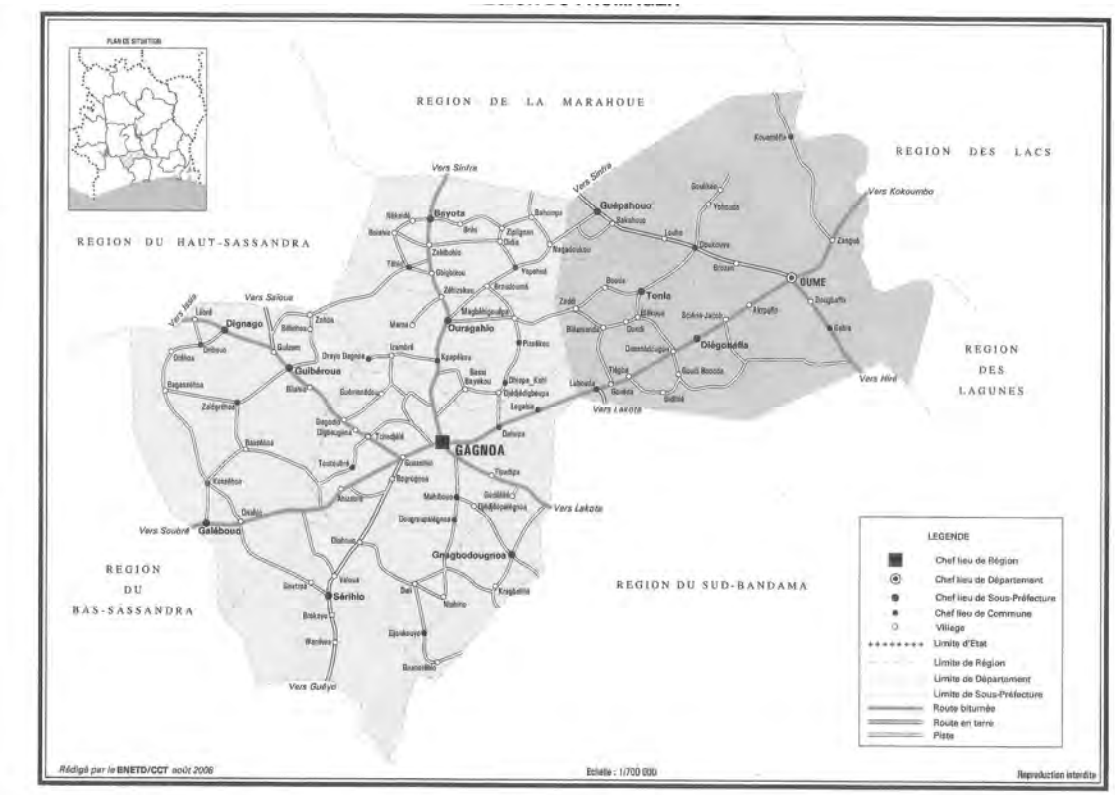

Figure 1. Carte de la situation géographique et administrative de la zone d'étude en Côte d'Ivoire

Les travaux se sont déroulés dans les Sous-préfecures de Ouragahio, Guibéroua et Gnagbodougnoa. Entre 1994 et 2004, la température moyenne annuelle y a été de 27°C et la pluviométrie moyenne annuelle de 1402 mm (Koné, 2004). Les formations pédologiques sont dominées par des sols ferrallitiques fortement désaturés (Monnier, 1983). La végétation originelle est la forêt dense humide semi-décidue (Guillaumet & Adjanohoun, 1971).

La région du Fromager, jadis forestière, a connu une déforestation brutale sous l'action conjuguée de l'agriculture et d'une très forte exploitation forestière. A la place de la végétation originelle, se dresse aujourd'hui une mosaïque de lambeaux forestiers, de vastes tapis de *Chromolaena odorata* (L.) R. M. King et H. Rob., des jachères et des plantations agricoles et forestières. La surexploitation des terres favorise l'installation de la principale espèce exotique envahissante *Chromolaena odorata* (L.) R. M. King et H. Rob. Par son effet inhibiteur du recru forestier, cette espèce empêche les jachères d'évoluer de la strate herbacée à la ligneuse (Gnahoua, 2004). La production de bois et la régénération spontanée des plantes alimentaires et médicinales sont fortement perturbées voire impossible dans ce type de jachères**.** Selon Gnahoua (2004) *Chromolaena odorata* est un obstacle à la dynamique naturelle et à la biodiversité de la jachère forestière d'autant plus que la plante fructifie dès la première année et atteint rapidement 4 m de hauteur (De Rouw, 1991).

Méthodologie des enquêtes ethnobotaniques

Avant les enquêtes ethnobotaniques proprement dites**,** des prospections ont été effectuées dans le Département pour une pré-enquête, afin de pouvoir élaborer des questionnaires soumis aux paysans et choisir les villages. Les enquêtes ont été effectuées dans trois sous-préfectures : Gnagbodougnoa (Sud-est), Ouragahio (Nord) et Guibéroua (Ouest). Dans chaque sous-préfecture, trois villages ont été retenus Le choix des villages s'est faite en fonction de leur position géographique par rapport à la Sous-Préfecture.

Douze personnes (autochtones Bété) par village choisies au hasard sans tenir compte du sexe et de l'âge ont été interviewées, soit un échantillon total de108 personnes. Nous avons soumis un questionnaire ouvert aux personnes interrogées. Les questions sont du genre « quelles sont les arbres et lianes que vous consommez et qui sont récoltées en brousse ? Quelles sont les parties consommées ? Où les trouvez-vous ? Comment les consommez-vous ? Vendez-vous votre récolte ? Trouvez-vous facilement ces plantes ou devez-vous aller de plus en plus loin en forêt ? » etc.…

Sur le terrain, il est courant qu'un même nom vernaculaire soit attribué à plusieurs espèces ou l'inverse. Ainsi, le recensement des plantes alimentaires spontanées à partir des noms locaux seulement comporte des risques d'erreurs. Ces risques ont été minimisés, par la récolte d'échantillons d'organes consommés et de parties aériennes pour la préparation d'un herbier. Des photographies ont été faites sur les sites de récolte ou sur les marchés locaux pour une meilleure identification des espèces.

Méthodologie des analyses chimiques

Parmi les espèces inventoriées, Six (6) d'entre elles vendues sur les marchés locaux des Sous-Préfectures du Département, ont fait l'objet d'une analyse physico-chimique de leurs organes. Ce sont : les graines de *Irvingia robur*, de *Ricinidendron heudelotii*, de *Beilschmiedia mannii*, de *Strombosia pustulata*, des syncarpes de *Treculia africana* et les feuilles de *Myrianthus arboreus*.

Les analyses biochimiques ont été effectuées par le Laboratoire de Chimie des Aliments et de la Nutrition de l'Université d'Abidjan. Les paramètres analysés sont : le taux d'humidité, les lipides, les protéines, les cendres et les sucres totaux. La matière sèche obtenue, après la détermination du taux d'humidité est transformée en poudre à l'aide d'un broyeur de marque Moulinex. La poudre obtenue est conservée dans des sachets en plastique dans un endroit sec. C'est cette poudre appelée échantillon qui est utilisée pour les différents dosages. Pour déterminer le taux d'humidité, on pèse une boite de Pétri vide (Cr) et on y introduit une quantité d'échantillon (fruits, graines, feuilles ou autres). L'opération est répétée trois fois. Les boîtes et leurs contenus (Cr + E) sont mis à l'étuve pendant 48 heures à 80°C. Ils sont pesés et après refroidissement au dessiccateur, sont repesés. L'opération est reprise plusieurs fois jusqu'à ce que le poids soit constant.

La détermination de la teneur en matières grasses de l'échantillon est faite selon la méthode de B.I.P.E.A. (1976). Elle consiste en une extraction de la matière grasse à l'aide d'un solvant organique. Dans le cadre de cette étude, c'est l'hexane qui est utilisé. Le dosage des protéines est fait par dosage de l'azote total par la méthode de Kjeldahl (BIPEA, 1976)**.** Cette méthode consiste à doser l'azote total contenu dans l'échantillon par une solution d'acide en présence d'indicateur de fin de réaction. Après la minéralisation, la distillation et la titration, le taux de protéines est déterminé grâce à un facteur de conversion (Glowa, 1974). Les cendres ont été déterminées selon la méthode AOAC (1975) qui consiste à incinérer l'échantillon à 550 °C. L'extraction des sucres solubles est faite selon la méthode de Dubois et al., (1956) et modifié par Agbo et al., (1986). Elle comprend une phase d'extraction proprement dite et une phase de défécation (purification en sucres). La quantité prélevée est fixée à l'alcool bouillant.

Méthode d'analyse de la flore

Afin de mieux présenter les résultats obtenus, nous avons combiné les critères de connaissance et de consommation effective selon Ambé (2001). Le niveau de connaissance et de consommation villageoise est estimé en pourcentage (Pr). Le pourcentage de chaque espèce a été calculé par le rapport du nombre de personnes reconnaissant l'espèce (n) au nombre total de personnes interrogées (N). Il est traduit par la formule : $Pr = (n / N) \times 100$.

Cette analyse permet de répartir les espèces en trois classes :

i. Les espèces les plus connues et les plus consommées. Leur niveau de connaissance et de consommation villageoise (Pr) est compris entre 50 et 100%.

ii. Les espèces moyennement connues et consommées (Pr = 25 à 50%).

iii. Les espèces peu connues et peu consommées (Pr = 0 à 25%).

À l'issue de l'enquête ethnobotanique, une liste des plantes alimentaires spontanées du département de Gagnoa a été dressée. Les espèces ont été identifiées avec l'aide du Professeur Aké Assi, en adoptant la nomenclature de Hutchinson & Dalziel (1954-1972) révisée par Keay et Hepper. Les noms des espèces ont été actualisés à l'aide des ouvrages de Lebrun et Stock (1991, 1992, 1995, 1997). Enfin, les espèces inventoriées ont été réparties en fonction de leur habitat (forêts, jachères, plantations).

Analyse des données des valeurs alimentaires

Les valeurs moyennes calculées des paramètres physico-chimiques ont été comparées entre les différentes espèces. Cette comparaison a nécessité l'utilisation de l'analyse de Variance (ANOVA) à l'aide du test de Newman Keuls au seuil de probabilité $\alpha \leq 0,05$. Pour ce test, nous avons émis deux hypothèses par rapport au seuil de probabilité. Si α calculé est inférieur à la valeur seuil (0,05), c'est que le résultat du test est significatif. Dans le cas où α calculé est supérieur au seuil, le test est non significatif.

Resultats

Arbres et lianes consommés

Au total, 50 espèces d'arbres et de lianes alimentaires spontanées ont été inventoriées. Elles se répartissent en 43 genres et 32 familles. Les arbres représentent 60%, les lianes 34% et les palmiers 6% (il s'agit de *Elaeis guineensis, Raphia hookeri* et *Calamus deërratus*). Les critères de connaissance et de consommation effective ont été combinés pour mieux illustrer les résultats obtenus.

Espèces les plus connues et consommées (Pr. = 50 à 100%)

Les espèces de cette catégorie, au nombre de huit, sont consignées dans le tableau I (probabilité de reconnaissance entre 50 et 100%).

Tableau I. Espèces les plus connues et consommées (Pr. = 50 à 100%) du Département de Gagnoa

N°	Espèces	Ourg.	Guib.	Gnag.	Département de Gagnoa	Organes consommés
1	*Elaeis guineensis* Jacq.	100	100	100	100	Fruits, Bourgeons, Sève
2	*Irvingia gabonensis* (Aubry-Lecomte) ex (O'Rorke) Baill.	100	100	100	100	Amandes
3	*Beilschmiedia mannii* Benth. & Hook. (Meissn)	100	89	58	82	Cotylédons
4	*Myrianthus arboreus* P. Beauv.	83	92	72	82	Jeunes feuilles, Fruits
5	*Myrianthus libericus* Rendle	83	92	72	82	Jeunes feuilles
6	*Myrianthus serratus* (Trécul) var. *serratus* Benth & Hook.	83	92	72	82	Jeunes feuilles
7	*Ricinodendron heudelotii* (Baill.) Pierre ex Pax	92	75	80	82	Graines
8	*Zanthoxylum gilletii* (De Willd.) Waterman	80	50	42	57	Jeunes feuilles

Oug. = Ouragahio ; Guib. = Guibéroua ; Gnag. = Gnagbodougnoa

Parmi ces espèces bien connues de la population, certaines ont été consommées au moins une fois par l'ensemble des personnes interrogées. Les caractéristiques communes à ces plantes semblent être le goût (généralement très apprécié) et leur disponibilité durant une grande partie de l'année. Les

trois espèces les plus importantes sont *Irvingia robur* Mildbr*, Beilschmiedia mannii* et *Ricinodendron heudelotii,* et en effet leurs fruits sont disponibles presque toute l'année sur les marchés locaux et nationaux. Ces espèces sont entretenues par les paysans au sein de leurs plantations de cacaoyers et de caféiers, ainsi que dans les jachères*. Myrianthus arboreus*, *M. libericus* et *M. serratus* sont des espèces également bien connues dont les feuilles sont consommées. Pour la plupart des espèces, les usages et les modes de consommation sont diversifiés: la pulpe des fruits de *Myrianthus arboreus* est, elle aussi, appréciée. Quant aux fruits secs, certains sont utilisés pour leurs amandes ou pour leurs graines destinées à la confection d'une sauce gluante et aromatique.

C'est le cas de *Beilschmiedia mannii* et d'*Irvingia robur*. *I. robur* est l'espèce la plus commune en Côte d'Ivoire. Elle se retrouve sur presque tous les grands, marchés. Les fruits, jaune-verdâtre et charnus, de *Ricinodendron heudelotii*, ramassés à terre, sont mis en tas. Les graines recueillies sont séchées, grillées, pilées et donnent une pâte onctueuse servant à la préparation de sauces. La pâte est ajoutée à d'autres sauces et sert aussi d'épice. Les graines sont conservées et sont vendues toute l'année sur lesmarchés. Quant aux jeunes feuilles de *Myrianthus arboreus,* elles se consomment cuites en sauce. Ces feuilles font l'objet d'un petit commerce sur les marchés locaux et de la capitale. Mais leur conservation reste difficile.

Espèces moyennement connues et consommées (Pr = 25 et 50%)

Les espèces de cette catégorie sont au nombre de onze (tableau II) (probabilité de reconnaissance entre 25 et 50%). Elles sont limitées à des habitats spécifiques et sont donc moins abondantes. Certaines possèdent des fruits au goût peu agréable et sont peu exploitées, d'autres en revanche possèdent des fruits succulents et bien appréciés. Parmi les plantes bien exploitées pour leurs fruits consommés crus, il est possible de citer *Dacryodes klaineana* et *Spondias mombin* ; cette dernière s'avère être une plante pantropicale (Burkill, 1985). Leurs fruits juteux sont en vente sur les marchés et leur consommation est fréquente dans toute l'Afrique occidentale.

Raphia hookeri, Laccosperma secundiflorum et *Calamus deërratus* sont moins connues. Chez ces espèces, ce sont le coeur et les bourgeons terminaux qui font l'objet d'un petit commerce sur les marchés locaux.

Tableau II : Espèces moyennement connues et consommées (Pr = 25 et 50%) du Département de Gagnoa

N°	Espèces	Ourg.	Guib.	Gnag.	Département de Gagnoa	Organes consommés
9	*Cola lateritia* Schum. var. maclaudii (A.Chev.) Brenan & Keay.	33	69	39	47	Fruits, Jeunes feuilles
10	*Cola gigantea* Brenan et Keay A. Chev.var.glabrescens	33	69	39	47	Arilles, Jeunes feuilles
11	*Treculia africana* Desc. Subsp. africana var. africana	47	50	42	46	Fruits
12	*Strombosia pustulata* Oliv. Var. lucida (Léonard) Villiers	58	33	36	43	Graines
13	*Dacryodes klaineana* (Pierre) Lam.	33	36	53	41	Fruits, Bourgeons
14	*Wissadula amplissima* (L.) R. E. Fries	47	58	5	37	Ecorces
15	*Raphia hookeri* Mann. & Wendl.	25	64	11	33	Bourgeons, Sèves
16	*Calamus deërratus* (Linn) Mann. & Wendl.	14	47	33	31	Bourgeon terminal
17	*Spondias mombin* Linn.	36	33	20	30	Fruits
18	*Xylopia aethiopica* (Dunal) A. Rich.	0	72	17	30	Fruits

Oug. = Ouragahio ; Guib. = Guibéroua ; Gnag. = Gnagbodougnoa

Espèces peu connues et consommées (0 et 25%)

Une trentaine d'espèces, consignées dans le tableau III, sont peu connues et leurs organes sont peu consommés (probabilité de reconnaissance entre 0 et 25%). Certaines espèces se révèlent comme très peu connues, mais bien exploitées et même vendues sur les marchés. *Piper guineense* et *Xylopia aethiopica* offrent des fruits qui sont valorisés sous forme d'épices dans les grillades et dans

les sauces tomate. Deux espèces stimulantes, *Cola nitida* et *Garcinia kola,* sont considérées en tant qu'espèces alimentaires dans l'étude et leurs fruits sont mâchés crus par des hommes adultes. Elles sont, par contre, peu consommées par la plupart des villageois et restent donc marginales. Certaines espèces ont presque disparu de toute végétation, c'est le cas de *Coula edulis, Landolphia hirsuta, Landolphia owariensis, Telfairia occidentalis* et *Trichoscypha arborea,* et la connaissance de leur utilité est très faible parmi les populations rurales

Tableau III. Espèces peu connues et consommées (0 et 25%) du Département de Gagnoa

N°	Espèces	Ourg.	Guib.	Gnag.	Département de Gagnoa	Organes consommés
19	*Zanthoxylum rubescens* Hook.f.	3	47	8	19	Jeunes feuilles
20	*Laccosperma secundiflorum* (P.Beauv.) O. Kuntze.	14	8	33	18	Bourgeons
21	*Dioscorea odoratissima* (Pax) Bull. Jard	19	0	30	16	Tubercules
22	*Bombax buonopozense* P. Beauv.	0	33	14	16	Pédoncules
23	*Momordica cabrae* (Cogn.) Jeffrey	33	11	3	16	Graines, Feuilles
24	*Salacia oliveriana* Loes. var. oliveriana	30	0	17	16	Feuilles, Graines
25	*Chrysophyllum perpulchrum* Hutch. & Dalz..	28	11	3	14	Fruits
26	*Coula edulis* Baill.	0	22	19	14	Amandes
27	*Piper guineense* Schum. & Thonn.	8	11	176	12	Fruits
28	Trichoscypha arborea (A. Chev.) A. Chev.	0	19	14	11	Fruits
29	*Ceiba pentandra* (Linn.) Gaernt.	3	14	14	10	Jeunes feuilles
30	*Cucumeropsis edulis*.Naud	0	25	3	9	Graines, jeunes feuilles
31	*Parkia bicolor* A. Chev.	3	0	22	8	Graines, Pulpe
32	*Landolphia hirsuta* (Hua) Pichon	17	0	8	8	Fruits
33	*Calpocalyx brevibracteatus* Auct.	0	0	228	7	Graines
34	*Cola nitida* (Vent.) Schott .et Endl.	3	14	5	7	Fruits
35	*Sterculia tragacantha* Lindl	3	14	5	7	Cotylédon, Jeunes feuilles
36	*Triplochiton scleroxylon* K.Schum	0	3	19	7	Jeunes feuilles
37	*Calpocalyx aubrevillei* Pellegr.	0	8	8	5	Graines
38	*Dioscorea smilacifolia* De Wild. var.	3	8	5	5	Tubercules
39	*Discorea praehensilis* Benth .	3	8	3	5	Tubercules
40	*Landolphia owariensis* P. Beauv.	5	3	8	5	Fruits
41	*Blighia sapida* Konig	0	3	8	4	Arilles
42	*Buchholzia coriacea* Engl.	11	0	0	4	Noix
43	*Tieghemella heckelii* Pierre ex A. Chev.	0	11	0	4	Amandes
44	*Garcinia kola* Heckel	8	0	0	3	Graines
45	*Telfairia occidentalis* Hook. f.	0	5	3	3	Graines
46	*Tetracera alnifolia* Wild.	8	0	0	3	Sève
47	*Cayratia gracilis* (Guill. & Pell.)	0	0	5	2	Fruits
48	*Cissus adenocaulis* Stend. (Berhaut)	0	0	5	2	Graines
49	*Clerodendrum splendens* G.Don.	0	0	3	1	Feuilles
50	*Passiflora foetida* L.	3	0	0	1	Fruits

Oug. = Ouragahio ; Guib. = Guibéroua ; Gnag. = Gnagbodougnoa

Biotope des espèces recensées

Plusieurs milieux écologiques abritent les arbres et les lianes spontanés qui ont leurs organes consommés. En forêt, 32 espèces ont été recensées, soit 64% des taxons. Les espèces ubiquistes représentent 21,9% et les espèces de jachère 12,5%. Les espèces plus connues, *Irvingia robur, Beilschmiedia mannii, Ricinodendron heudelotii* et *Myrianthus arboreus,* sont entretenues par les paysans dans les plantations de cacaoyers et de caféiers, ainsi que dans les jachères. *Spondias*

mombin est une plante pantropicale, subspontanée en Afrique de l'Ouest. C'est une espèce régulièrement rencontrée aux abords des villages, dans les formations secondaires, en lisière de forêt ou encore dans les zones moins dégradées. Les espèces comme *Raphia hookeri, Laccosperma secundiflorum* et *Calamus deërratus* se retrouvent généralement dans les bas-fonds ou dans les galeries forestières.

Principaux organes consommés

La répartition des taxons en fonction des organes consommés montre que les fruits sont les organes les plus consommés. Ils représentent 34 espèces (graines, cotylédons et amandes), soit 68% des plantes recensées. Les feuilles représentent 38%. Quant aux autres organes (écorces, pédoncules, tubercules, tiges, etc.), ils concernent 16% des espèces recensées.

Comparaison des résultats avec ceux de la région de Lamto

En comparant les résultats obtenus avec ceux de la région de Lamto («V-Baoulé »), Gautier-Béguin a recensé 58 espèces alimentaires appartenant à toutes les formes biologiques, dont 14 espèces d'arbres et de lianes en moins que dans notre étude. Les résultats ont montré que 10 espèces alimentaires spontanées sont communes aux deux zones d'études. Ce sont six espèces d'arbres (*Ricinodendron heudelotii, Spondias mombin, Triplochyton scleroxylon, Xylopia aethiopica, Raphia hookeri* et *Elaeis guineensis*) et quatre lianes (*Landolphia hirsuta, Landolphia owariensis*, *Dioscorea praehensilis* et *Passiflora foetida*).

Dans ces deux régions, les espèces rencontrées ont les mêmes organes consommés et se développent dans les mêmes types de milieux écologiques. La seule différence réside dans le niveau d'utilisation de ces plantes par les populations.

Les valeurs alimentaires des organes des plantes spontanées analysés

Le tableau IV montre les principales compositions physico-chimiques des organes analysés. Le taux d'humidité le plus élevé est celui de *Myrianthus arboreus* (63,80%). Au contraire, les plus faibles concentrations en eau ont été observées chez *Ricinodendron heudelotii* (5,05%) et *Irvingia robur* (4,74%).

Les espèces les plus riches en protéines sont *Ricinodendron heudelotii* (24,72%) et *Myrianthus arboreus* (17,50%). Celles les plus pauvres en protéines sont *Treculia africana* et *Irvingia robur* avec un taux de 5,85% chacun.

Irvingia robur et *Treculia africana* sont les espèces qui présentent les taux les plus élevés de sucres totaux (4,4 et 4%). *Strombosia pustulata* (1,55%) a une concentration moyenne en sucre. Les valeurs les plus faibles de sucres ont été trouvées chez *Myrianthus arboreus* (0,32%) et *Ricinodendron heudelotii* (0,62%).

Concernant les cendres*, Myrianthus arboreus* est l'espèce qui présente le taux le plus élevé d'éléments minéraux dissous (11,07%). Les plus faibles valeurs de cendres sont celles de S*trombosia pustulata* (2,66%) et *Irvingia robur* (2,31%).

Deux espèces ont montré les teneurs en huile les plus élevées. Ce sont *Irvingia robur* (65,84%.) et *Ricinodendron heudelotii* (44,13%). Les 4 autres espèces ont présenté de très faibles concentrations en huiles, allant de 1,80 (*Myrianthus arboreus*) à 3,55 (S*trombosia pustulata*).

Tableau IV . Compositions physico-chimiques des organes consommés (%)

Espèces	Taux d'humidité	Protéines	Cendres	Sucres totaux	Lipides
Beilschmeidia manii	9,44 d	6,67 e	5,70 bc	1,16 bc	2,04 d
Irvingia gabonensis	4,74 e	5,83 f	2,31d	**4,40 a**	**65,84 a**
Myrianthus arboreus	**63,80 b**	**17,50 c**	**11,07 a**	0,32 c	1,80 d
Ricinodendron heudelotii	5,05 e	**24,72 a**	5,63 bc	0,62 c	**44,13 c**
Strombosia pustulata	8,22 de	9,44 d	2,66 d	**1,55 bc**	3,55 d
Treculia africana	**13,66 c**	5,85	4,68 c	**4,00 a**	2,77 d

Discussion

Les arbres les plus recherchés sont présents en forêt, dans les jachères et au sein des plantations agricoles, ce qui montre bien l'intérêt que leur accordent les paysans qui les préservent lors des défrichements. Les plus importants parmi ces arbres sont *Irvingia robur*, *Ricinodendron heudelotii et Beilschmiedia mannii* qui produisent des graines que l'on peut conserver et commercialiser toute l'année*. Irvingia robur* et *Ricinodendron heudelotii* sont des espèces particulièrement importantes en zone forestière (N'Dri, 1986; N'Guessan, 1995; Kouamé, 2000). Ces arbres produisent des amandes très recherchées pour la préparation des sauces. Leur ramassage donne lieu à une importante activité commerciale qui occupe les femmes rurales de ces régions, selon ces mêmes auteurs. Pour *Myrianthus arboreus, M. libericus, M. serratus* et *Zanthoxylum gilletii*, ce sont les bourgeons et les jeunes feuilles qui sont récoltés. La présence de bourgeons et de jeunes feuilles de ces espèces sur les arbres tout au long de l'année fait de ces organes des produits de consommation disponibles en permanence et leur donne une grande importance à l'échelle régionale. Dans cette catégorie d'espèces les plus connues et les plus consommées, certaines sont protégées, entretenues et mêmes plantées par les agriculteurs, d'où l'importance et l'intérêt accordés à ces plantes de même que le souci d'éviter leur extinction. Les espèces peu connues et peu consommées sont néanmoins nombreuses (32 espèces). La plupart ont des organes qui sont récoltés ou ramassés pour une consommation individuelle en collation et/ou pendant les périodes de soudure ou de pénurie. Ces espèces (*Triplochiton scleroxylon*, *Landolphia owariensis*, *Piper guineense, Laccosperma secundiflorum*…) sont très rarement commercialisées, selon plusieurs auteurs (Ogle & Grivetii, 1985; Herzog & Bachmann, 1992; Malaisse, 1997).

Les arbres et les lianes alimentaires sont plus nombreux en milieux non anthropisés (forêts et jachères) qu'en plantation. Le défrichement de la forêt et l'entretien des cultures sont des menaces pour la survie de ces plantes. Ces mêmes observations ont été signalées par Herzog et Bachmann (1992) en Afrique occidentale et Noumi (1984) en Afrique centrale. Dans les vergers de caféiers et de cacaoyers, les espèces arborées les plus rencontrées sont *Irvingia robur*, *Beilschmiedia mannii*, *Myrianthus arboreus*, *Elaeis guineensis*, *Zanthoxylum gilletii*, *Strombosia pustulata*, *Spondias mombin*, *Garcinia kola*, *Ricinodendron heudelotii*, *Treculia africana,* etc. Ces observations sont proches des résultats de Gautier-Béguin (1992), de Herzog et Bachmann (1992) et de Kouamé (2000). Ces espèces jouent un rôle important dans les formations forestières secondaires et peuvent donner lieu à des pratiques d'agroforesterie. Dans le département de Gagnoa, les fruits sont produits par 68% des taxons rencontrés et constituent les organes les plus consommés. L'utilisation de certains de ces fruits reste variable en fonction des localités. C'est le cas du mésocarpe du fruit de *Irvingia robur*, qui a un goût de mangue, un peu amer, mais qui selon N'Dri (1986) est comestible. Étant donné le goût amer de ce fruit, sa consommation reste limitée à son amande dans notre zone d'étude et même en Côte d'Ivoire. Au Congo, les cotylédons sont écrasés et grillés pour préparer une sorte de pâte connue sous le nom de pain de dika ou d'odika, ou chocolat (Gautier- Béguin, 1992). Ces cotylédons sont riches en huile. Selon Joseph (1995), les teneurs en huile varient entre 60 et 80%.

Les travaux de Tabuna (1999) révèlent que les pays du bassin du Congo exportent des quantités considérables d'amandes d'*Irvingia robur* vers l'Europe (France et Belgique). En Côte d'Ivoire, l'exploitation de la plante est assurée par les femmes, rarement par les hommes et les enfants. Ce secteur d'activité demeure dans l'informel et mérite d'être organisé pour lutter contre la pauvreté. Au Sénégal, selon Baumer (1995), les fruits fermentés de *Spondias mombin* donnent par distillation un alcool blanc consommé par la population. Dans la confection des repas familiaux, les feuilles sont très recherchées. Elles représentent environ 50% des organes consommés. Les feuilles sont des organes présents sur les plantes presque tout au long de l'année, ce qui les rend disponibles à toute période. Le plus souvent, elles servent de base à la confection des sauces, des ragoûts et des condiments. La préparation la plus courante consiste à faire bouillir les feuilles fraîches pour la confection des sauces. Une autre possibilité est de les faire sécher et de les réduire en poudre. Les usages ont été rapportés par N'Dri (1986) et Gautier-Beguin (1992) pour des espèces comme *Ceiba pentandra*, *Myrianthus arboreus*, *Triplochyton scleroxylon.*

Dans la flore des espèces alimentaires spontanées du Département de Gagnoa, les arbres aux fruits recherchés sont les espèces les plus connues et les plus consommées. Ces espèces sont présentes en forêt, dans les jachères se retrouve également en plantations agricoles, ce qui dénote de l'intérêt que leur accordent les paysans qui les préservent lors des défrichements. Les plus importants parmi ces arbres sont : *Irvingia gabonensis*, *Ricinodendron heudelotii et Beilschmiedia mannii* qui

produisent des graines que l'on peut conserver et commercialiser toute l'année. *Irvingia gabonensis* et *Ricinodendron heudelotii* sont des espèces particulièrement importantes en zone forestière (N'Dri, 1986; N'Guessan, 1995; Kouamé, 2000). Ces arbres produisent des amandes très recherchées pour la préparation des sauces. Leur ramassage donne lieu à une importante activité commerciale qui occupe les femmes rurales de ces régions, selon ces mêmes auteurs. Pour *Myrianthus arboreus, Myrianthus libericus, Myrianthus serratus* et *Zanthoxylum gilletii*, ce sont les bourgeons et les jeunes feuilles qui sont récoltés. La présence des bourgeons et de jeunes feuilles de ces espèces sur les arbres tout au long de l'année fait de ces organes des produits de consommation disponibles en permanence et leur donne une grande importance à l'échelle régionale. Dans cette catégorie d'espèces les plus connues et les plus consommées, certaines sont protégées, entretenues et mêmes plantées par les agriculteurs. Cette attitude montre le niveau d'importance et l'intérêt accordés à ces plantes de même que le souci d'éviter leur extinction. Les espèces peu connues et peu consommées sont néanmoins nombreuses, 32 espèces. La plupart ont des organes qui sont récoltés ou ramassés pour une consommation individuelle en collation et ou pendant les périodes de disette. Ces espèces (*Triplochiton scleroxylon*, *Landolphia owariensis*, *Piper guineense, Laccosperma secundiflorum* etc.) sont très rarement commercialisées, selon plusieurs auteurs (Ogle & Grivetii, 1985 ; Herzog & Bachmann, 1992 ; Malaise, 1997).

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Les espèces telles *Irvingia gabonensis*, *Ricinodendron heudelotii* et *Sesamum indicum* ont montré de très faibles teneurs en eau. Ces données expliquent pourquoi leurs graines peuvent être conservés longuement sans risque de contamination microbienne. Au contraire, les jeunes feuilles de *Myrianthus arboreus* présentent des quantités d'eau très importantes et sont donc inaptes à la consommation moins de 24 heures après la récolte. Les taux de protéines trouvés chez *Ricinodendron heudelotii* et *Myrianthus arboreus* sont importants (17 à 25%). Busson (1965) a mis en évidence des valeurs similaires de protéines (28%) dans des graines de *Ricinodendron heudelotii* récoltées en forêt à Grand YAPO (Sud Est de la Côte d'Ivoire). Toutefois, les taux de protéines observés dans ces deux espèces *Ricinodendron heudelotii* et *Myrianthus arboreus* sont comparables

et parfois supérieurs à ceux des viandes et autres aliments protéagineux : viande fraîche de bœuf (22,4%), poisson frais (18,7%), volaille (18,5%), jaune d'œufs (16,7%), fromage (6,2 à 17,2%) et maïs jaune (8,6 à 9,2%). Des teneurs en huiles assez élevées ont été observées dans les amandes de *Irvingia gabonensis* et *Ricinodendron heudelotii* (44 à 66%). Concernant *Irvingia gabonensis*, des taux d'huile plus élevés, de 70 et 73% ont été signalés respectivement par Kouakou (2002) et Traore (2005). Joseph (1995) a indiqué par ailleurs que ces teneurs variaient entre 71% et 76%.

Ces teneurs en d'huile des organes végétaux consommés en milieu rural sont largement supérieurs à celles de quelques huiles dosées par AGBO (1986), notamment la graine fraîche de palme (45 à 50% d'huile), la graine de soja (18%), l'amande de coton (18%), la graine de tournesol (18%), l'amande de l'arachide (46%). Ainsi malgré la pauvreté relative des populations rurales d'Afrique, la consommation de ces organes végétaux leur assure des compléments nutritionnels parfois importantes et à moindre coût.

Conclusion

Les enquêtes conduites dans trois sous-préfectures du Département de Gagnoa ont montré qu'il existe encore de nombreuses espèces de lianes et d'arbres spontanées alimentaires. Celles-ci se développent dans divers milieux écologiques : forêts, jachères et vergers de cultures pérennes. Les formes biologiques qui produisent les organes les plus couramment consommés sont les arbres. Les espèces les plus connues sont au nombre de sept (7). Les fruits sont les organes les plus consommés. Mais dans l'ensemble, les organes qui rentrent dans la préparation des repas familiaux sont les feuilles. Les fruits sont les organes les moins utilisés dans les mets. Les autres organes (écorces, tubercules, sève…) font l'objet d'une consommation occasionnelle (temps de disette).

Les espèces rencontrées ont montré des valeurs nutritionnelles (protéines, glucides et lipides) insoupçonnées qui incitent à une meilleure politique de préservation et de promotion de ces plantes jusque là négligées. La valorisation de ces espèces se présente ainsi comme une exigence écologique de même qu'une stratégie de la sécurité alimentaire et de la lutte contre la pauvreté en milieu rural. Aussi, les recherches dans le domaine de domestication devraient être elles s'accentuer sur ces espèces en vue de la valorisation effective de leurs potentialités.

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SOME OTHER USES OF ACCEPTED AGROFORESTRY FUELWOOD SPECIES BASED ON TRADITIONAL KNOWLEDGE IN SELECTED RURAL COMMUNITIES OF OYO STATE, SOUTHWEST NIGERIA

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Abstract

The fact that the bulk of wood used in the sub-Sahara African region and many other developing countries is as woodfuel is incontrovertible. The literature is replete with various reports that revealed that the people of the rural areas of the developing countries rely on trees/shrubs and other non-wood forest resources for sustenance. This study was carried out to assess other traditional uses which accepted agroforestry fuelwood species can be put using Akinyele and Ido Local Government Areas (LGAs) of Oyo State, Nigeria, where the predominant type of agroforestry system practiced is that of scattered trees in croplands, as a case study. The woody species used in agroforestry schemes in the study area, were compiled from questionnaires retrieved from 179 respondents. The compiled woody species were prioritized using the respondents' ranking, from which twelve of them that top the ranking were selected based on this prioritization. Friedman chi-square result revealed that there was no significant difference in the ranking pattern of the respondents in the two LGAs (χ^2=2.17; $p<0.05$). The questionnaire survey and literature search of other traditional uses to which the various parts of the accepted agroforestry fuelwood species can be put other than their use for heating and cooking revealed that culinary and medicinal uses were dominant among these other uses. It was therefore recommended that strategies that aim at balancing wood use as fuel and other uses should be encouraged based on traditional knowledge.

Introduction

Wood use as a means of cooking and heating is still very much relevant in the developing countries, most especially those of sub-Saharan Africa. According to Arnborg (1984), half of the timber cut in the world is used as fuelwood for cooking and heating, most of which are used in the developing countries (IEA, 2002), where fuelwood accounts for about 90% of the timber harvested (Brooks, 1993; FAO, 2007).

Temu (2002) estimated that over 90% of the people of Africa depend either on firewood or charcoal for cooking and heating, a trend that is not likely to reverse in many decades to come (FAO, 2001; Kituyi, 2002; UNDP, 2002; Erakhrumen, 2007; 2008) with quantity needed expected to increase continuously (FAO, 1999; ITTO, 2005). This is perhaps because of the demographic and socio-economic characteristics including the interplay between these factors in these areas (Erakhrumen, 2007; 2008) coupled with the unpredictable fluctuations in the prices of domestic fossil fuel like kerosene, liquefied petroleum gas, and others.

Apart from the use of biomass, especially wood, for cooking and heating, the inhabitants of these countries have depended for centuries on their indigenous plants resources based on traditional knowledge for sustenance. They depend on them for food security and a host of everyday products, from medicines to fibres (Leakey and Izac, 1996). The increase in the use of woodfuel has contributed partly to the depletion of forests (FAO, 2002). The implications of this on the environment, biodiversity stability, and by extension on the well being of human are well documented in the literature.

Owing to the increasing consumption of woody biomass as fuel in the world, it is imperative to be in tune with other traditional uses to which accepted fuelwood species are put by the cross section of users in order to be armed with information that may assist in various strategies at preventing the situation whereby these species are overexploited for energy generation at the detriment of other

traditional uses central to survival in these communities where large number of people living below poverty line are concentrated (Canagarajah, 1998; Popoola & Akinwumi, 2001).

This paper is therefore, focused on the assessment of woody species found on agroforestry plots in Akinyele and Ido Local Government Areas (LGAs), where the predominant type of agroforestry system practiced is that of scattered trees in croplands, prioritize them based on users' perspective, native intelligence, and indigenous/traditional knowledge and select twelve mostly used among them in terms of their usefulness as fuelwood based on users' perception and compile some other traditional uses, apart from their use as fuelwood, to which the twelve species can be put.

Methodology

Study Area

The study area is located in between the humid and sub-humid tropical climate (latitude 7°17′–7°26′N, longitude 3°17′–3°30′E). The mean annual rainfall ranges from 1,117.1 to 1,693.3mm. The rainfall pattern has a characteristic bimodal distribution with peaks usually in June or July and September and the period of low precipitation in August with four months of dry season (December-March). The annual temperature ranges from an average minimum of 24.6°C to average maximum of 31.5°C. The mean monthly relative humidity reaches a minimum of about 52% in February and a maximum of about 83% in August (IITA, 1993; FRIN, 1999).

Questionnaire surveys

In order to prioritize the wood species in croplands in this study area and obtain those mostly preferred to be in their croplands and agroforestry plots by farmers and inhabitants of the study area based on their usefulness as fuelwood, questionnaire was drawn for administration on this target group, in such a way as to utilize their native intelligence, and indigenous/traditional knowledge for prioritizing the species.

A random survey of respondents was done using questionnaires targeting two hundred and forty (240) respondents. One hundred and twenty (120) copies of a set of questionnaires were randomly administered in each LGA. This was achieved by partitioning each LGA into four (4) geographical zones i.e. North, West, South and East based on the information obtained from each LGA headquarters with a village/community randomly selected to represent each zone in each LGA as stated: Akinyele LGA: North: Aba Isale Community, South: Papa Malu Community, West: Motosho Community, East: Bagadaje Community. Ido LGA: North: Odetola Community, South: Dagilogba Community, West: Tade Community, East: Patako Community.

Thirty copies of the questionnaires were randomly administered on respondents in each geographical zone in order to ensure randomization, equitable distribution and even spread of the questionnaires in the two LGAs. The questionnaire was drawn in such a way that the respondents listed all the woody species in his/her farm or those that he/she has information about and prioritize them based on how preferable they are for agroforestry, in terms of their importance for fuel generation as firewood, from his/her perspective based on experience.

The respondents listed the wood species from 1 to 10 in order of preference with the species in position number 1 being the most preferred while the species in position number 10 being the least preferred out of the ten species in that order. Numerical values of 1 to 10 were allocated to each position on the ranking. Numerical values were allocated to each position on the ranking in descending order i.e. numerical value 10 was allocated to position number 1 on the ranking while numerical value 1 was allocated to position number 10 on the ranking in that order.

Collating the numerical values allocated to each position occupied by each species on the ranking, it was found that twelve species had the highest cumulative values as against the ten species that was originally planned to be selected. These methods of questionnaires administration and allocation of values to ranking position of species were described by Erakhrumen, (2005).

The number of copies of questionnaires that was retrieved from Akinyele and Ido LGAs was 83 and 96 out of the 120 administered respectively totaling 179 owing to incomplete information in and non-retrieval of some of the questionnaires totaling sixty one (61). The 179 questionnaires served as the effective sample size used in the subsequent analyses.

Statistical Analysis

Friedman chi-square analysis was employed in analyzing the ranking pattern of the prioritized species by the respondents to ascertain if there exists significant difference in their ranking in the two LGAs. The statistical package used for the analysis was SPSS14®. The analysis was carried out at 5% probability level.

Results

The twelve woody species that were at the top of the priority ranking of the respondents are shown on Table 1 while the Friedman chi-square result of the ranking pattern of the respondents in the two LGAs is tabulated on Table 2. Some other traditional uses of the twelve wood species, apart from their use as fuelwood are also tabulated on Table 3.

Table 1. Twelve species that top the ranking of the wood species in agroforestry plots by respondents in the two Local Government Areas

Species scientific names	Family
Annona senegalensis Pers.	Annonaceae
Anogeissus leiocarpus (DC.) Guill. & Perr.	Combretaceae
Bridelia ferruginea Benth.	Euphorbiaceae
Daniellia oliveri (Rolfe) Hutch. & Dalziel.	Caesalpiniaceae
Detarium microcarpum Guill. & Perr.	Caesalpiniaceae
Gardenia ternifolia Schumach. & Thonn.	Rubiaceae
Hymenocardia acida Tul.	Phyllanthaceae
Lophira lanceolata Tiegh. ex Keay.	Ochnaceae
Parkia biglobosa (Jacq.) R. Br. ex G. Don.	Mimosaceae
Terminalia avicennioides Guill. & Perr.	Combretaceae
Triplochiton scleroxylon K. Schum.	Sterculiaceae
Vitellaria paradoxa C.F. Gaertn.	Sapotaceae

Table 2: Friedman Chi-Square result for the ranking pattern of the respondents in the two Local Government Areas (LGAs)

Local Government Areas (LGAs)	Friedman chi-square value	Critical value	Singificance ($p < 0.05$)
Akinyele LGA Ido LGA	2.17	3.84	No significant difference

Table 3: Some other traditional uses of the twelve most preferred fuelwood species

Species	Parts used and for what purpose
Annona senegalensis	**Fruits/Seeds:** Food, jam production **Leaves:** Treatment of dysentery, yellow fever, insecticide **Stem bark:** Treatment of diarrhoea, use as insecticide **Wood:** Treatment of diarrhoea **Roots:** Treatment of yellow fever and jaundice
Anogeissus leiocarpus	**Leaves:** Fodder, dye production, treatment of skin diseases, sores, pile, malaria **Stem bark:** Dye production, treatment of skin diseases, sores **Wood:** Chewing stick, mortar & pestle production **Roots:** Chewing stick, treatment of toothache, tooth decay, febrile convulsion
Bridelia ferruginea	**Leaves:** Prevention of miscarriage, intestinal & bladder trouble, treatment of skin diseases **Stem bark:** Mouth wash, treatment of cough, pile, prevention of miscarriage **Wood:** Tannin production, anti-poison **Roots:** Chewing stick, tooth decay treatment
Daniellia oliveri	**Leaves:** Treatment of tooth-ache, fever, colic diseases, wound, fodder **Stem bark:** Treatment of toothache, colic diseases, skin diseases **Wood:** Chewing stick, Timber production **Roots:** Chewing stick, treatment of deep wounds
Detarium microcarpum	**Fruits/Seeds:** Fodder, oil extraction, soup thickening, gum, colourant **Leaves:** Medical uses
Gardenia ternifolia	**Leaves:** Treatment of Hypertension, skin diseases **Roots:** Treatment of Hypertension, skin diseases
Hymenocardia acida	**Fruits/Seeds:** Eaten as food, Treatment of diabetes **Leaves:** Medicinal use, fodder **Stem bark:** Treatment of small pox, & other skin diseases, diarrhoea, dysentery **Roots:** Treatment of nasal blockage
Lophira lanceolata	**Leaves:** Treatment of fever, jaundice diarrhoea, vomiting, stomach ache **Stem bark:** Treatment of jaundice treatment, malaria **Wood:** Stake, minor carving, scaffolding
Parkia biglobosa	**Fruits/Seeds:** Condiment, fruit juice, veterinary use, treatment of hypertension **Leaves:** Fodder, treatment of stroke, eye infections, skin lesion, leprosy **Stem bark:** Treatment of fever, toothache, wound, ulcer, **Wood:** Timber, tannin, gums **Roots:** Treatment of hypertension & skin diseases treatment, stomach-ache, sore eye, infertility, anti-poison
Terminalia avicennioides	**Leaves:** Treatment of malaria, fever **Stem bark:** Ethno-veterinary uses **Wood:** Chewing stick **Roots:** Chewing stick, treatment of cough, toothache, dental caries, skin infection, Ethno-veterinary uses
Triplochiton scleroxylon	**Leaves:** Vegetable, habitat for silkworms **Stem bark:** Treatment of malaria, roofing and partitioning of huts **Wood:** Timber production **Fruits/Seeds:** Shea butter oil production, treatment of bees & wasp sting, diarrhoea, anti-venom, anti-poison, rheumatism, waist pain, yellow fever, rheumatic pains, wastewater from shea-butter production as insecticide, shea butter is used to treat inflammation, rashes in children, dermatitis, sunburn, chapping, irritation, ulcers and as a rub for rheumatism
Vitellaria paradoxa	**Leaves:** Treatment of fracture, conjunctivitis, trachoma, convulsion, stomach-ache, headache, as an eye lotion **Stem bark:** Treatment of dysentery, haemorrhoids, schistosomiasis, coughs, jaundice, nausea, diarrhoea, constipation, headaches, fever **Wood:** Timber, Mortar & pestle carving, gum production, hoe handles, bowls, dugout canoes, chewing stick, latex for gum production, tannins or dyestuff from ashes of burnt wood **Roots:** Treatment of female sterility, gastritis, liver cancer, ascites, sores, jaundice, diarrhoea and stomach-ache, use as chewing stick

Sources: FAN (1989); Yakubu et al., (2001); Arbonnier (2002); Agbidye & Igbabo (2003); Field Survey (2005)

Discussion

The fact that wood is an important source of energy in most rural communities of the developing countries cannot be overemphasized. Various reasons have been attributed to this, among which are the unreliability in demographic parameters, socio-economic realities, and interplay between these factors (Erakhrumen, 2007; 2008). This natural resource is so important to the inhabitants of the rural, peri-urban and some urban communities that it is harvested and or purchased and stored in order to reduce its moisture content for use as firewood.

For instance, in the two LGAs that fall within the study area of this work, apart from their headquarters and few adjoining communities, the other villages and communities were largely without electric power supply from the national or state power grid, an observation which is not unexpected, as IEA (2002) had earlier observed that four out five people without electricity live in the rural areas of the developing world, mainly in south-east Asia and sub-Saharan Africa. The dependence on biomass, especially fuelwood, as a source of energy should not be unexpected in communities with such characteristics.

The result of the survey showed that majority of the inhabitants of the study area depends on fuelwood for generating energy most especially for cooking. This observation was corroborated by the result of a study by Anaukwu (1992) which revealed that people with low income consume more fuelwood than those with higher income while the consumption in the rural areas were higher than that in the urban centres in Nigeria, an observation which is supported by that of Popoola & Akinwumi (2001), who stated that large population of poor people live in the rural areas of the country.

The response of the respondents revealed that twelve species top their priority ranking based on their perceived energy value (Table 1). There was similarity in their preference in the two LGAs as revealed by the result of Friedman chi-square analysis (Table 2) which showed that the ranking pattern in the two LGAs did not significantly differ statistically from the expected value at 5% probability level.

This result indicates the fact that the indigenous/traditional knowledge is an important factor that governs the acceptance and use of any wood species or any other plant resource for any purpose in any community. It also shows that the 'rural' people are aware of the fact that not all wood species possess the ability to provide same quantity of energy at the same rate based on their personal and inherited generational experience. Although, it is important to note that the problem associated with defining 'rurality' is not new irrespective of the fact that division between 'urban' and 'rural' areas is often based on the assumption that the physical distinction between the two is self-explanatory and uncontroversial.

Various studies have shown the importance of trees and non-tree resources for the sustenance of livelihood in many local communities in this part of the world. Result of questionnaire survey and information from literature tabulated on Table 3 revealed that there are other traditional uses to which the twelve most preferred wood species as fuelwood can be put in the rural areas, thus, making their inclusion on the list of fuelwood species a good pointer to both the importance of wood as energy source in the rural and some urban areas of the developing countries and the declining state of wood resources for this purpose.

For instance, the use of plant medicines plays an important role in daily health care in many parts of Africa. It has been observed in some rural areas that "local" medicines are even preferred to "modern" medicines. They are of course less expensive, but they are often regarded as being more "effective" (Betti, 2004). The use of herbal medicine have produced results of proven efficacies compared to conventional modern medicine (Chopra et al., 1956), it should therefore, not be surprising that various parts of the twelve prioritized wood species has one medicinal use or another as shown on Table 3. It is also important to note that trade in plant parts for medicinal uses also serve as a means of livelihood to some rural inhabitants.

Although some of the respondents indicated that the branches are mostly used for fuelwood, it should be noted that the same branches produce fruits and leaves of invaluable importance to the rural and urban communities as also shown in Table 3. For instance, branches of *Parkia biglobosa* serve as a source of locust beans that has been found to be of high nutritive value. In an ethno-botanical and socio-economic survey carried out for preferred economic trees by farmers and stakeholders in the savannah region of Nigeria, *P. biglobosa* topped the list of eighteen selected indigenous fruit trees providing services and income (Popoola & Maishanu, 1995).

Apart from the consumptive use of the fruit/seeds and leaves of the species as food, juice, spices, condiments, production of oil, among others, some of them also serve as source of chewing stick some of which have been demonstrated to have inhibitory effect on some mouth disease-causing organisms (Rotimi et al., 1988).

They also serve as habitat for specific edible caterpillars and other insects of economic value. For instance, *Triplochiton scleroxylon* particularly serves as a good habitat for silkworm to spin their cocoon for silk production. Others like *Daniellia oliveri* ranked high among browse species for cattle in a study by Bayer, (1988). The importance of species like *Vitellaria paradoxa* (Fajimi et al., 2002) and *Terminalia avicennoides* (Gefu et al., 2000) in ethno-veterinary medicine have been well highlighted in the literature.

Therefore, the continuous unsustainable removal of these wood species for energy will obviously have negative effect on these other services rendered by them and by extension affect health (both for human and animals), environment, and biodiversity stability.

Conclusion

Studies have shown that the inhabitants of the developing countries, especially in the rural areas, are dependent on plant resources for sustenance. The use of biomass, especially wood, for energy generation in this part of the world is an issue that may not be easily wished away in the nearest future, probably owing to the vagaries associated with demographic and socio-economic conditions coupled with the level of technological advancement in this part of the world.

The result of this study have shown that all parts of the twelve species preferred for fuelwood have other important traditional uses which thus, make their preference for use for this purpose a pointer to both the importance of woodfuel and declining status of wood resource for this purpose in this and many other rural areas with similar characteristics in this part of the world.

Since a cheaper alternative is yet to be found for the use of wood as fuelwood, it is important that strategies that will enhance sustainable means of producing wood for energy generation and other traditional uses be developed and supported with the active participation and cooperation of all stakeholders especially the rural dwellers in line with generational traditional knowledge concerning these resources in order to prevent overexploitation of accepted selected woody species as fuelwood at the expense of other traditional uses.

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WHAT WE CAN LEARN FROM HISTORY: THE PRESENT ROLE OF COMMONS IN MANAGING THE ENVIRONMENT, AN AUSTRIAN CASE STUDY

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Abstract

Austria's commons, which are still generally accepted, are rooted in the traditional forms of settlement and in the rescue of common utilisation rights on outside property. Its members have participated in the administration and management of local resources since the 13th century. They accepted responsibility for managing the woodland, the waters and the village infrastructure. Traditional commons are characterized by certain features which are important for the future. The structure of commons is still evident and can be illustrated by social fairness, internal rules to reduce the misuse of power, economic principles, which concern the priority of subsistence over profitability, and the priority of local factors over global ones. This model of participatory intercourse with nature makes harmful impacts more difficult, and encourages responsibility for the shaping of the landscape and the sustainable protection of natural resources.

Introduction

The development of culture is strongly interconnected with the resources of the living space (i.e climate, soil, topography) through human intervention. It can be considered as the co-evolution of men and landscape resulting in specific cultural landscapes based the entire society including nature-social agreements. These agreements are the precondition for resolving conflicts about the sustainable utilization of resources. There are a multitude of factors contributing to conflicts between different interests of stakeholders However, social fairness includes cultural, social and spiritual dimensions, such as myths, ideologies and identities (Zenkl, 2000, p. 87).

The Austrian landscape is characterized by a remarkable proportion in alpine regions and a high proportion of forests (47% of the land and 0, 5 ha per capita). Eighty-two percent of the forest surface is privately owned, the rest is public owned. Fifty percent of the private forests are small scale forests, about 10% have joint ownership structures. In the discourse of development, small structures have been considered to be underdeveloped and provincial. However, rural and craftsmen's small-scale enterprises contribute remarkably to biodiversity and livelihood of the local people. About 280.000 people (around 5% of the total population) earn their living in forestry and the timber industry. The population has always been associated closely to the forests. In the Early Middle Ages it valued the forest largely for the area that could be cleared for agriculture. However later, the protection and safeguarding of forest itself gained increasing importance due to the growing demand for timber and grazing.

Methodology

Unlike the usually well-documented history of public forest management systems, the history of village-level forestry has very little be determined by survey till now. One of the greatest difficulties in many situations is the unreality of the notations of "participation" and "community" so frequently used by official literature. Villages may be deeply divided by classes being a powerful determinant of an individual's experience or "social reality".

In the past commons were exposed to different social systems and many changes. In some, sustainable development has been possible, in others not. In considering today's challenges, historians are able to answer the question: What are the characteristics of systems where development has been sustained successfully? Therewith woodland history turns out to be a source for legal, technical and political conclusions, stimulation and solutions in the field of forestry. Taking

the development in Austria as case study the paper deals with the role of commons in the past and present days related to the management of the given resources. The attempt was and still is to keep the natural resources of the villages (water, woodland) sustainable. Therefore local traditional forest related knowledge was handed down orally from generation to generation. It became part of the customary law of the villages and was written down from the 13th century onwards. In the 19th century many of these regulations were collected and recorded by the Austrian Academy of Science. For this study these records have been analysed in detail in order to gain knowledge about villagers' forest utilisation practises and the relationship among the villagers and their attachment to the close surrounding (Winter, 1886, 1896, 1898, 1913). Moreover political, legal and social framework and other influencing factors have been investigated to provide information about the characteristics of traditional forest management and the impacting factors. Thus the analysis is based on contemporary local, regional and national legislation (from the 14th century onwards) (Johann, 1994), documents referring to the effects of legal policy on the local people, particularly commons (cases at court) (Johann, 2004), and daily papers and journals (Lukesch, 2000; Rest-Hinterseer & Marchner, 2005) discussing the present role of commons within the society.

Results

The development of common property

Austria's commons, which are generally still accepted by today's society, are rooted in the traditional forms of settlement and in the rescue of common utilisation rights on outside property. Commons and forest rights are rooted in the undivided village-owned cultural land of the Middle Ages. It was one of the essential elements of colonization that forests, pastures and alpine pastures were jointly used, whereas fields were distributed among the individual farmers. Depending on the region, the common land was called *Nachbarschaft, Gemein* or *Allmende*. In some regions, landlords were able to take possession of the common woodland. In this case villagers obtained rights for timber and fuelwood harvesting, the collection of litter and forest grazing in the manorial forest. In other regions, forests and pastures remained in the ownership of the village where the different kinds of commons that still exist developed (Johann, 1981/82, p. 71). From the 14th century increasing controversies, due to a variety of reasons (shortage of available cultivated land, buying and selling of land, increasing population), caused remarkable changes in the ownership structure. For the first time, villagers asked for the common land to be distributed among them. This development was due to the fact that their increasing uncertainty about forest ownership and utilization rights had led to senseless forest devastation by forest users. In the course of centuries the allocation of common land to individuals was practised among villagers as well as the entitled farmers in ways which varied with time and place. Even the position of the local authorities being legitimated to accept or neglect the demands of the farmers varied between promotion and prohibition when the result of allocation did no come up to expectations. However, political forest authorities and public forest management only aimed at the highest production of timber and did not take into account other types of forest utilization such as grazing or litter harvesting.

The Imperial law from July 1853 enabled the regulation and suspension of former forest rights and common utilisation. In many cases the conveyance of the forest area happened with regard to the benefit of commons, communities, villages or the summary of the villagers being entitled to the utilisation of the former common land. In 1871, when land records got rearranged in Austria, it was necessary to formally install these ownership rights and attribute them to specific bodies.

The Imperial skeleton law of July 7 1883 also enabled common land to be allocated and forest rights to be regulated. Wherever it seemed to be favourable, the commons were separated and distributed to all co-owners, according to their shares of rights; wherever this turned out to be unfavourable for ecologic or economical reasons, the commons were regulated and became "*Agrargemeinschaften*". Such regulations specified the rights and duties of all members (share holders) and the organizational structure of each *Agrargemeinschaft*, provided a clear distinction of the scope of duties of the local communities (political self-governing bodies) on the one hand, and that of the *Agrargemeinschaften* on the other (Herbst, 2004). This development varied from federal province to federal province. In Carinthia and Lower Austria common land was split up during the following decades, whereas, in some provinces, such as Tyrol and Vorarlberg, the government passed public forests into the ownership of communities or commons to guarantee the livelihood of the villagers (Johann, 1983c, p

55). In the 1890s the portion of common forests varied markedly from 1% in Upper Austria to 54% in Tyrol and Vorarlberg (Dimitz, 1890).

At present rural common property in Austria can be traced back to either the settlement-related origin or the easement-related origin. Common property is one of the prevalent categories of rural land ownership and therefore a major factor in land use planning and policy in Austria. The administration of these joint ownership structures was institutionalised by 1853, and their legal status is that of corporations under public law ("*Agrargemeinschaften*", rural common property). A special supervising authority ("*Agrarbehörde*"), installed in 1883, safeguards sustainable management of the commons,. which consist mainly of pastures, alpine pastures and forests (Herbst, 2004). Their size varies between one and thousands of hectares and also their number varies between about 100 in Salzburg to 570 in Vorarlberg. Common rights are usually attached to the farmstead except Vorarlberg where they are attached to the person. Vorarlberg has the highest proportion of commons, which cover over 50% of the land.

Organisation and administration

In its origin all members of the commons had equal rights and duties, and participated in the administration and management of the local resources. Written sources going back to the 13th century show that. They accepted responsibility for the management of the nearby environment in particular with regard to the woodland, the waters and the infrastructure of the village. The basics of the *Nachbarschaft* were relationship and neighbourhood. They collaborated about the management of the cultivated land and the utilization of the woodland, and had essential obligations for the cleaning of waterways and streets and the maintenance of bridges and roads. When historical development brought out the division of farmsteads into smaller units, the extent of utilization rights and service obligations were determined by the size of the farmstead. From the first beginning, *Nachbarschaft* aimed at self government. The villagers insisted on generating their own rules concerning resource management and the right to punish illegal activities. Once a year the assembly of all land-owning villagers discussed economic questions related to the administration of the commons and elected a chief and an executive body. Forest management was often handed to a forester who received a certain wage.

From at least the beginning of the 16th century, the old common rights were weakened by the growing power of the manorial system which demanded authority over the common land. As alien authorities (state, landlords) took increasing control the farmers were inhibited in managing the land in the traditional way, and they lost the interest in self government so that the functions of rural *Nachbarschaften* lost their importance. The change varied in time, space and duration, and the impact on the common land was strongest when there was a comprehensive demand from outside (fuel wood for the salt works and mining industry, hunting ground for noblemen).

From the 14th century, village population increased more rapidly due to the immigration of miners, craftsmen and workers who were either landless or owned only a small portion of land. They did not share in obligations, nor did they take part in the benefits offered by the utilization of the common land. This inequality caused several problems because the old established residents wanted to exclude the migrants from participating in the common land. The problems were handled differently. In some communities the migrants got the full right to participate, in some they were left out.

Even though there were legal regulations (1871, 1883) governing common land, farmers who were entitled to benefit from the commons continued to engage themselves in the duties of the commons, either fully or partly. In many cases farmers took on the financial burdens of the administration of their communities or covered particular demands, such as the nourishment of the underprivileged or the preservation of bridges and roads. In other communities *Agrargemeinschaften* offered particular help to the community such as transport and work free of charge. Even at the end of the 19th century these benefits were offered as traditional services taken over from the predecessors. In the course of time these services were called voluntary services and at least passed into the financial responsibility of the communities (Johann, 1983b).

The present organization of commons does not differ remarkably from the time of their establishment. *Agrargemeinschaften* are decentralized corporations under public law and thus self-governing. It is their legal obligation to manage their commonly owned lands sustainable. Administration and management of *Agrargemeinschaften* are performed through their executive bodies which are the Plenary Assembly, the Management Committee and the Headman. All regulations related to

Agrargemeinschaften are found in the respective Austrian Federal skeleton law and the detailed legislation of the Federal states (i.e. Vorarlberg 1951, Salzburg 1973). The regulations cover the orderly management and use of commons by a majority of owners, and the procedure for dissolution of *Agrargemeinschaften*. *Agrargemeinschaften* are self-governing bodies entitled to decide all their internal matters autonomously and self-responsibly. However, they are subject to supervision by the *Agrarbehörde*. The *Agrarbehörde* can: decide on the existence of a certain *Agrargemeinschaft*, rule on shares and ownership relations, regulate or separate *Agrargemeinschaften*, settle disputes, examine the *Agrargemeinschaft* decisions, cancel illegal decisions, approve the alienation, encumbrance or mortgage of commonly owned parcels, and approve the alienation of shares (Herbst, 2004).

Objectives and tasks of management

The idea of sustainable management of forests and pastures is a tradition many centuries old in the Austrian Alps. However, it is in the commons-related legislation that this idea was first laid down. Today's clear legal basis and strict system of law enforcement reflect the overall significance attributed to appropriate management of the *Agrargemeinschaften*.

Economic measures

Laws and orders dating back to the 13th century prove the responsible local planning and management of the environment particularly the allocation of woodland and pastures as well as the management und utilization of forest land. It was a customary law developed by the commons and locally differentiated and adapted to the demands and the needs of the shareholders (Johann, 1983a, p. 106). Standard was the annual consumption of the farmstead. Villager's acts tackled fuelwood and timber harvesting, the collection of litter and forest grazing. Limitations were enacted with regard to the amount, time, location and kind of utilisation and control. Manual work often was practised cooperating by the shareholders and was controlled by members of the *Nachbarschaften* (management committee) or an employed forester. The kind of harvesting was adjusted to local conditions. On the plains such as those in Lower Austria clearcuts were preferred in coppice forests and in coppice forests with standards with rotation periods from 7 to 25 years. In mountain regions such as those in Tyrol, selection systems (single tree felling modified to the required diameter) were used. The allowable cut, and the number of cattle, sheep and goats tolerated in the forest depended on the available resources that means the size of the common land and the number of villagers entitled to rights. Young stands were excluded from grazing, and slash and burn activities were limited with regard to duration and site.

A variety of measures were undertaken to preserve the resources and avoid over-utilization, for example by too many cattle, the wrong time, or the wrong kind of forest grazing. Because cattle were the most important source of income for the farmsteads and were indispensable for producing manure, these measures were of great importance and required the agreement of the whole *Nachbarschaft*. In case of a shortage, often caused by the increase in population, the annual amount had to be reduced. In some cases the restrictions only concerned specific products such as timber, while fuel wood was not limited. In the second half of the 19th century these restrictions were confirmed by law (*Allgemeines Bürgerliches Gesetzbuch*) and were specified in some Federal provinces (Vorarlberger Gemeindeordnung 1904). The general aim was to secure the sustainable maintenance of the local resource for future generations. It was well accepted by the old residents but sometimes questioned by the migrants who were not entitled to rights. It resulted in a breach in the traditional practised principle of participation and shared responsibility.

Protective measures

The protection of cultivated land and settlements against natural hazards, such as avalanches and torrents, was one of the main tasks of the commons. Agreements based on local customary laws give evidence of the cautious handling of the resources and the respect for nature. The first protective activities aimed at safeguarding cultural land along streams and torrents. In the Austrian Alps constructions to protect the riverbanks have been proved since 1277 along the river Talfer in South Tyrol (Killlian, 1994, p. 454). In the course of centuries, commons developed several techniques to avoid floods and other impacts on common property. Bans on parts of the forest surface considered to fulfil specific protection functions, referred to fuelwood and timber harvesting, forest grazing and litter collection (branch and soil litter). Some tree species received special attention and protection and were excluded from utilization when needed for specific purposes. This holds particularly true for

larch and alder growing along the river banks because they were required for protective constructions. Since the Middle Ages protection forests were dropped out of utilisation by a considerable number of commons in all parts of Austria. They were excluded from general utilization and reserved to protective measures carried out by the commons[2].

Present missions

Although regulations and structures of these *Agrargemeinschaften* in most cases are more than 100 years old (though regularly adapted), their economic and cultural values are important today: on the one hand, large areas of land which would not otherwise be managed because of their low economical value are being managed because they are commonly owned, on the other hand there are multiple synergetic effects of common management by saving time, labour and resources.

One of the main contemporary functions of the commons is to use the land carefully for timber and fuelwood harvesting and for forest grazing. Thereby two goals are aimed at: the sustainable maintenance of the common property, and the maintenance of the cultural landscape by also considering the public interest. At present, for instance, there are a variety of social demands that forests have to fulfil, such as recreation and protection, which can only be provided by sustainable and careful forest management. Over the last few years this responsibility has increased, and in some Federal provinces also the protection of nature becomes one of the management tasks of commons such as the management of areas being significant with regard to biodiversity. *Agrargemeinschaften* are important economic factors in the rural areas of the Austrian Alps. They generate considerable income that is mostly re-invested in conservation and possible improvement of the common property. The Plenary Assembly may, however, distribute income to the shareholders according to the shares held (Herbst, 2004).

Discussion: what we can learn from history

The campaign for participation

Agrargemeinschaften fulfil a variety of functions, but foremost enable farmers' subsistence in the harsh conditions of Alpine mountain valleys. Shareholders could use their common property in a sustainable way, within the framework of annual allowable cuts and bearing capacities. However, as the area of cultivated land could not be increased by other means, there was pressure to clear forest land. This was strengthened by: increasing population, increasing demands for wood by the mining industry and timber trade, and the market. As the crop yield hardly met the local demand the required cash was only guaranteed by livestock breeding and the selling of cattle. Villagers increasingly campaigned for participation in the traditional rights. Two factors aggravated this: on the one hand there was a strong pressure from inside the community, mainly caused by a growing population and an increasing shortage of available agricultural land, and on the other hand there was a strong pressure from outside the *Nachbarschaft,* particularly caused by government and industry. The conflicting interests between agricultural use of the forest surface on the one hand, and the handling of the forest as the main source for the production of energy on the other hand, resulted in the destruction of the common woodlands in many cases and regions. In 1890 an eye-witness gave evidence of the deserted state of common-owned land and the decrease of participatory responsibility. Management plans did not exist or were not taken into consideration by the shareholders when utilizing the woodland (Dimitz, 1890). Common property and its sustainable management were looked upon as nothing but a theoretical ideal. The Management Committees being responsible for proper business management of the commonly-owned assets had neither the required authority nor the independence needed to oblige the members to practise conservation and sustainable management (Österreichischer Reichsforstverein, 1882). Most frequently the bad shape of the common land could be observed when ownership structures were under discussion and not clearly defined. These problems could only be solved by legal intervention and clear solutions with regard to ownership and the definition of administrative responsibilities. When over-exploitation and even devastation of common lands had reached an intolerable extent a special supervising authority was installed in 1883. This law, mentioned earlier, was also the basis that commons have remained self-governing bodies till present day.

[2] Source: Archive FV Lainach: 1684, 22. 4. : Pflegschaft Stall Protokoll- und Verlackbuch

What can we learn from history? The way a society tries to establish an interaction with its environment depends on the social and economic position of the population. Within a certain type of society there are different demands with regard to the type and extent of forest utilization and there are also differences between interest groups within that society. For the sustainable management of common land self responsibility (governance), participation, social fairness, balance of supply and demand, and a low increase of population (surplus demand) are of major importance.

Today commons bear a certain degree of social responsibility within the local community. Although communities and *Agrargemeinschaften* generally collaborate well, and the management committees act in the interest of the commons as well in the interest of the whole community most of the time, the campaign for sharing the benefits of common land has been recently stirred up again. The focal point is not participation in forest and woodland utilisation, such as timber harvesting or grazing, but to have the land at the community's disposal. Mayors and political representatives of certain communities in tourist regions (above all in Tyrol) argue that the fundamental idea of *Agrargemeinschaften* to safeguard the livelihood of the entitled farmers is no longer relevant. They argue that only one quarter of the shareholders would still earn the living from farming but all benefit at the expense of the community. They question how commons could own forests, pastures and even mountains and valleys whereas present-day communities with an increasing population do not own the land. At present a passionate political discussion is taking place, particularly in Tyrol, to modify the old laws and facilitate access to common land. The communities claim on the common land results from demands on them for the construction of roads, mountain bike routes, cross county skiing facilities, sports grounds, ground for the construction of buildings and access to springs and water-resources. The promoters of this change do not take into account, that the cultural landscape, which is the result of mountain farming, is the basis for the region's attractiveness and additionally offers a high cultural and spiritual value. However as landscape is considered to be public good, it has no calculated price, although tourists as well as residents benefit from the ecological management. The promoters do not take into account the knowledge which can only be gained from history: that disputes about shares in utilisation and uncertainties about ownership have always encouraged the destruction, or at least the over-utilization, of the landscape.

Potentials and limits of self governance and participation

It seems important to mediate between the parties in the contemporary arguments and make clear that the value of agriculture and forestry can not be regarded in its primary function only. On the contrary, agriculture and forestry has to be emphasized strongly within the context of regional planning. Regional plans should maintain the cultural landscape as a whole, thereby pointing out the social and economic importance of agriculture and forestry (Thöne, 1997). It has to be an open process considering not only the demands of all residents in a specific region but also inviting them to participate actively. Open discussion should formulate the main targets including all fields of public interest such as traffic, nature protection, watershed management and land use planning. It has to take into account the demands of future generations with regard to social, economic ecological and cultural dimensions, which are the key elements of the sustainable development of landscapes in the future. Sustainable utilisation of the resources therefore aims to balance the different interests and prevents irreversible utilization. Open participation in the planning process should strengthen and re-stimulate the cultural and social identity of the population concerned (Hellbart, 1999, pp. 12-14).

Traditional lifestyles having shaped the cultural landscape in the past are declining at present. Therefore new activities have to be substituted in order to maintain and utilize these cultural landscapes in the future. Several ways can be found. One of them leads to the establishment of a historical park showing the traditional forms of agriculture, arts and crafts, woodland management and architecture. A more constructive way is the creation of products with synergistic effects, such as the combination of the maintenance of endangered biotopes and hiking, orchards with ancient species, and the production of wine and brandy, the cultivation of hedges and woods combined with biological agricultural management activities. However the questions is whether this will be enough to maintain the sustainable management of the cultural landscape, which should be more than woodland (Lukesch, 2000, pp. 141).

The local political culture decides on the accomplishment of new challenges, it encourages or holds it back. Many communities only partly use the potentials of its citizens. Mobile groups within the society show only a little interest in local policy because they do not rely on the local resources. With a growing population the close connection between citizens and community is decreasing. This

development is influencing the framework of the local community which depends in many cases on the voluntary services of the citizens for responsibilities as the fire brigade or water management. Communities are challenged to support the identification of the citizens (old and new residents) with the living space. The regional level is a challenge and a chance for cooperative activities of *Agrargemeinschaften* and communities (Rest-Hinterseer and Marchner, 2005).

Conclusion

Traditional *Nachbarschaften*, later on called *Agrargemeinschaften* are characterized by certain features which envisage their outstanding importance in the future. The structure of the commons is still evident and can be illustrated by the following strong points: social fairness, considerable reduction of the misuse of power by adequate internal rules, economic principles, and the priority of local influencing factors compared to global ones. The model is based on the participatory interaction with nature and inhibits harmful impacts. In participating in the administration and management of the close surroundings in particular the wooded area, *Agrargemeinschaften* take responsibility for the shaping the landscape and the sustainable protection of its natural resources.

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INTRODUCING TRADITIONAL KNOWLEDGE IN SUSTAINABLE FOREST MANAGEMENT: THE GUIDELINES DEVELOPED FOR THE MINISTERIAL CONFERENCE ON THE PROTECTION OF FORESTS IN EUROPE

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Abstract

European forests have been shaped by millennia of human influence that have affected all their features. They represent a fundamental part of the cultural heritage of the continent. Socioeconomic development, the abandonment of marginal lands, re-naturalization, and inappropriate policies are rapidly erasing cultural values and contributing to the globalization of cultural forest landscapes, often simplified into areas either managed for commercial exploitation or areas left to natural evolution. Although, timber production is regulated and the ecological functions and natural values protected by a number of EU directives, cultural values and related traditional forest knowledge are not preserved by specific European initiatives at management level, nor included in certification standards. After many decades official forestry is finally recognizing the importance of cultural values. The Ministerial Conference on the Protection of Forests in Europe (MCPFE) has developed an agreement with IUFRO research group, Forest and woodland History and the IUFRO Task Force on Traditional Knowledge in order to produce guidelines for the conservation of cultural, historical and landscape values in Sustainable Forest Management, implementing the Vienna Declaration 3 of 2003. The guidelines try to integrate the conservation of cultural values and related traditional knowledge in rural development and the management of protected areas, developing strategies and actions at planning level and management that can be included in the forest policies of member states. The guidelines include also a list of indicators that can be added in the existing list of indicators for SFM produced by MCPFE. Several experts from various countries have contributed to the preparation of the document, as well as international institutions such as UNESCO, Council of Europe, World Bank, United Nation Forum on Forest, European Environmental History Society. The paper is a summary of the document submitted to MCPFE and describes the main approaches presented in the guidelines, the author is the coordinator of the group of international experts that produced the document.

LOCAL CONCEPTUALIZATION OF NATURE, FOREST KNOWLEDGE SYSTEMS AND ADAPTIVE MANAGEMENT IN SOUTHERN CAMEROON

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Abstract

The paper examines the relationships between local conceptualization of nature, forest knowledge systems and adaptive natural resource management practices in Southern Cameroon. The results show that the concept of nature is well embedded in the social representation of the vital space of the people of the study area. Three forest management knowledge systems derived from this conception of nature that put together the space, the time and the surnatural. The results show that these perceptions are bipolarized including one relationship towards God and another involves the combination of social systems and natural resources systems and their entities such like trees, animals, fishes and water. Moreover, the results show that the transition of climate in term of seasonality determine the dynamics of local bio-ecological knowledge at the spatio-temporal scale. This local concept of nature and their local knowledge systems affect forest management and agricultural practices in term of understanding and interpretation of states of nature where human activities will take place. Far from 'romanticizing', while the local knowledge and practices of natural management and their contribution to community livelihoods and conservation of natural resources, these results confirm the existence of cognitive background of local knowledge systems supporting the implementation of adaptive forest and natural resources management (NRM) practices.

Introduction and Background

Conventional management of forests and natural resources (NR) in the tropics has been dominated over the past decades by a segregation approach. This approach has sought to separate forests and agriculture spatially, administratively and conceptually into two separate units for management and research (GEF, 1993; Garrity & Bandy, 1996; Instone, 2003b). Impacts of field processes resulting from this approach on sustainable forest management outcomes remain weak, limited and localized (Diaw et al., 1999). One key reason for this state of affairs is the weak integration between science, policy and management practices (Holling, 2001; Ruitenbeek & Cartier, 2001; Prabhu, 2003). These three components are described below as follow: (i) scientific knowledge is a critical input to inform policy and natural resource managers to facilitate progress and change (Funtowicz, 1999). However, the main approach towards acquiring scientific knowledge and development of sustainable forest and natural resource management outcomes remains based on the prism of Western orthodox view and on their segregation approach of human-nature relationships (Sinclair & Walker, 1998; Haïla, 1999); (ii) forest policy formulations have been dominated by global thinking. Forest, deforestation, biodiversity, slash and burn agriculture and recently climate change which are the expressions of global environmental narratives (Helms, 2002; Instone, 2003b), have not yet been translated to integrate social representation of forest, local practices and their knowledge systems, and the dynamics of local institutions (Fairhead & Leach, 1995); (iii) management practices are dominated by the conflict between technical versus local practices. Technical forest and natural resource management options tend to overshadow local forest management practices and ecological knowledge on which rural communities base their survival and livelihood strategies (FAO, 1999).

In the humid forests of Central Africa and particularly in Southern Cameroon, these technical managements are focused on sustaining the agricultural and forest productivity for only for commercial and environmental perspectives (Mala et al., 2005). The opposition between mono-cropping and mixed cropping farming systems, technical land use management plan and traditional land use system, local and modern crops and trees species dominated the thinking around the innovations of management practices of forest and natural resources (Armitage, 2003). These result on weak socio-ecological fitness. In addition, these innovations overlap on the connections of different land uses and on local agro-ecological knowledge determining the adaptive capacity of local management practices at spatio-temporal scale. For example, innovations in forest management such like community forest with their simple management plan overlaps on community managing forests and on agricultural landscape mosaics in terms of institutions of tenure and cropping-fallow-forest conversion cycle (Dounias, 1996a, 1996b; Diaw, 1997; Diaw & Oyono, 1998; Vermeulem & Carrière, 2001).

Some of the failures of many technical management approaches in the tropics occurred because there is a gap in mutual understanding when people with different world views are working together on a common issue. Despite, the recent recognition and relevance of local ecological knowledge as an asset for sustainable forest management outcomes, their integration remains weak in the design of research and local management processes (Joshi et al., 2001). To properly address this gap, an integrated conceptual approach is needed. In fact, local management practices of forest and NR are the results of the interactions between culture, history, society, environment and socio-economic context, have not yet been properly examined to capture the cognitive bases of knowledge systems supporting adaptive NRM practices. The conceptualization of nature by people in the study area is based on the world-views, philosophy of life and beliefs (Mviena, 1970; Laburthe-Tolra, 1981; Diaw, 1999; Oyono, 2002). The local representation of world is made by the spiritual world and terrestrial world including human and natural (Figure 1).

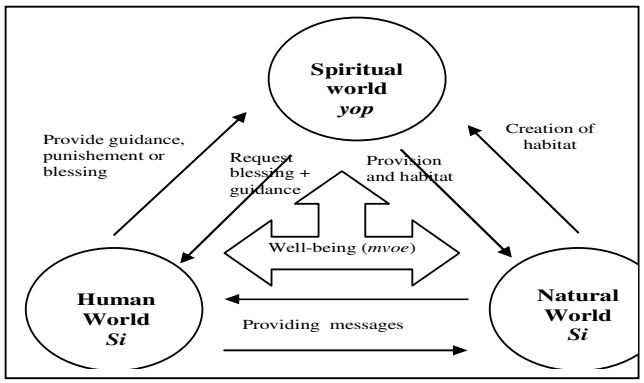

Figure 1. The Bantu's conception of nature
(adapted from Gonese, 1999; Haverkort & Rist, 2004)

With this in mind, we asked ourselves: What are the local conceptions of nature within the people of Ntem-Sanaga region? What are the relationships between the components of these conceptions of nature? What are the perceptions of forests and knowledge systems derived from them? How do they affect forest management and agricultural practices? This paper examines the relationships between local conception of nature, forest knowledge management systems and adaptive forest-agriculture practices.

Methodology

Description of study area

The study was conducted in humid forest zone of southern Cameroon within the forest margins benchmark (FMB) that has been designed by Alternatives to Slash and Burn Programme (Gockowski et al., 2005). This benchmark area delineated research and development domains on the basis of

resource use intensification and demographic density in three blocks (low=Ebolowa; medium=Mbalmayo; high=Yaoundé). The socio-economic and biophysical characteristics of the study area are well described (Gockowski et al., 2005). The habitants of this study area are Western Bantu forest dwellers who practicise shifting cultivation and the study area fully corresponds to the description of the physical and cultural area extending from the Sanaga to the Ntem and Woleu rivers in the Southern Cameroon, Northern Gabon and Equatorial Guinea, and to emphasize its cultural and linguistic coherence (Diaw, 1997).

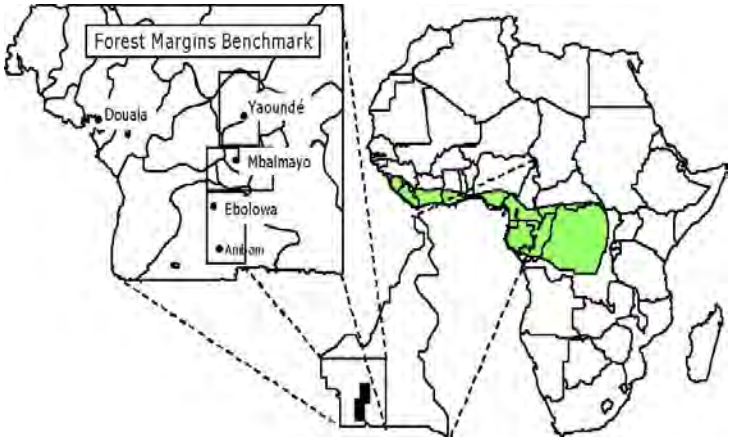

Figure 2. The ASB forest margins benchmark area in southern Cameroon (Gockowski et al., 2005).

Sampling methods

Six villages were selected within the humid forest benchmark of Southern Cameroon, equally distributed between the three blocks along a resource intensification use and population gradient. Focus groups of 15-20 persons were organized in each village, to capture the representation of their vital space and general discussion on concept of nature, perception of forests and local knowledge and NRM practices. 10 persons were selected per each of the six villages for individual interview based on the advices of villagers (internal socio-diversity in term of number of clans/lineages, knowledge of the history of the villages, balance in representation of age (old, adult and young), gender and user groups (such as hunters, fishermen and “artisanal” loggers).

Data collection

Semi-structured questionnaire divided in two broad sections and managed in three rounds: (i) First round with focus discussion groups per village generated agro-ecological map with several layers of information: positioning of all the rivers and streams with their courses; cocoa plantations; different forests and fallow stages and current mixed food crop farms; hunting and fishing areas, sacred places; places for collection of non wood forest products (NWFP); (ii) Second round with individual interviews, the data were collected on: components of the vital space; relationships between society, natural world and spiritual world; perception of forests and how its components affect livelihoods, its major uses and resource management practices; social and economic functions of forests; local classification of forests with their main activities; local agro-climatic and time management knowledge systems affecting forest and NRM practices; (iii) Third round with focus groups at village level was organized for general discussions followed by their validation of information with a large group. The discussions were made around: identification/names of local indicators for the description of forests, classification of forests; management of time, and to respond and clarify with the whole group to pending questions that were found about the individual interviews. Each focus group discussion took three to four hours because some discussions among village members took a long time before a consensus could be reached.

Data analysis

The discourses of respondents have been transcripted and organized by clustering data into meaningful information. A Matrix was developed to deconstruct the discourse of respondents on the

concepts of nature guiding the management of local knowledge of forest management; Extracts of respondents' discourse that brought out some generalizations of the perceptions, beliefs and the ideological values were identified. Traits relating to local perceptions of forests were characterized based on the aggregation of markers of the discourse. These markers were either for utilitarian uses, functional and representative descriptors of the forest perception. Thereafter, for each marker, some element of perceived distance between the forests, its utilizations, and its socio-economic functions was assigned and a percentage of farmers responding were assigned to each of them. Cross-checking of similarities and contradictions were made through the identification of indicators by type of markers of forest classification, tree and animal names, relationships between trees/animals, management of time and management of natural resources.

Results and Discussion

Conception of vital space of the people of Ntem-Sanaga region

The conception of nature is based social representation of vital space (*dza'a*), which is spatially structured from the household or family (*nda bot/mvôg*) to the village territory (*dza'a*), as one entire global system. It emphases the integration of six components: household combining the house plus man house (*n'da*, *aba'a*), court (*n'seng),* bin (*akun*), private zone (*fa'a*), agricultural lands (*ekotok* or *ekorog*) and the forest lands (*afane*). Each component is defined and delimited, as well as their social meanings, their forms and their uses. These relationships are presented in details in Table 1.

Table 1. Representation of the vital space of the people of Ntem-Sanaga region

Component	Local names	Social meaning	Forms	Uses
Household House + Men house	*nda*	Symbolize freedom within the house	Rectangular	Private house, habitation of wifes, kept the important goods and tools for hunting, fishing and agriculture. Bedrooms for sleeping and preparation of food
	aba'a	Derived from *aba* meaning both to dismember and to carve	Rectangular	Social and public area where bushmeat captured or domesticated animal killed is dismember and shared, where timber is carve, basket work is weaved; Area of education and information where young acquired the knowledge of traditions via proverbs, tells and epics; Area where customary court is hold to solve conflicts and others social problems; Social place for family council and palavage.
Court	*n'seng*	Derived from *aseng* that means to welcome guests	Uncovered and clean soil	Social meetings, ritual ceremonies, games and festivities
Bin	*akun*	Derived from *akune* meaning spoil	No particular form	Gabbages are dropped; the richness of its humus is suitable to plant plantain (*Musa spp.),* wild peper (*Capsicum spp.*) and others horticultural crops. It is more or less the home garden.
Private zone	*fa'a*	Derived from *afack* that means both to dig and penetrate	No particular form	Private zone where the secrets of the family or the village are buried or hidden. The area is often cultivated by fruit trees.
Agricultural lands	*Mesi bidi and ekotog*	From *akore* that means leave to come back later	No particular form	Area where land is cultivated to cover the food needs and income generation
Forest lands	*afane*	Derived from *afane* that means narrow focus	Diverse and changing forms	Area where hunting/trapping and fishing, collection of non wood forest products, rituals and collection of medicinal plants are conducted

Characterization of the relationships between the components of vital space

Four categories of natural resources management knowledge of landscape affecting human activities have identified. These categories include markers of local perception of space such like forests and agricultural lands and its biodiversity agricultural lands, animals and rivers. Each category of NRM provides message for human, which serves to build the maintenance of communication channels. The links with interpretation of natural phenomena, capitalization of practices and utilizations of references for food consumption, house building, medicine, rituals and human names. These relationships are presented in details in Table 2.

Table 2. Relationships between components of vital space representation

NRM categories	Messages provided to human systems	Maintenance of communication channels	Benefits to Human and Natural systems
Forests and agricultural landscapes (Trees and food crops)	Behaviour, physical qualities; Ecological and biophysical responses to climate stress; Attacks by animals and humans; their uses	Regulation in use and maintenance of use; Domestication and cultivation space markers	Human names derived from such knowledge such as trees (*Bile*), forest (*Afana*), *Gnetum spp.*(*Okoa*), stone (*Akoa*), etc.
	Agronomic performances and qualities; Yield and resistance to pests-diseases within crops and comparison among crops in terms of quality of crops; and food taste and qualities	Cropping and farming practices	Crop varieties are given names which are symbolically charged and transferred them a 'spirit' to produce high and quality yields. Wild fruit trees such as *Dracryodes edulis* and *Persea americana* are given names that reflected the abundance and the quality of their fruits
Animals	Behaviour, ecology, biology of reproduction and representativness vis à vis other animals Insects movements	Domestication, hunting, trapping, consumption for good health and protection against certain diseases	Animal names are given to humans such as panthers (*Ze*) and elephant (*Zoa*), etc… Natural phenomena names such as the transition from one season to the other such as dry season (*esep*) are linked to the movements of animals and insects such as termites, birds, butterflies…etc, on one hand, on the spread of human diseases, on the others
Rivers	Behaviour of rivers and their content, quality of their contents, abundance of specific fishery products and others indicators of animals	Fishing; Space marker	Rivers names are linked to local knowledge of bio-indicators of the dominant fish species or niche of animals or other social events Humans received the names of some fish products
Lands and hills	Complexity of nature and ecological niches	Uses and markers of lands and spaces	Lands, hills, mountains are given names to maintain communication channels and names are also given to these resources such like toponyms

Local perceptions of forests and natural resources management

Three markers and seven categories of perceptions on forests and natural resources have identified from interviewer discourse. These markers are described as follow: (i) forest perception based on descriptive markers such like forest types or lands resources (Mesi); (ii) forest perception based on practical/utilitarian markers such like gift of life, source of human well-being activities, tool for time and weather management; (iii) forest perception based on symbolic/representative markers such like gift of God, mystery, hide-out and shelter. The very high distance between forest perceptions, its uses, socio-cultural and economic functions are related to animals and plants species, and Creator (90%) and food (80%) and source of income (75%). The details of these results are presented in Table 3.

Table 3. Local perceptions of nature and forests resources management

Markers of the perception on nature and forest	Content of markers	Perception of distance between forest, its uses, its socio-cultural and economic functions	Percentage of responses
Descriptive	Forest types or land use system (*Mesi*)	Animal and plant species	90
Practical/utilitarian	Gift of life Source of human well-being activities Tool for time and weather management	Labor Food Raw material/House building Income generation (money) Hunting Fishing	40 80 55 75 40 30
Representative	Gift of God Mystery /hide-out/shelter Fear	Creator Creation Witchcraft	90 75 65

Local knowledge systems of forest dynamics and associated NRM practices

Several local knowledge systems are related to the description of the states of forest dynamics. These states are organized in five broad types of forest ecological successions and included: (i) virgin forest (afan adam) which is a place where, in the collective memory, there have never been human conduct and there is no presence of indicators of human disturbance; (ii) old secondary forest (mbiam); (iii) secondary forest (nnom ekotog); (iv) pre-secondary forest fallow (ekotog); (v) young fallow (nfefe ekotog). Each category differs from the other by a single or several socio-ecological, bio-indicators and/or associated with NRM practices. The details of these results are presented in Table 4.

Table 4. Local classification of forest land use, socio-ecological indicators and NRM practices

Categories of land use	Socio-ecological descriptors	Associated NRM practices
Virgin forest (*afan adam*)	Total absence of indications of human disturbance ; Big size of animals; Abundance and diversity of animals	Commercial hunting or trapping ; Collection of specific commercial NTFPs
Old secondary forest (*mbiam*)	Big size of animals ; Abundance and diversity of animals; Far away from the villages ; Few indicators of activity such as 'huts' for seasonal migrations ; Presence of isolated old oil palm trees (*nfon alen*) ; Presence of *Irvingia* spp and *Cola acuminata*	Commercial food-crop agriculture with *Cucumeropsis manii* or *Musa* spp ; Commercial hunting/trapping Collection of NTFPs
Intermediate secondary forest (*nnom ekotog*)	Abundance of mature oil palm trees; of *Musa* spp and *Macaranga* spp, of rodents and other small mammals attracted by the farming activities	Commercial food crops agriculture such like with *Cucumeropsis manii* or *Musa* spp; Domestic hunting and trapping; Intensive collection of *Raphia* and palm tree wines
Pre-secondary forest fallow and/or young fallow (*ekotog-nfefe ekotog*)	Abundance of seedlings and young trees of oil palm *(Eleais guineensis*), of *Chromoleana odorata* in agricultural land closer to the villages, of Maranthaceae in agricultural fields distant from the villages. Dispersed presence of food crops such as *Musa* spp and *Cassava* spp. Abundance of rodents and other small mammals attracted by the farming activities	Food crop agriculture where indicators of fertility are abundant ; Intensive collection of Raphia and Palm tree wines; Intensive collection of NTFPs ; Domestic trapping

Local agro-climatic and time management knowledge systems affecting NRM practices

Three broad categories of time management - parts of a day, moon cycle (*ngon*) and year of activities (*mbu*) - are organized in 4 seasons (Table 5). For the last one, its two outcomes are bioecological cycle, and agricultural and forest resources management calendar. These categories are described as follows: (i) Moment of a day breaks the time in a 24-hours day. It is organized into four main moments: morning (*kikirigi*); mid day (*zan amos*); evening (*ngegole*); and midnight (*zang alu*); (ii)

Moon cycle also affects the human activities and determines the management of natural resources and the farming practices when it is full or middle full; (iii) Four seasons of the year (*mbu*) derived from main dry season (*esep*) and short dry season (*oyôn*), on one hand, the main rainy season *(sugu-oyôn*) and the short rainy season (*sugu-esep*); this division of time affect agricultural, gathering of forests products, hunting and fishing, and livelihood strategies. For this last description of time management, the details results are presented in Table 5.

Table 5. Relationships between seasonality knowledge and local natural resources management activities

Main Seasonality category	Seasonality classification	Local name	Type of indicators	Associated activities by gender	
				Men	Women
Dry season	Short dry season	*Oyôn*	Presence of caterpillars Abundance of wild fruits	Forest clearing Trees felling	Harvesting of food crops Patch clearing and cultivation of food crops farms Harvesting and commercialization of forest products
	Long dry season	*Esep*	Movement of insects, birds and wildlife Falling of tree leaves	Forest patch clearing Hunting of small rodents	Traditional fishing
Rainy season	Short rainy season	*Sugu esep*	Flowering of cocoa plantations	Maintenance of cocoa plantations	Intensive farming activities and harvesting of food crops Harvesting of forest products
	Long rainy season	*Sugu oyôn*	Abundance of wildlife	Harvesting of cocoa Commercialization of cocoa production Intensive hunting and trapping	Support to cocoa harvesting Harvesting of food crops

The conception of nature is embedded on the social presentation of vital space of people of the study area; it is both a geographical and sociological space (Table 1 & Table 2). Each trait of this vital space has a function that affects economic, social and spiritual life of people (Mviena, 1970; Laburthe-Tolra, 1981; Bahuchet, 1996). The relationships between the natural and human worlds are the important channels to maintain interactions with the spiritual world; they contribute to the structuration of local ecological and environmental knowledge and to keep their focus in the search of common livelihood in the context where local community have used to live with uncertainty (Gonese, 1999; Ruitenbeck & Cartier, 2001; Oyono, 2002; Prabhu, 2003; Haverkort & Rist, 2004). Moreover, the results show that the local descriptions of forests and natural resources are based on the perception of the distance between forests and its socio-economic values with very high frequency for forest-tree-animals-hunting (90%), forest-food (80%) and forest-money (75%), and not only on technical definition that put forwards biophysical elements such like the size and the height of trees (Helms, 2002). Moreover, local knowledge systems of forest dynamics and forest management are correlated to socio-ecological descriptors and associated NRM practices such like trees and forests (Oyono, 2002; Sène, 2003).

These results moderate the conventional thinking on biodiversity conservation and sustainable natural resources management outcomes claiming the inability of local systems of forest management systems to rationalize their practices. However, the results show that the concept of nature and the associated local knowledge and practices are effective in the interpretation on natural processes and in management of forest resources (Tables 3, 4, 5). These results confirm the potential of concept of nature and local forest knowledge as an emergent property of complex system that requires an integrated conceptual approach (Armitage, 2003; Prahbu, 2003; Woodley, 2004). Local perceptions of nature and forest knowledge management systems are tools that affect the management systems at the forest agriculture interface. These tools guide the implementation of adaptive forest management and agricultural practices incorporating the dynamics of space, biodiversity management, time and surnatural and social institutions.

Concluding remarks

Local conception of nature is based on the social representation of vital space of the people and in relationships with their life activities. Forest knowledge systems that derived, delineated ecological, social and economical indicators of the dynamics of ecological forest successions and the level of resources abundance. Local perception of nature and natural resources knowledge systems is a tool that guides the implementation of human activities in order to warrantee a threshold of forest and forest productivity at spatio-temporal scales. There is a need to revise the way scientific knowledge is generated, policy are formulated and sustainable forest management options are designed and implemented to address complex issues such like the integration of conservation and development outcomes in Africa, were the problems still need to be addressed. Adaptive co-management and innovations systems processes are opportunities and propose an avenue to improve the integration between science, policy and management practices.

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INDIGENOUS KNOWLEDGE (IK) AND CONSERVATION ATTITUDES ON BIODIVERSITY OUTSIDE PROTECTED AREA SYSTEMS IN UGANDA: IGARA COUNTY SCENARIO

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Abstract

Global awareness of the crisis concerning the conservation of biodiversity is assured following the United Nations Conference on Environment and Development held in June 1992 in Rio de Janeiro. Of equal concern to many world citizens, is the uncertain status of the indigenous knowledge that reflects many generations of experience and problem-solving by thousands of ethnic groups across the globe. Very little of this knowledge has been recorded, yet it represents an immensely valuable data base that provides humankind with insights on how numerous communities have interacted with their changing environment including its floral and faunal resources. Igara county is located on the fringe parts of the great Albertine rift. Much of the resources are outide protected forest reserves and national parks. These resources are still abundant, not by fashin but by the choice of indigenous and traditional setting techniques. Indigenous knowledge is local knowledge unique to a agiven culture or society. It is an immensely valuable resource that provides humankind with insights on how communities have interacted with their changing environemt. IK, particularly in the African context has long been ignored and maligned by the western world, referring to local communities and their knowledge as primitive, simple and static. Today, however, a growing number of African governments and international development agencies are recognising that local level knowledge and organisations provide the foundation for participatory approaches to development that are both cost-effective and sustainable. This has been characterised by rapidly expanding data base generated by both biological and social scientists that describes the complexity and sophistication of many indigenous natural resource management systems. It is from this stand that IK's and development are complementary. It will therefore be difficult to conserve in-situ anima diversity without understanding and invigorating local institutions and embedded knowledge systems. Therefore just as cultural heritage sites are preserved as human heritage, some of the rare and endangered domesticated breeds may need incentives for local communities to conserve these even on immediate non-utilitarian ground. African countires are predominatly agriterial; therefore IK is important in taming nature. On the other hand therefore, the gender dimension of knowledge system is extremely crucial and its neglect can thwart the entire mission of conservation. Women and men had defined roles in African tradition. It is therefore imperative to understand the indigenous management strategies of farmers and other rural persons that foster diversity in domesticated and wild species to help in the establishment of national programmes for in-situ conservation so as to complement ex-situ programmes already in existence. This will uphold environmental values and sustainability system for preferred animal and plant species. The programmes, fora, conferences and think tank systems that uphold IK and Traditional Knowledge are a big boost to sustainble development in developing counties of Africa and other areas. This explains the role of intergrated conservation development programmes (ICDPs). Igara County is one of the areas that have benefited from ICDPs and multiple use concepts.

THE IMPACT OF THE INDIGENOUS KNOWLEDGE SYSTEM ON THE CONSERVATION OF FOREST MEDICINAL PLANTS IN GURUVE, ZIMBABWE

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Abstract

Since the ancient time, the forest has been the main source of medicinal plants used by the various people of Africa. Today, some medicinal plants face extinction due to the extensive use of the species coupled with deforestation caused by the various activities of humans. Too often in the past, the contributions of the indigenous people to forest conservation have been ignored or belittled. Yet, indigenous peoples control most of the world's remaining natural forest areas either consciously or unconsciously through their traditional practice and often have strong conservation ethics. This paper reports on the influence of indigenous knowledge systems on conservation of forest medicinal plants in the rural communities of Guruve district of Zimbabwe. The methods are associated with taboos and social beliefs. Collaboration among herbalists, researchers and policy makers could build the encouragement of such customary practices in the modern ways of forest conservation to ensure continued plant diversity.

TRADITIONAL FOREST PERCEPTION AND ITS RELEVANCE FOR FOREST CONSERVATION AMONG THE TIRIKI IN KENYA

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Abstract

Despite rapidly ongoing globalisation, some forests in Kenya are managed by local people in a traditional and sustainable way. The aim of this paper is to investigate intangible forest-related values and attitudes of the Tiriki. The sacred community forests of the Tiriki are described as rich in biodiversity. The study investigates cultural constructs that influence the perception and use of these forests and the role of traditional and religious practices. The main emphasis is given to contemporary connections of the Tiriki and 'their' sacred forests. Traditional and modern intangible values are investigated to understand the importance of sacred forests and to elucidate differences that distinguish these places from governmentally administered forests. Based on case study approach the following data collection methods are being applied: review of secondary material, participatory observation, group discussion, interviews. Interviews were recorded, transcribed and analysed using the software MAXqda2. The analysis of the data reveals that forest-related intangible values can be classified and hierarchically structured taking reference to Bargatzky (1986). On the highest level of abstract principles the Tiriki common spirit and the closed canopy as well as a selection of special indigenous tree species of sacred forests as cultural places can be identified. The direct protection of the forest and related practical rules are clearly stated on lower levels e. g. who is allowed to perform which activities in these forests. Further data analysis aims to derive tangible indicators of culturally appropriate forest use that may be used for the formulation of guidelines for sustainable forest management.

Background

Societies around the world differ guided by their prevailing culture[3]. Human behaviour towards forests in a particular society is guided by the prevailing perceptions of the entire environment, and is reflected by the variety of different skills and practices that exist in relation to natural resources. To understand the cultural variation among the forest users and their world views, values and attitudes it is a precondition to assess their forest related behaviours and activities to formulate appropriate and effective interventions and policies for sustainable natural resource management. That holds true in particular for transforming societies and value systems, such as in many African countries. In the past African societies viewed land as common property of the dead, the living and future generations (Omar, 1990). Forests have been perceived as useful resource but also as sacred site and cultural heritage.

This contribution intends to foster the understanding of cultural relevance of different forest types among the Tiriki. Their villages are found in vicinity to the last residue of a tropical rainforest the

[3] The concept of culture is not clearly defined from the perspective of natural resources management related disciplines. Therefore, brief definitions shall be provided here. According to Haviland (1993) culture is defined as: "Often unconscious standards by which societies – groups of people – operate". Seeland (1997) adds that "The amalgamation of both local resources and their mobilisation through social cognition and institutions at distinct local levels is what culture means". Haviland (1993) stresses the importance of religion as a core element of culture. According to Griswold (1994, p.50) religion can be understood as "the system of ideas by which people represent their society." Finally this pre-existent design in our minds, transmitted across generations in the form of received conceptual schemata, and manifested physically in the artificial products of their implementation, is what commonly is known as 'culture' (Ingold 2005).

Kakamega forest. Located at an altitude of about 1600 m with two major hills looming inside and two large river systems passing through, the Kakamega forest has been fragmented to varying degrees due to continuous human impact during the last decades. Nowadays the forest constitutes an ecosystem of mosaics of secondary forests with different size, structure and distances to each other (Althof 2005). The south eastern part of Kakamega forest, where the Tiriki live, is administered by the Kenyan Forest Service and shows clear signs of overuse and degradation (Bleher et al., 2006). Yet, more than 40 smaller, species rich (Onyango J.C. 2004) and obvious less disturbed "cultural forests" of the Tiriki are situated in the same densely populated area south-east of Kakamega forest (see Figure 1).

The aim is to investigate the ways in which the Tiriki perceive and value aspects of the local landscape, particularly forests, and how this may ultimately influence environmental behaviour and forest use. Therefore, this case study will address the following questions.

- Which differences exist in the perception of governmentally administered forests and local sacred forests?
- How relevant are the forests for which part of the local cultural concept?

Methodology

In view of little existing knowledge about the meaning and influence of spiritual perception of forest use in Kenya this study adopts a qualitative-explorative research approach. The methods include different types of qualitative interviews, group discussions, participant observation, documentation of the study sites using photographs, and the review of secondary materials. Primary data have been collected during a four month field research in 2006 and 2007[4].

The investigation itself has been conducted in form of case studies (Yin, 2007) on two analytical levels. To be in accordance with the investigation area forms the higher-ranking level. It is characterised by the diversity of forest related traditions and behaviour, cooperation of local people and existence of secondary data material. Within the investigation area case studies on the level of individuals in their social environment have been conducted.

Key players

The Tiriki form one of eighteen sub-tribes of the Luhya, one of the major tribes in Kenya. The Luhya are farmers and traditionally settle around Kakamega forest. In the past while all other Luhya tribes managed the forest on a clan basis for the Tiriki was clan unity of secondary importance. Age groups (warrior, senior warrior, judicial elder, ritual elder and aged elder) have been the most important social categories. Membership in local councils was determined by age grade and not by clan affiliation (Opole, 1992). Rituals were performed in the community rather than on clan basis, with blessings sought from ancestors of a certain age group. Circumcision rituals were organised by the whole community and not by single clans. With regard to the natural resources all initiated Tiriki were allowed to occupy and manage unused parts of the land. After demarcation of the Kakamega forest by the colonial government in the early 1930's, traditional boundaries have been removed. This drastically reduced the power of traditional authorities. During that time the Tiriki community started to develop and conserve the present "sacred forests" (Opole, 1992) whereas the government manages the Kakamega forest up to date.

Following the principle of maximal contrast the interviewees have been chosen to represent varied demographic, socioeconomic and world view backgrounds. By no means only Tiriki were interviewed. Local governmental authorities like chiefs and foresters were also included to obtain a holistic picture of the local forest perception.

[4] The results presented in this paper are part of an on-going PhD project on "Stakeholder Value Systems, Attitudes and Acting - the case of forest management in Kenya" at the Institute of International Forestry and Forest Products, Technische Universität Dresden.

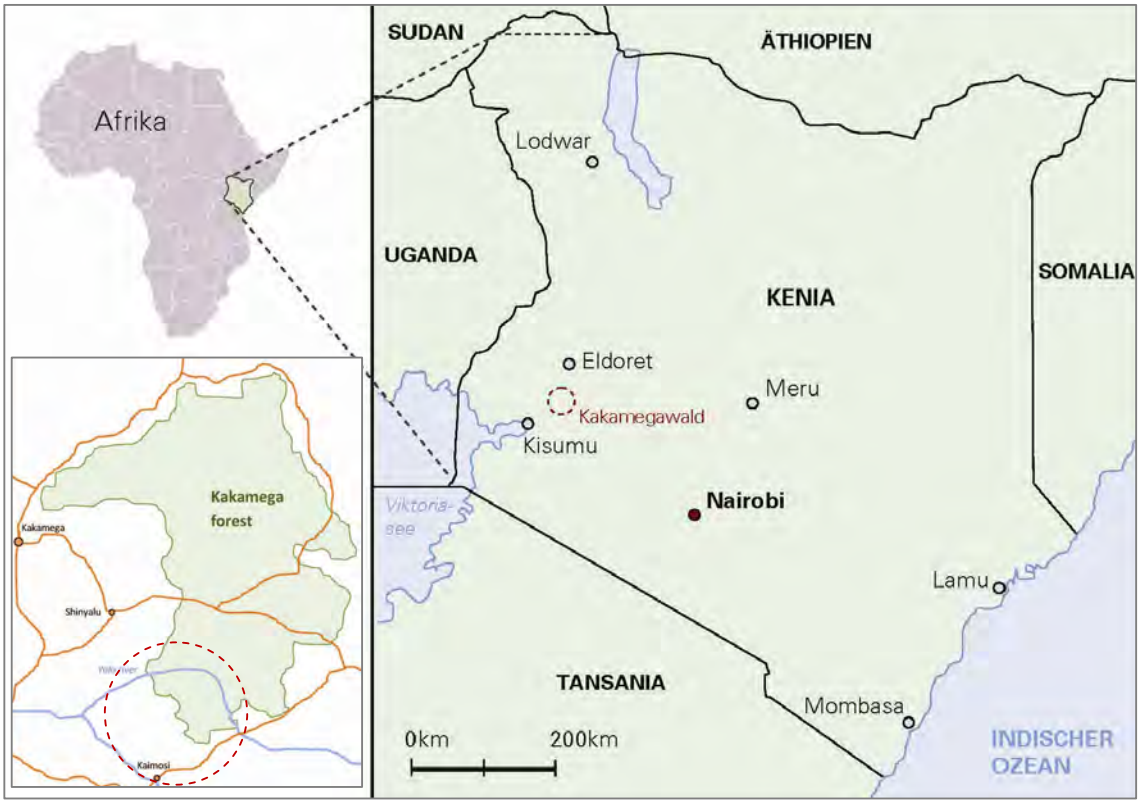

Figure 1. Location of Kakamega forest and investigation area.

Results and Discussion

The Tiriki perceive clearly visible and more hidden differences between the two forest types. We were especially interested in the question why participants differentiated between the two forest types. The obtained categories are summarised in Table 1.

The cultural forests are described to vary in size between 0.5 and 8 ha. They generally consist of indigenous tree species such as Musutsu (*Croton macrostachyus*) or Mutere (*Maesopsis eminii*). Numerous trees are said to be more than 100 years old. Since for traditional circumcision ceremonies water is required, the cultural forest sites are normally situated in valleys. In order to be useful for circumcision ceremonies, the forests need to be densely stocked, so as to provide a good shelter and hiding place for the boys during the circumcision and initiation time, which nowadays lasts four to eight weeks, and which is practiced every 5 years.

Nearly all of the 43 cultural forest sites are hold as trust land, which is administered by the local authorities (Count Councillor) in more or less close cooperation with the villagers. This ensures that the forests serve the local people and their cultural uses. In every village at least one of the village elders is responsible to control the forest. Additionally, via social pressure the whole village controls the adherence to customary rules that protect the cultural forests. The “secrets” referring to the initiation rituals are told from the old men to the younger ones, and they are not allowed to share them with outsiders like woman, strangers and children. The circumcision ceremonies are accompanied by cheerful dances and beer drinking outside of the forest. During these activities the forest will not be entered and all villagers as well as strangers are invited to join.

Table 1. First and second coding category of perceived differences between the two forest types.

Category	Sacred Forest	Governmental Forest *
structure	closed canopy (cover) naturally grown	natural and artificial (plantations)
tree species	indigenous trees naturally grown	indigenous and exotic tree species
size	just small (0,5-8ha)	large
location	near the water, mostly in a valley	-no comment-
visit frequency	men: every 5 years for 4-6 weeks women: never	daily basis
origin of rules	rules are set by the community	forest act
rituals performed inside	initiation prayers	cleansing rain making prayers
"practical" protection	taboos (if somebody enters either he will stick there, get mad or will die) elders are very strict	police and forest guards control (they beat you or bring you into the prison
normal behaviour	in general: women, children and strangers are not allowed to enter wood is not allowed to bring outside old people are allowed to enter during circumcision time: women have to cook for the boys boys are taken there every 5 years in former time the boys stayed there for 6 month (1931) today they stay there for 4-6 weeks in the school holidays man disclose their secrets given from the old man to the younger should not make harsh noise plant trees when necessary - place needs to be covered	everybody can enter get a receipt from the forester for every activity (medicine, grass, cleansing, rain making) collect only dry wood don't go alone inside the forest woman are not allowed to climb trees herbalists should not uproot the whole tree illegal activities like charcoal, burning, timber sawing, grazing animals without permission go there for praying people don't obey the rules government employs people to plant
meaning	spiritual meaning identity hiding place for initiates man find convenient time to spent with their boys boys are trained to take full responsibility for their families traditional way of the ancestors very secret and silent place only and specifically for circumcision	resource forest for trees home of the wild animals lonely place
resource in terms of	culture most of the used materials for circumcision and initiation comes direct from the forest	herbal medicine rain attractive for strangers (tourists, researchers) fire wood collection fresh air grass for the animals and the roof in the past building material (timber) fruits food (e.g. roots and seeds) gold mining

origin	natural forests were created by God and given to the Tiriki	planted by people and natural grown
wishes	men wish continue with the practice women wish to see the place	should continue with indigenous trees
feelings towards	men: feel shy feel free feel good consider this place very much special don't want people to see inside love forest priest: "I have learned hating those things - because they are not good" women: worried about the boys feel "free" when the boys stay in the forest are happy when the boys dance people should be threatened by the taboos	men: worried because of the forest guard or wild animals can't feel very much comfortable love forest women: feel nervous inside the forest - because of snakes and evil minded people feels not free be aware of risks good feeling in the shade children should be afraid of going there (stories about monsters in the forest)

*n= 10 (6 men + 4 women, 18-91 years)

The adherence to the protection rules is motivated by strongly rooted and inherited fears. Nevertheless, most of the interviewees assume a positive attitude towards the cultural forests and perceive it as a major part of their identity as Tiriki. The cultural forest has clearly more spiritual meaning to them than the governmental forest. It represents the infinite bond and long-lasting relationship that unites the former, the actual and the coming generations which is described in Omari (1990) and Omo-Fakada (1990). The vital rituals celebrated in those forests contribute to the continuance of this perception. Byers et al. (2001) state that knowledge about sacred forests is mainly bound to local people. They claim that the traditional African religion plays an important role in the protection of sacred forests. This is also emphasized by the interviewees. On the other side the governmentally administered forest is clearly perceived as officially protected by the forest guards and the foresters, although it is recognised that the rules are not so strict and the government is far away.

The main value of the governmental forest for the interviewees consists in meeting their profane daily needs such as firewood, grass and building materials, traditional medicine and grazing ground for cattle (see also Table 3). Further the forest is valued for attracting rain as much as tourists who come to visit the forest for its natural beauty and biodiversity. No direct protection rules exist among the Tiriki community regarding the forest since it is seen as property of the government. However, traditional beliefs and rules refer to certain features of single trees such as Murembe *(Erithrina abyssinica)* which is referred to heal mumps.

Table 2. Valuable aspects of the sacred forests as mentioned by the interviewees

"Those forests or shrines are considered holy places for all those circumcision things and so they are totally protected by the culture because from our forefathers [ancestors] it was said if you cut a tree from my shrine you will die! You will die. So that fear has grown from age to age. …And people are happy to protect the shrines."

"The sacred forests gives us happiness … I am happy when my boys come safe from the circumcision"

"The place [sacred forest] is only and specifically for circumcision – all trees found in that place they are considered special. It is not a planted forest it is natural grown …"

Table 3. Perception of the Kakamega forest as mentioned by the interviewees

"…A natural resource that God gave us. A good thing that gives rainfall so we do not get harsh climate. We get our firewood from the forest. Nowadays according to Christianity we do not have customary rules related to that forest"

"The Kakamega forest is a helpful thing that helps to attract rainfall. Also cattle go to graze in the forest. A place potential for crop planting. … Nowadays it is forbidden by the government"

"Generally people have eh admired the forest apart from a few individuals of course that may want to steal firewood from the forest, which is a benefit to them despite the fact that they steal it. It is a benefit to them but generally I have seen the forest as a resource, a place where people get food during dry seasons when they have no food … the people who are totally poor … walk to the forest, you see a lot of children when the harvest is poor."

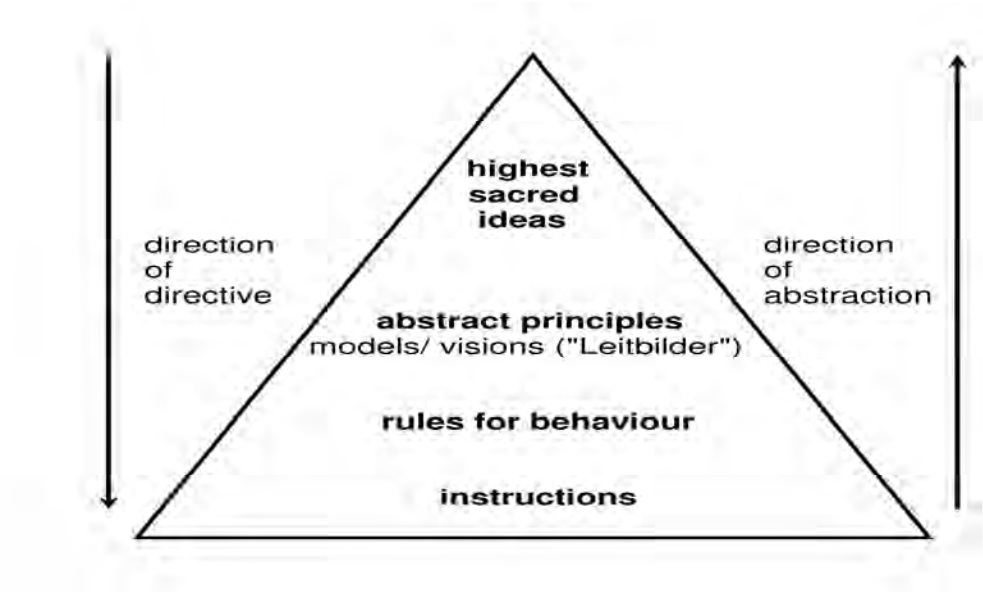

Figure 2. Ordered adaptive structure (Bargatzky 1986) modified by Irrgang (2005).

To understand the more hidden and not obvious visible intangible values we will employ the Ordered Adaptive Structure (Fig. 2). The culture ecologist Bargatzky (1986) used this model to classify and to structure values. The pyramid consists of several hierarchically arranged sub-systems. The sub-systems of the lower level denote specific and exact tasks. On the top of the hierarchy the most abstract ideas are located. They are at the same time the most lasting ones. The ideas about the sense of the world or God are placed there. Changes of these highest sacred ideas take time. Changes of the lower level will occur much faster.

Since the cultural forests exist longer as a cultural construct of all levels, they are less disturbed in their hierarchical structure as the governmental forest. The highest sacred ideas of these forests have been in existence since time immemorial. The vision and the behaviour rules as well as the instructions are clear for the community. Instructions are easy to understand and to follow. This is illustrated in Figure 3. A main potential is the long lasting effect of the coexistence – culture and forest because it has been developed over centuries and will last in the mind of the people longer than the pure instructions of the lower level.

Till today, the cultural forests of the Tiriki are valued in terms of identity and old traditions. This includes the indigenous tree species growing at these sites. The common spirit of the Tiriki helps and assists conservation and maintenance of the cultural forests. Indeed, a man is only accepted in the society if he has undergone the ritual of circumcision and initiation inside the forest. This ritual based on the traditional religion is also practiced by Christians and remains the basis for the involvement of all community members. Although women are not allowed to enter the forests they also participate in the traditions during the outside ceremonies at the fourth week of the circumcision celebrations. The small size of the forests and their most central place helps the community to easily control the place. The long history of the sites and the related rituals, and the reference to the ancestors gives these places their high value. The highest abstract ideas of the governmental forest seems not clear to the

Tiriki. Therefore, the protection of this resource is not in the responsibility of the local people and is not part of their local hierarchy. Only the lowest part of the pyramid is vivid – the instructions are clear. But on the level of the rules for behaviour it differs already from the idea of the governmental authorities (Fig. 4).

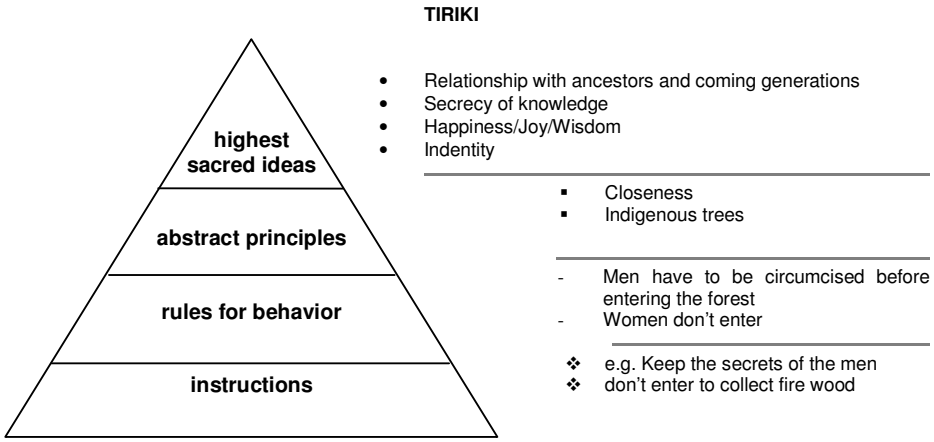

Figure 3. Ordered adaptive structure for the sacred forests.

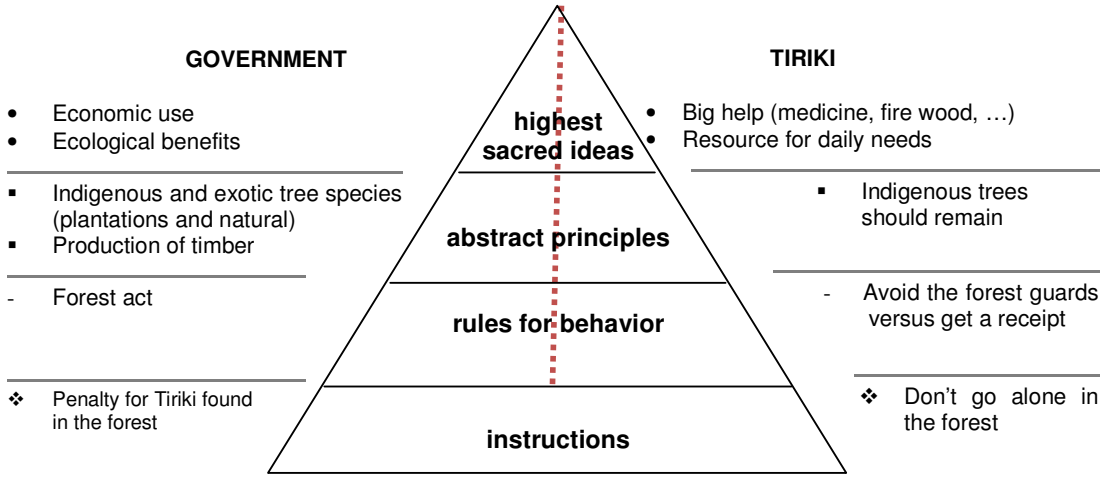

Figure 4. Ordered adaptive structure for the governmental forest.

The government aims to protect the forest by laws and forest administration. The main objective is to maintain the forest area and to plant timber trees. Hence, the governmental aims concerning the forest use are not identical with the value system of the Tiriki. They value the governmental forest as a benefit and help to their daily lives.

By no means is this new. Our findings correspond well with studies about the management of natural resources in other parts of Africa (e.g. Tengö et al., 2007, Byers et al., 2001). We agree that this kind of half formal institutions represent an important mechanism for conservation. They shouldn't be neglected. They need to be integrated into the legal political framework as already started with the new forest bill 2005 in Kenya. This enhanced forest act tries to fix participation of local communities in the forest management. However the practical implementation hasn't been carried out so far. If the traditional values and perceptions of the Tiriki can become part of the picture throughout the process of further administration of the Kakamega forest, a better understanding of the management of forests in the region can be achieved, and improved decisions on the management of governmental forests can eventually be arrived at.

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SOME GHANAIAN TRADITIONAL PRACTICES OF FOREST MANAGEMENT AND BIODIVERSITY CONSERVATION

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Abstract

Forest management systems are referred to as indigenous, when they are primarily based on local experience of the specific society and have evolved over time and transmitted from generation to generation by word of mouth or by practice. Based on this definition the presentation examines indigenous knowledge and practices performed in many Ghanaian communities with respect to the use and protection of forest and wildlife resources. The presentation begins with description of the main features that differentiate indigenous knowledge from scientific forest knowledge. The main part deals with the traditional knowledge that explains the intricate relationship between human and the forest (Cultural and traditional systems) and proceeds to demonstrate how the traditional knowledge has contributed to improving forest science and forest management in Ghana.

TRADITIONAL KNOWLEDGE SYSTEMS FOR MANAGEMENT OF KAYA FORESTS IN COAST REGION OF KENYA

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Abstract

The Kayas are sacred forests at the Kenyan coast, from which indigenous Mijikenda communities have over generations derived biological, cultural and spiritual goods and services. These forests were sustainably managed as collective biocultural heritage by Kaya elders through a traditional knowledge system (TKS). However, in 1992, a central governance system was introduced which may have affected the TKS and the management of the Kaya forests. A study was therefore undertaken to determine the effect of the introduction of the central governance system. Both primary and secondary data were collected on three Kaya forests. Primary data was collected on customary laws and principles of the Mijikenda, as well the effect of the central governance system. Methods included interviews, focused group discussions and experts' meetings. Results reveal a TKS that has mechanisms for ensuring sustainable utilisation of the biological resources. These include principles of equity, reciprocity and equilibrium in the management of the resource and benefit sharing for all. Through these mechanisms traditional institutions managed the Kaya forests as communal property. The elders were the primary custodians of the sacred forests and were respected by all within and outside the community. This system played an important role in maintaining the integrity of the natural forests and conservation of the biodiversity therein. Over time, various processes have influenced the effectiveness of the traditional governance system to conserve the forests. These include: formal governance institutions, anthropogenic factors, modernisation and religion. Introduction of the central governance structure has been the most significant in eroding the influence of the community elders to enforce customary laws and principles that sustained the forests. This paper highlights the positive elements of both systems and explores opportunities for integrating them for enhanced management of sacred forests.

Introduction

Kenya's gazetted closed forests cover a total of 1.4million ha (Wass, 1995). This represents about 1.7% of total land area which compares unfavorably to the internationally recommended minimum of 10.0%. These forests include Coastal, East and West Rift Valley montane and the Guinea-Congolan upland forests. Other ungazzetted forests include pockets of indigenous forests in private farms and county council land. Despite the low cover, forests rank high as one of the important national assets for economic, environmental, social and cultural values. The country's forest sector contributes about 1.0% and 13.0% to monetary and non-monetary economies respectively.

Much of the closed canopy forests are under threat due to various human activities that include illegal encroachment, excisions, short-term political interests leading to invasion of gazetted forests, conflicts on resource use and unwarranted land use changes paving way to degradation. The archaic forest policies and legislation have also contributed to degradation of the forest resource.

Prudent forest management practices, backed by updated forest legislation and policy, strong institutional arrangements and sound developmental options can turn around the sad state of forest management in Kenya. One such option is the use of traditional knowledge developed by rural indigenous communities for sustainable forest management. The traditional knowledge system (TKS) is the framework within which traditional people interact with their local environment to generate knowledge, technologies and innovations to fulfill their physical, spiritual and socio-ecological needs (UNEP, 1997; Johnson, 1992a, 1992b).

For centuries, traditional knowledge has enabled rural indigenous communities to survive in balance with their natural environment. The TKS provides for *inter alia*, their health, food and spiritual needs (Prance et al., 1987; Kloppenburg, 1988; Moran, 1991; Rhotz-Arriaza, 1996; Cunningham, 2001; Twarog & Kapoor, 2004). It is also well established that the system plays an important role in natural forests management (UNEP, 1992; Martin, 1995; Hamwey, 2004). Some of the rituals and practices of the rural indigenous communities towards natural forests, including sacred groves, effect a non-exploitative use of natural resources by playing a regulatory function to ensure sustainability. Further, the resulting ecosystems form important repositories of biodiversity. For many practitioners and scientists, traditional knowledge about the environment provides valuable information that can be incorporated into the decision making processes (Kuhn and Duerden, 1996; Cunningham, 2001). By virtue of providing for this balanced relationship, traditional knowledge is truly the "science" of sustainable development at the local level.

The Rio Declaration states that "Indigenous people and their communities, and other local communities, have a vital role in environmental management and development because of their knowledge and traditional practices". This principle is echoed in a number of international agreements including the Convention on Biological Diversity (CBD) and the Convention to Combat Desertification (CCD) and the Statement of Principles for the Sustainable Management of Forests, among others.

In Kenya, there are over three million rural indigenous people living within 5 km of forests (Ruotsalainen, 2004) who have a developed TKS. For example, the Mijikenda[5] community in the coastal part of Kenya live adjacent to the indigenous forests popularly known as the Kayas. These communities have been managing the Kayas sustainably since time immemorial. Kayas are regarded as sacred by these communities and indeed owe their existence directly to beliefs, culture and history of the Mijikenda ethnic groups. However, in 1992, the central governance system was introduced for the management of indigenous forests, which rarely recognizes the role of traditional knowledge. A study was therefore undertaken to determine the effect of the introduction of the central governance system.

The main objective of this paper is to highlight results of the study made on the role of the TKS in the management of three Kayas namely Kaya Fungo, Kaya Chonyi and Kaya Kinondo. The traditional forest management approach is analyzed with the view to determine the key principles, laws and institutions that sustained these natural forests. The effect of the formal governance system on the traditional approach is also discussed.

Methodology

The Study Area

The coastal forests of Kenya are part of an 'ancient coastal vegetation mosaic' of eastern Africa, rich in biodiversity, and form one of the most important biological systems of the world (Robertson & Luke 1993). There are about 70 coastal forest fragments covering about 660 km^2 (Burgess et al. 1998). The coastal forest is today represented by forest patches that include the Kayas, which were fortified forest homes of the Mijikenda community (Spear 1978; Walsh 1992; Willis 1996). There are over fifty Kaya forest patches each identifiable to one of the nine Mijikenda sub-tribes.

This study focuses on the Kaya patches belonging to the Giriama, Digo and Chonyi subtribes as follows: (i) Kaya Fungo: Giriama sub-tribe; (ii) Kaya Kinondo: Digo subtribe, and (iii) Kaya Chonyi: Chonyi sub tribe.

Data Collection

Both primary and secondary data was collected from the communities neighbouring the three Kaya forests, i.e., Kaya Fungo, Kaya Chonyi and Kaya Kinondo.

A rapid appraisal was first undertaken in all the Kaya forests to sensitise the local administration and community members on the objectives of the study, as well as to test a questionnaire that had been

[5] The Mijkenda are a Bantu –speaking people consisting of nine sub-communities namely, the Digo, Duruma, Giriama, Rabai, Chonyi, Kambe, Ribe, Kauma and Jibana that are linguistically and culturally closely related (Willis, 1996)

developed. The appraisal was also designed to determine the scope and number of potential respondents from which a representative sample of target respondents was drawn.

Subsequent to the rapid appraisal, the questionnaire was refined and a comprehensive survey conducted. In Kaya Fungo, the target community was the Giriama, in Kaya Chonyi the Chonyi and in Kaya Kinondo, the Digo. In each target population, some stratification along gender, age and socio-political status was considered to capture diverse views and opinions. Elderly persons and healers were the key informants for discussions on customary law and traditional practice. In total, 111 respondents were involved, 31 Digo, 40 Giriama and 40 Chonyi (Table 1).

Table 1. Respondents sample used in the study.

Respondents	Digo	Giriama	Chonyi
Kaya elders	5	7	9
Healers	7	8	7
Traditional birth attendants	5	6	7
Opinion leaders	7	10	9
Youth	7	9	8
TOTAL	**31**	**40**	**40**

The main research methods used for data collection in the comprehensive survey were semi-structured interviews, open-ended discussions and meetings with experts, with a strong emphasis on active community participation. Some guiding thematic questions were used to steer the discussion in the semi-structured interviews and open-ended discussions. Meetings with experts were used to capture collective opinion, particularly from Kaya elders and traditional healers, and to supplement results captured from the interviews. Qualitative data was the main target for capture, and forms the main body of discussion in this paper.

The guiding thematic questions covered different aspects and were used to investigate the following broad areas:

i) The basic customary laws, and their application in the use of and access to biological resources and traditional knowledge among target communities;

ii) The criteria of ownership, sharing and transmission mode of traditional knowledge and biological resources among the indigenous communities;

iii) Traditional systems used for the protection, conservation and maintenance of the Kayas.

To capture most of the targeted information and to create a levelled platform for the respondents, the interviews were conducted in the language of the target population. Thus, among the Mijikenda, Chidigo, Kichonyi and Kigiriama languages were used for the respective sub-tribes. Some interviews were recorded using digital voice recorders after consent from the respondents.

The data gathered included descriptive responses or narratives on the Mijikenda biocultural heritage. The responses included information on physical, ecological, spiritual and governance attributes of their relationship with the Kaya forests.

Results and Discussion

The Traditional Management of the Kayas

The Kayas

The Kayas, which average 10 - 200 ha. each are botanically diverse and have a high conservation value (Robertson, 1986, Githitho, 1998, Robertson & Luke, 1993). More than half of Kenya's rare plants are found within the Kayas. In addition to being areas of inspiration, these forest patches are also sources of plants for a wide range of ethnobotanical uses (Pakia & Cooke 2003a, b). The

Mijikenda used the Kayas as protective premises, in particular when they took refuge from nomadic tribes from the north, the Galla or the Orma. In the 19th century, the Mijikenda moved out of the forests and settled in neighbouring land, but the sacred status of the Kaya forests remained, and traditional protection through customary laws continued.

Traditional Governance System

Traditionally, the Mijikenda governed the Kaya forests as a collective biocultural heritage (CBCH). This may be defined as knowledge, innovations and practices of indigenous peoples and local communities which are held collectively and inextricably linked to traditional resources and territories; including the diversity of species and ecosystems; cultural and spiritual values; and customary laws shaped within the socio-ecological context of communities.

The Mijikenda governance system constituted the *ngambi,* who were Kaya elders, responsible for rule making and enforcement, such as management, control and access to biological resources and traditional knowledge within the CBCH. Access to the Kaya forests was subjected to traditional rules and rituals, which were organized by elders, under the advice of a seer who communicated with the spirit world to explain the immediate future.

The *ngambi* governing system was developed through progressive initiations into the senior positions. At each initiation level, the trainee received secretive knowledge that equipped them to be managers and advisors of the subjects. A fee was paid to the senior *ngambi* who conducted the initiation, and the training culminated with a 'graduation' ceremony. The various *ngambi* levels were designated by the type of stick they carried. The secrets that were known only to the graduands enhanced trust from the rest of the community.

Whilst knowledge in the *ngambi* was to specific individuals, the study revealed that custodians of the CBCH may be individuals, a group of individuals or groups of communities. Most collective bio-cultural knowledge was passed on orally, while some, for instance medicinal knowledge, was codified. The nature of the bio-cultural knowledge was also diverse and covered for example, literary, artistic or scientific works, rituals, song, dance, medical treatments, divination, rain making and practices in agricultural technologies and techniques. Essentially, the existence of CBCH suggests associated customary law or practice.

Customary Laws and Principles of the Mijikenda

Analysis of the responses to the discussions revealed a wide range of principles and customs governing various aspects of management of the Kaya biocultural resources.

Customary Laws

Among the Mijikenda, customary laws are locally recognized principles, and more specific norms or rules, which are orally held and transmitted. They are applied by community institutions to internally govern or guide all aspects of the lives and activities of indigenous communities.

The Mijikenda customary law contributes to generating and sustaining knowledge by regulating practices. For example, only traditionally acknowledged healer practitioners are allowed to administer certain medicines. In such cases other individuals who might know the plant combinations would be fined if found administering the medicines. The healers on the other hand are guided in terms of medicinal plant resource collection. Such customs serve as norms or laws for limiting overuse of the natural resources. These communally beneficial practices become established norms or customs. Hence, at local level, the customary laws, knowledge, practices and beliefs are intertwined, and these are in turn closely interlinked with landscapes. On the other hand, the landscapes provide the physical space for sharing of knowledge and resources, and hence for sustaining traditional knowledge.

Community elders are the arbiters of customary law. Thus, all feuds and occasions are deliberated upon by the elders, who guide and advice the rest of the community. This includes access and use of resources, such as land and traditional medicines. However, access to and use of Mijikenda traditional medicine by strangers is rarely a matter of formal customary law but tends to be more a question of practice based on the principles of customary law, and belief systems. Since the Mijikenda accept traditional medicine from other communities, they allow non-Mijikenda to access theirs. However, the Mijikenda customary law is partly void on how non- Mijikenda who access their medicinal resource or knowledge irregularly should be dealt with. It is the Mijikenda individuals participating in such abuse with outsiders are subjected to traditional penalties.

Principles

Customary laws are based on the following principles, which are common to many traditional societies:

Equilibrium**:** refers to balance and harmony, in both nature and society, e.g. respect for mother earth, for the upper world, and gods; and resolving conflicts to restore social harmony. It is also about complementarity (e.g. between ecological niches). Equilibrium needs to be observed in applying customary laws, all of which are essentially derived from this principle. Among the Mijikenda the belief in the spiritual world as a source of social and environmental harmony, including health is based on the principle of equilibrium. Munyi and Mutta (2007) also reported that among the Maasais in Kenya, the principle of equilibrium is demonstrated through their deep respect for customary values, the order of elders and the power of spirits.

Reciprocity**:** stipulates that what is received has to be given back in equal measure. It encompasses the principle of equity, and provides the basis for negotiation, sharing and exchange between humans, and also with gods, animals etc. Among the Mijikenda Kaya rituals, materials offered as sacrifice include the seven seed grain types (commonly cultivated crops), which are given to the gods during prayers for adequate rains. This manifests in the belief that the spirits that help in the good harvest must be offered part thereof. Among the Maasais in Kenya, the general knowledge holder is expected to share all his general knowledge for free (Munyi & Mutta, 2007).

Duality**:** maintains that everything has an opposite which complements it (like *ying* and *yang*). Thus behaviour cannot be individualistic for example, in the union between man and woman; and other systems can be accepted or other paradigms used. The Mijikenda believe in three spiritual beings: natural spirits (*pepho*), spirits of the dead ancestors (*koma*) and bad spirits (*shetani*). *Pepho* and *koma* are believed to be a blessing force that counters the evil power. The principle of duality among the Maasais in Kenya is depicted in the belief that the Maasai worship on god who is said to dwell in all things and is good or bad depending on the conduct of the community (Munyi & Mutta, 2007).

Effect of Formal Governance on Traditional Governance System

Traditionally, the relationship between the formal and traditional governance system has been antagonistic. This is because the two compete for legitimacy and influence. In Africa, given the colonial experience, state based legal systems have predominated and have succeeded in marginalizing community based legal systems.

In Kenya, the first forest policy was published in 1957, updated in 1968 and is currently under revision. This policy and other rural development policies and strategies assumed that indigenous communities mismanage their natural environment. This attitude principally led to development of the western top-down system where indigenous communities were seen merely as recipients of instructions to protect natural resources rather than as participants in their management. This is evidenced by the policy and legislative framework that systematically increased central governance and diminished the role of indigenous communities in the decision making process. Since the beginning of the colonial rule in the 1890s, most natural forests in Kenya have been gazetted thus eliminating the role of indigenous people. Four of the Kayas are forest reserves, while 37 are national monuments and are under the control of Kenya Forest Service and National Museums of Kenya (NMK) respectively. More recently, 10 of the Kayas were listed as World Heritage Sites and are under the control of NMK and the stewardship of United National Educational and Scientific and Cultural Organization (UNESCO).

These changes have effectively revoked historic rights derived from community based legal systems, opened up community rights to exploitation and use by persons considered outsiders by the community, community based traditional leaders and authorities systems have been invalidated and replaced by state appointed leaders and community enforcement systems have been invalidated. The effect has been to alienate indigenous communities from their heritage and reduce their traditional governance system to a peripheral management system, which is often ineffective and secondary in status (Mumma, 2004). Communal ownership and the concept of CBCH has also gradually reduced. In addition to the impact of the central governance system, the traditional governance system has declined as a consequence of changes in the wider economic, social and cultural circumstances. As a result of the exclusion of indigenous communities in decision making and the other factors, there has been increased insensitivity by the people towards forest conservation and increased encroachment of cultural forests.

Of the three Mijikenda groups that were studied, and from other similar studies (Parkin, 1972; Githito, 1988) the Giriama *ngambi* is the most active. Among the Chonyi, the *ngambi* were infiltrated by modernity, and its functioning is limited to willing community members, who are considered traditionals. Among the Digo, the *ngambi* has been a powerful governing organ that liaised with the Provincial Administration (Chief's office), until late 1970s. At the time, the *ngambi* controlled even the harvest of farm produce, particularly the cash crops such as the coconuts. However, with the introduction of western education system, which became the emphasis for employment and management, the *ngambi* was slowly rendered irrelevant

Effect of Governance on Sustainable Management of The Kayas

Literature reveals that inclusion of indigenous people is key to increased appreciation of indigenous forests and subsequent conservation of the same (Crucible Group, 1994; Vernooy, 2003; Twarog and Kapoor, 2004). There is a scientific rationale for such a focus: it is that these communities are the principal stewards of the greater share of biodiversity. Communities contain skills and knowledge that have contributed to the preservation of the wide range of biocultural resources under their custody. Communities have shaped and maintained the environments that support the diversity. Their involvement is therefore crucial in sustainable management of natural forests and calls for rethinking conventional forest management approaches, as currently recognised in the current Forest Act, 2005 that entrenches Participatory Forest Management.

Analysis of the traditional conservation approach on the Kaya forests reveals that in the past, customary laws effectively conserved these forests which by the continued application of traditional knowledge. When the seemingly 'better' conservation strategies were introduced by the government, the biodiversity of these areas reduced as members of the community started to clear the forests for agricultural expansion, and human settlements through construction of schools, churches and private development in the forest area. This can be interpreted as a protest, probably for not clearly understanding the newly introduced measures. Else, new life style and beliefs changed the community's perception and interest in the Kaya forests. Overall, the research documented that the boundaries of the studied Kaya forests have receded significantly. Other studies indicate that coverage of some Kayas has reduced to as low as 20 percent of the original area and many have almost disappeared (Githito, undated, 1998).

Compounded by other influences, the marginalised role of the Kaya elders has meant that components of the associated traditional knowledge or specific forests resource materials are likely to be dropped from the lives of the Mijikenda. For example, during the reign of the *ngambi* among the Chonyi, the community members followed the traditional rule without question, with the members respecting, and to a large extent, fearing the social implication of breaking the customary law. On the other hand, the *ngambi* was non-partisan in the application of the traditional law, fearing spiritual wrath for unfair application. Furthermore, during the study, the elders reported a strong presence of cosmic forces. In the presence of such a strong traditional rule, and availability of the cultural components, associated traditional knowledge was kept alive. With the absence of the traditional rule and lack of some cultural materials, the associated traditional knowledge will certainly be lost. The continued presence of traditional customary rule offers an invaluable opportunity for the continued conservation of the sacred forests and the application of the associated traditional knowledge.

Because traditional knowledge and CBCH are closely related to survival and subsistence, they provide a basis for efficient local decision making in the exploitation of natural resources, ensuring the long term viability of natural ecosystems so that the resource needs of future generations can be met. Indigenous communities throughout the world have prevented land and soil degradation, biodiversity erosion and deforestation (Hamwey, 2004).

Conclusions

Rethinking conventional forest management strategies means above all recognising the key roles of indigenous people and their knowledge and social organisation in the management and maintenance of biocultural resources. Recognising these roles is the basis for greater integration of traditional approaches in forest management.

It is evident that the conventional forest management system differs from the traditional approach. The indigenous cultural belief system or environmental philosophy is chiefly concerned with ensuring that resources are utilised in a way that preserves them for future posterity. By contrast, the formal

governance system is mainly concerned with ensuring that resources are utilised for present and future posterity and resources are seen as objects for human exploitation. A balance of these two systems is needed.

As the rural communities have been the custodians of traditional knowledge and biocultural resources are key to their conservation, a participatory approach to management that brings forest managers and local communities together in the field as equal partners offers the best opportunity for the conservation and sustainable use of natural resources. In a collaborative approach, the managers and local communities discuss and share the decision making on an equal footing. Customary laws and principles should therefore inform natural forest management plans for example in the protection of biodiversity and traditional knowledge.

To achieve the balance an appreciation and understanding of the traditional knowledge system including indigenous cultural values and customary laws will be critical to developing any framework for sustainable and locally acceptable management of the indigenous forests. Priority needs to be given to strengthening and protecting existing customary law systems, because of the important values inherent in those systems, which are critical to the maintenance of the cultures concerned and also to the maintenance and enhancement of biological diversity. The legitimization of the traditional governance system, reinstating historic ownership, community leaders and traditional structures that define authority will be crucial.

Recommendations

The following are recommended:

- Legal recognition, institutionalization and empowerment of the Kaya elders in the management of the Kayas
- Capacity building of the community in management
- Remuneration of community members involved in the management of the Kayas.
- Integration of the customary laws in the formal law.
- Securing ownership of the Kayas for the communities
- Reconciling the values placed on the Kayas by local communities with other values and practices such as biological research and ecotourism.
- Enhanced collaboration with local administration.

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INDIGENOUS FIRE MANAGEMENT PRACTICES IN GHANA

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Abstract

The use of fire is fundamental to the rural economy of Ghana. Like most parts of the tropics, Ghana knows fire mostly through agriculture. Most farmers consider farming without fire within the forest zone impractical. Farmers burn to increase land surface area and allows for more sowing of crops such as maize, clear away competing weeds, release nutrients and prevent microfaunal pest from attacking crops. Other notable reasons for fire usage are to enhance fast growth of crops, to manage shade on farms or fell snags by firing around the base. Fire is used both in hunting and for gathering of honey. Local people in the North set fires under trees such as *Parkia biglobasa* (dawadawa) trees to promote fruiting. The practice of burning has been developed over the years by local people. Practices include the use of locally adapted Indicators before ignition of the fuel. Major fire management activities use by indigenous people are the use of fire belts which are mostly constructed through burning to reduce spread of fires to houses, sacred groves and unharvested cash crops. Present indigenous practices for fire usage and management in Ghana are comparable to scientific practises. However these practices are fraught with certain weaknesses such as repeated burning inappropriate time of burning and not well developed alternatives to the use of fire. These weaknesses need to be addressed through on farm research which aims at improving indigenous practices.

Introduction

Fire has been used by humans for more than 1.5 million years (Goldammer, 1991). Every facet of rural life depends in some way on the use of fire. For instance herding and farming shape fuels, and the needs of crop and herd dictate patterns of burning (Pyne, 1999). The use of fire is fundamental to the rural economy of Ghana due to the fact that over 70% of the population of Ghana are rural and depend on agriculture for survival (MOFA, 2001). Before 1983 the use of fire did not raise any alarm though fire was extensively used by the local people in their livelihoods activities. This is partly because most fires used in agriculture especially in the forest zone were set in an environment that had low susceptibility to fire due to low degradation of the vegetation as well as invasion by savanna grasses. However, an extended drought triggered by the El Nino-Southern Oscillation (ENSO) event in 1982/83 predisposed the forests of Ghana to fires. Since then wildfires have become an annual ritual both in the forest and the savanna zones of Ghana. Wildfires have subsequently degraded the environment and also impacted negatively on the productivity of the forest. According to Hawthorne (1994) fire has altered the structure and composition of 30% of semi-deciduous forest. Majority of wildfire incidence has been attributed to anthropogenic factors associated with land use. In Ghana hunting, smoking and herding have been identified as sources of most fire incidence. However, wildfire incidences in Ghana have been strongly linked with farming. Consequently, to effectively manage wildfire incidence it is important to understand the role fire plays in livelihood activities especially farming from the perspective of the indigenous people. In addition indigenous people live close to the resources that are being protected, unlike government officials whose mandate it is to manage the resources. It becomes imperative that their active participation is sought in curbing wildfire incidence and the extent of damage. This can only be effectively done when their indigenous knowledge is properly integrated into scientific way of using fire and managing wildfires. This paper describes indigenous knowledge of the role of fire in agriculture and other livelihood activities as well as its management and how these are comparable with scientific knowledge and standard fire management practices.

Methodology

The results presented in this paper are based on a survey conducted in 2001 on 120 farmers in eight communities at the periphery of Afram Headwaters, Tain II, Pamu Berekum and Worobong South Forest Reserves in the Transition Zone of Ghana. Semi-structured questionnaires were used to gather information on the role of fire in farming systems of Ghana. In addition, in 2005 focus group discussions were conducted in communities around five additional forest reserves (Bosumkese. Mpameso, Mankrang, Sapawsu, Bomfobiri). The focus of discussion was to identify measures being adopted by farmers in response to wildfires or potential measures that could be adopted to curb the incidence of agricultural related fires. Consultation with chiefs, community elders and opinion leaders were made to collate information on local structures for suppressing wildfires. Finally a review of various studies on fire related issues in Ghana was carried out.

Results and Discussion

Fire usage and role in farming

The practices of slash and burn agriculture are common world-wide (Jansen 1995). However there are tremendous differences in the use of fire in cultivation (Peters & Neuenchwander, 1988). Farmers perceived burning of cleared fields to be vital in farming because of the perceived advantages obtained. According to the farmers burning reduces labour cost, suppresses the growth of weeds, allows for more planting to be done per unit area of land, improves yield and is mandatory for successful cultivation of some crops (maize, pepper, tomatoes, and yam) especially in the forest zone.

Fire as a Means to Reduce Labour

An important factor influencing the choice of land clearing method is the cost of clearing farmlands (Amanor, 1996). The use of fire in the process of land preparation is an important tool which helps to reduce cost of labour on a farm enterprise. The ordinary farmer in the rural areas uses fire in land clearing because it is actually the cheapest, fastest and easiest method of clearing. Hence, it is the dominant factor influencing respondents' decision to burn. Though labour is said to be in surplus in the Ghanaian economy farm labour is very scarce and expensive (Atsu, n.d.) so the small farmer deems it economical by substituting fire for labour. In the forest, fire also reduces biomass and makes way for farming since there is no real alternative for removing tree growth unless one uproots all the trees and transforms the environment to a treeless zone through the use of bulldozers and tractors. Most farmers would want to sow on a clean field with all the debris cleared. According to farmers a good burn provides the clean field and allows the farmer to sow more seeds, which is very helpful to farmers. This has also been observed elsewhere in the tropics (Jansen, 1995).

Farmers' use of fire to suppress the growth of weeds and makes farm maintenance easy thus ensuring the proper growth of the crop has also been observed in other parts of Ghana (Korem, 1985, Amanor 1994). To the farmers burning also ensures the elimination of weeds, making farm maintenance less labour intensive. The usefulness of burning in the short term makes it difficult for some farmers to appreciate why burning at certain times of the year should be forbidden.

Fire as a Means to Control Pests and Diseases

The use of fire for pest control is wide spread in farming communities in both the forest and the savanna zones. According to Nsiah-Gyabaah (1996), fire is used to destroy or control some pests and diseases (e.g. grasshoppers, ticks, locusts, anthrax) and livestock parasites which live and thrive on the vegetation. In recent time in Ghana chemicals for pest control have become expensive since subsidies on them were removed under the economic recovery programme (Amanor, 1996; Quartey & Peasah, 2000). Most small-scale farmers do not have the resources to purchase the chemical. Fire thus offers them a cheap source of protection against certain pests and ants in the soil that have the tendency of destroying crops (Ahn, 1970). Such fires according to farmers need to be less intense and slow enough to move into the earth in order to achieve the desired objective.

Fire as a Means to Improve Crop Yield

Burning also produces ash containing highly soluble nutrients, which are made immediately available to plants during the growing season (Korem, 1985). The ash produced is the cheapest fertiliser. A good yield is what every farmer expects after going through the difficult process of land preparation,

cultivation and regular maintenance. Farmers' use of fire as a tool to improve yield is due to nutrients provided by the ash. This observation is supported by research, which showed that burning generally makes nutrients available, and improves crop yield (Seubert et al., 1977). However those nutrients are made available only when the temperature of the fire does not exceed 200^{o}C (White et al., 1973; Wills, 1962).

Type of Crop as a Factor for Fire Usage

The type of crop being grown by farmers influences the use of fire in farming system. Farmers believe fire is inevitable for some crops, where as for others alternative methods can be used. Fire is claimed to be very suitable for crops like maize, yam, pepper and tomatoes. This is due to the fact that in the forest zone crops such as yam and tomatoes are cultivated on mounds, which require the land to be cleared of all debris to allow for the construction of the mounds (Amissah, 2003).

Fire as a Means to Manage Shade on the Farm

Fire is used to assist in the management of shade cast by trees left on the farm. This is because farmers need to incorporate trees effectively on a farm in order to reap the maximum benefit. Some trees left on the farm with broad leaves cast shade on the farm and prevent enough sunlight reaching the crops and their subsequent growth (Amanor, 1996). Farmers use fire as a tool to kill the tree to gain enough sunlight and also nutrients from the leaves that fall off such trees. This practice is declining as few farmers are now using fire to manage shade. The decline may be due to presence of fewer trees, small trees especially in the transition zone and the availability of chain saw.

Fire usage for Hunting and Honey Extraction

Hunters intentionally set bushfires for the purpose of trapping game. However, when the fire begins to burn the hunters abandon the fire and chase after the fleeing animals, leaving the fire to burn uncontrollably. This is done to drive the animals in the desired direction, drive away snakes to prevent any snakebite and to reduce the discomfort of hunting in tall grasses. Searching for wild colonies of bees living in hollow trees is a common practice in Ghana (Korem, 1985). The hunters use fire at night to drive the bees away or kill them and some of these fires get out of control. Though some hunters use hot water instead of fire to subdue the bees majority of the farmers are not able to practice this method because it is more difficult to apply.

Burning of Pasture

Burning of pastures in the northern part of Ghana is not a recent practice. It is used by herdsmen who burn before the onset of dry season to destroy old unpalatable grass in order to get a second growth of short green grass at the beginning of the dry season. According to Korem (1985) many herdsmen in the North also burn bushes when there is the danger that grazing land can easily be turned into forestlands. Bush fires damage the shrubs and trees enhancing the growth of grass.

Herdsmen burn the pasture to protect their animals against snakebites and harmful pests such as ticks. They burn the pasture in patches. It is ideal for a patch of pasture to be burnt once but sometimes twice depending on how fast the grass grows or turns brown. As a result burning is done during the main dry season between December and April (Korem, 1985). With the advancement of the savanna vegetation to the transition zone this practiced is now popular with Herds men in the transition zone.

Religious and Ceremonial Bush Burning

Religious or ceremonial burning is peculiar to the Northern part of Ghana among different tribes notably the, Dagombas, Moshie, Mamprusi, Kusasis, Gonjas, Gurimas, Talensis, Komkombas, Walas and Dagartis (Korem, 1985). These fires are said not to be a frequent source of fire. This custom is performed in the evening on the ninth day of the month of fire. The month of burning could occur during the dry season or the rainy season. This is due to the fact that the natives use the lunar calendar in arriving at the month of burning. During the actual ceremony many people get ready their grass torches and assembly in the chief's house at the sound of a drum. Then with dancing, singing, shouting and drumming the chief and all the people move to a particular tree chosen for the occasion. On reaching the tree every one tries to throw his torch very high to the crown of the tree. It is believed that something good will happen to them in the coming year when a torch remains higher on the tree (Korem, 1985).

Indigenous burning techniques

The practice of burning has been developed over the years by local populace. In the past burning was carried out mostly in March at the end of the dry season. However in recent time burning is mostly carried out in the months of March and April depending on the onset of the rainy season. In order to achieve effective burning and reduce fire danger or risk at the same time farmers use certain environmental cues for the right time to burn. Indicators used before ignition takes place include; 2-3 rains after the end of dry season in March, low temperature and relative humidity, leaf flush of *Morus mesozygia* (Wonton), and a throw of soil into the air to check the direction and speed of the wind to ensure safe burning (Amissah, 2003). Broadcast burning as well as burning in heaps is among the techniques of burning developed by local people over the years. The idea of checking of these signs locally are somewhat consistent with the scientific way to burn except that these locals procedures are not specific and heavily depends on the experience of the farmer involved in burning.

Wildfire Management practices

Over the last two decades since wildfires became a threat to agriculture and forest resources in Ghana indigenous people have managed fires through prevention and suppression activities. Fires are prevented from spreading to farms and settlement through the construction of fire breaks and early burning which were not common in the forest zone in the past. In situation where it becomes necessary to suppress fires inhabitant of the communities are assembled through the beating of Gong Gong or drums authorized by the chief. Community members use construction of fire breaks to stop the fires indirectly or directly by beating the fires with palm fronts and water. The men normally have the responsibility of constructing the fire breaks whilst the women fetch the water. In recent times in response to the fire menace fire volunteer groups have been formed in communities who have the responsibility of conducting fire prevention education and suppression. However, Communities without fire Volunteers still use their traditional authority structures to deal with fire incidence. 'Proka' (a system where crops are sowed in a decomposed slash) is an alternative to the use of fire in farming. However, according to farmers it is labour intensive and unable to protect crops against pest infestation.

Conclusion

Some of the present indigenous practices for fire usage and management in Ghana are comparable to scientific and standard fire management practices. However, some of these practices are fraught with weaknesses such as the non use of weather data and the absence of locally developed fire danger rating system for early warning to direct the time to conduct burning exercise. In addition there is limited availability of fire fighting equipments as well as absence of standardised local methods for assessing onsite weather conditions before ignition. Predictions of climate change have indicated that West Africa would be drier and this could result in drought that would be a recipe for wildfires if some of the local practices of fire usage are not improved. Improving indigenous practices particularly weaknesses within practices on fire use and its management would enable us respond to a changing global climate and thereby reduce potential destruction of forests resources and ecosystem processes tied to fire. On farm research into alternatives to the use of fire in farming need to be given the needed attention in order to curb agricultural related fires.

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LOCAL PEOPLE AND FOREST MANAGEMENT IN CAMEROON

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Abstract

Local people are widely recognized as important partners for conservation with valuable knowledge of nature and natural resources. However, forestry laws in force in most of the African countries in the post colonial period have for long compromised local community rights to forest ownership. These laws expropriated resources and control over such resources from local communities, and excluded them from accessing forest resources and their economic benefits. As a consequence, forests disappeared at an alarming rate with the increasing global impacts that this will entail. In the 1990's, most of the tropical countries embark on decentralized forest management. In Cameroon, a new forest law was passed in 1994 with support from the World Bank. The objective of the new law included not only resource conservation, but also the greater involvement of local communities in managing and sharing the benefits accruing from the forests. This was done for many reasons: (1) local populations had a long-term interest in the natural resource than do outsiders, so local management will be more sustainable than that controlled by regional or national bodies which, generally was under control of foreign logging companies; (2) local representative bodies were believed to be more accountable to their local populations than were regional or national bodies, so there will be less opportunity for corruption to guide forest management decisions; and (3) given the often lack of funding in developing countries concerning natural resource management, local management could be more administratively and financially feasible, and therefore, more likely to be effective in more sustainable resource management. The paper shows that though involving local people in protecting forests constitutes a ray of hope for the future, current practices in Cameroon need a serious review. Improvements in the standard of living, in equity and in ecological sustainability which local people involvement in forest management was supposed to bring about have not been reached yet. The paper concludes that the ray of hope represented by local people in forest management in Cameroon is, however, still very weak and needs support from all organizations working for the respect for human rights and environmental conservation. Such support should not be seen, however, as "us" assisting "them", but as a collaborative effort to ensure present and future livelihoods for all people on Earth.

LOCAL COMMUNITIES' TRADITIONAL KNOWLEDGE OF THE MANGROVE FOREST ECOSYSTEM IN NZEMA EAST AND MFANTSEMAN DISTRICTS IN GHANA

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Abstract

Natural resources are scarce as a consequence of environmental degradation, with depletion of these resources as the major factor contributing to loss of habitats especially in Africa. The efficient management and conservation of forest ecosystems is therefore critical to the continued survival of man on earth. Mangrove forest ecosystem provides both environmental and socio-economic support to the local populace yet has not received much recognition from scientists in most part of the world and Ghana is not exempted. In 2006, the International Tropical Timber Organization (ITTO) funded a one-year pre-proposal project on "Sustainable Community Management, Utilization and Conservation of Mangrove Ecosystems in Ghana". To determine areas for increasing the capacity of the local communities there was the need to understand their real situation so as to define objectives according to their positive values. A study was then conducted on the traditional knowledge of mangrove management and conservation, which is the focus of this paper. The study was undertaken in nine communities around the Amanzure River in the Nzema-East District of Western Region and six communities dotted around the Ama Emissa River in the Mfantseman District of the Central Region. The major approaches used for the execution of this task were desk study, focus group discussions and pre-validation workshops. The study revealed that the communities have comprehensible rich knowledge of their mangrove ecosystem environment. In view of the key findings, this paper recommends documentation of these rich indigenous knowledge and practices as educational material to aid awareness creation and education processes.

Introduction

Natural resources are scarce as a consequence of environmental degradation, with depletion of the resources as the major factor contributing to loss of habitats in Africa. The efficient management and conservation of forest ecosystems is critical to the continued survival of man on earth. Not only do forest ecosystems provide man with certain basic necessities (such as food, timber, oil etc), but they are also homes to a lot of plant and animal species. Mangrove forest ecosystem which provides both environmental and socio-economic support to the local populace has not received much recognition from scientists in most part of the world. In Africa the extensive mangrove forests according to FAO (2007) have an important role in natural economies and local livelihoods. They represent a significant, traditional source of wood (timber, fuel wood and charcoal) and tannins and they support the fisheries of local population. Notwithstanding these benefits, the mangrove ecosystem is under threat as a result of rapid population growth and its resulting pressure for the resources as well as for other alternative land use systems. The FAO (2007) publication The *World's Mangroves 1980-2005* gives an overview of the species availability, the declining state of mangrove ecosystems as well as the factors facilitating their decline.

In Ghana, scientists and scholars have given much research attention to forest and tree ecosystem for decades however little research has been awarded in the mangrove ecosystem let alone the

collection and documentation of the local people's rich traditional knowledge. FAO (2007) reports that Ghana has also experienced gradual decline in mangrove forests stands. The rate of decline is from 18,000 ha to 12,400 ha during1980 to 2005. Thus exploitation may not be very severe yet, but pollution has been cited as a major threat within the mangrove ecosystem. The question then is why have mangrove forests not received much attention from scientific community in Ghana? To overcome this dilemma, in November 2006, the International Tropical Timber Organization (ITTO) approved of a one-year pre-proposal project on "Sustainable Community Management, Utilization and Conservation of Mangrove Ecosystems in Ghana". To determine areas for increasing the capacity of the local communities there was the need to understand their real situation from their perspectives so as to define objectives according to their positive values. A study was then conducted on the traditional systems of knowledge of mangrove management and conservation. The study was undertaken in nine communities around the Amanzure River in the Nzema-East District of Western Region and six communities dotted around the Ama Emissa River in the Mfantseman District of the Central Region.

In line with IUFRO-SPDC collecting, synthesizing and documenting traditional forest knowledge to foster science-policy interface, this paper presents a vivid overview of local people's perceptions of mangrove forest ecosystem from seven thematic areas. These include communities' pictorial perceptions and views of their mangrove resources; uses and benefits, ecological knowledge; mangrove durability; mangroves role in environmental stabilization and mangrove management and conservation.

Methodology

Study Districts

The Nzema East District is located between longitude $2^{\circ}05^{'}$ and $2^{\circ}35^{'}$ West and latitude 4^{0} 40^{1} and $5^{0}20^{1}$North. The district is endowed with tropical rainforest with an annual average rainfall of 157mm. According to the 2000 national population census, the total population is 142,959 being represented by 71,723 males constituting 50.2% and 71,326 females representing 49.8%. Seventy percent (70%) of the population are engaged in the agriculture sector; with this 4,000 people are in the fishery industry. There are about 600 registered canoes. The peak fishing period is in June-September. The major cash crops within the district are coconut, oil palm, rubber, cocoa and cassava. The two most scenically attractive and navigable water, the Ankobra and Amansure Rivers are found in the district. The Ankobra River sweeps through the mineral rich interior and is not only navigable but also in its journey to the sea, flows through very scenic rural areas. The changes of riverbanks from forest trees through bamboo, to mangrove are rich to behold.

The Amansure flows south from the interior and makes a ninety-degree turn to the right and heads for the lagoon that is the home of the river people of Nzuleso. It is a very beautiful river for a boat ride as the mangrove; the coconut trees, birds and riverside villages provide a peaceful and serene environment to visitors. The Amansure's estuary confluence, just off Esiama, is a great place for picnic. Axim is the capital town. (Nzema-East District Assembly, MTP, 2006).

Mfantseman District is located along the Atlantic coastline of the Central Region of Ghana. It extends from latitudes $5^{\circ}7^{'}$ to $5^{\circ}20^{'}$ North of the equator and longitudes $0^{\circ}44^{'}$ to $1^{\circ}11^{'}$ West of the Greenwich Meridian, stretching for about 21 kilometers along the coastline and for about 13 kilometers inland. The District is bounded to the West and Northwest by Abura-Asebu-Kwamankese District, to the North by Ajumako Enyan Essiam District and Assin South District, to the East by Gomoa District and to the South by the Atlantic Ocean. According to the 2000 population and housing census, the district has a total population of 152,264 comprising 69,670 males and 82,594 females. Farming and fishing constitute the main economic activities of the district, employing about three-quarters of the total workforce. Saltpond is the district capital (Mfantseman District Assembly, MTP, 2007).

Study Communities

The studies were conducted in two coastal districts (fig.1). The study involved a total of 15 mangrove fringe communities - nine communities around the Amanzure River in the Nzema-East District of Western Region (Alabokazo, Ampain, Azulenloanu, Alloakpoke, Eikwe, Krisan, New Bakanta (Anyanzinli) and Old Bakanta, Sanzule, and Alabokazo), and six communities dotted around the Ama Emissa River in the Mfantseman District of the Central Region (Suprudo, Emissano, Asaafa, Edumafa, Nakwa, and Kuntu). The rationale for selecting the communities was based on the close

proximity to the mangrove ecosystem thus would be interesting to find out about their perceptions of the resources.

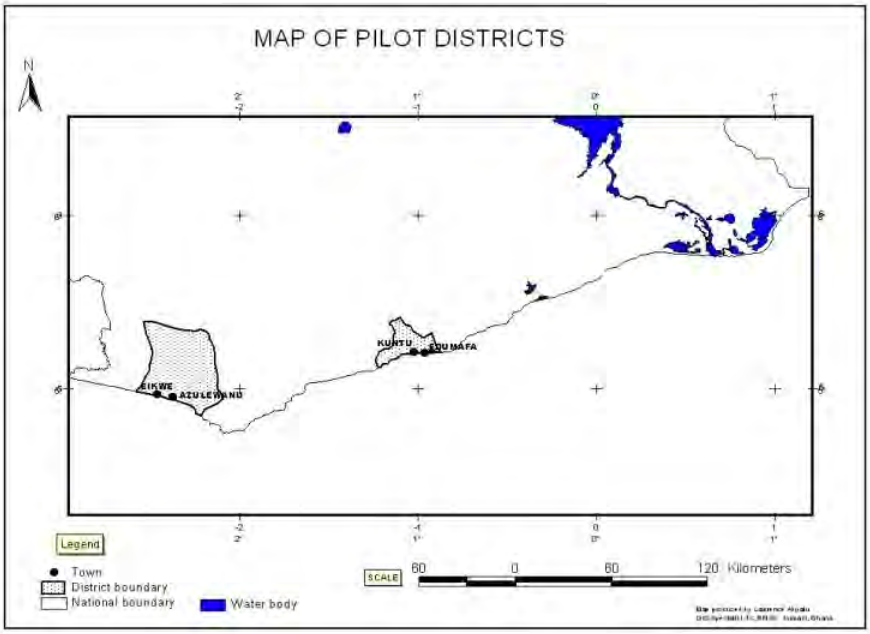

Figure 1. Map of southern Ghana showing Nzema East (shaded, left) and Mfantseman Districts (shaded, centre).

From the communities perceptions, Azulenloanu is spelt (Azuleoanu) – literally translated *'mouth of the river'* while Alloakpoke is spelt (Alapoke), name derived from local name of water hyacinth, which is abundant on the surface of the Amanzure River.

Approach

In trying to understand how local communities perceive their mangrove forest ecosystem, the studies employed desk studies as well as participatory approaches.

- Reviewed available literature: Focused on the concept of traditional or indigenous knowledge as well as on utilization, management and conservation of mangrove forests in Ghana and elsewhere.
- Reconnaissance surveys conducted: This was done to introduce the pre-project to stakeholders; to pre-test checklist used for the data collection; rapidly appraised some of the main biophysical and socio-economic features in the study area; select communities and made appointments with other stakeholders for latter visits.
- Focus group discussions held: The use of checklists assisted the research team to hold discussions with different stakeholder groups (fishmongers, fishermen, traditional authorities, firewood sellers, traditional authorities etc).
- Pre-validation workshop organised: In each district one day was used for meeting stakeholders' representatives. During this meeting, data collected in the various communities were synthesized and presented back to the communities' representatives to validate the data as well as draw common action plan for future management of the mangrove forest.

Study data were integrated, synthesized and subjected to descriptive analysis.

The Concept of Traditional Knowledge

Traditional knowledge is the local knowledge that is unique to a given culture or society. It is also known as local knowledge, folk knowledge, people's knowledge, indigenous wisdom or traditional

science. It is the basis for agriculture, health care, food preparation, education, environmental conservation, and a host of other activities. Much of such knowledge is passed down from generation to generation, usually by word of mouth. Indigenous people have a wide knowledge of the ecosystem they live in and ways to ensure that natural resources are used sustainably. Therefore, indigenous knowledge which has been accumulated over centuries has potential value for sustainable development. It can also help other people learn how to live in harmony with nature and the environment in a sustainable fashion (Sri Lanka, 1996). The avenue through which indigenous knowledge is passed from one generation to the other is known as traditional education. Traditional education is the process by which a society gradually socializes its youths into its norms, religious beliefs and moral values as well as collective opinions of the whole society. Both adults and children are involved informally in the traditional learning process through ceremonies, rituals, imitation, recitation and demonstration. It is a method of informal education which is based on a wide range of cultural items such as folklore, folk drama, folk story, songs, village meetings, taboos and superstitions. All these are parts of indigenous knowledge, and people learn them, practice them, and teach them to the next generation. Modern education, was introduced during the colonial period to many developing countries with the objective of producing administrators, clerks, teachers, and interpreters, etc (Ulluwishewa et al., 1997). This type of education was based on alien knowledge systems - scientific knowledge - which evolved and developed in the western industrialized world. Modern education systems have had no place for either indigenous knowledge or indigenous methods of education. It was assumed that indigenous knowledge was irrelevant, unscientific and outdated and, therefore, no attempts were made to integrate indigenous knowledge into the modern educational system. In other words, indigenous knowledge was rejected without making attempt to test its validity and potential value in solving contemporary problems.

Indigenous knowledge is best understood by establishing the difference between it and non-indigenous knowledge-scientific knowledge which many are familiar with. Table 2 depicts the basic differences between indigenous and scientific knowledge.

Table 2. Basic Differences of Indigenous and Scientific knowledge

Indigenous	**Scientific**
Generated by local people through their day-to-day experiences in facing challenges of nature and society	Generated by professional scientists through systematic scientific research and experiments
Often not documented	Often documented
Not standardized and localised	Standardized and expressed in global terms

Scholars however believe that traditional practices that have been the anchors of sustaining nature conservation have been eroded by multiple factors: influx of different western cultures and practices; high population growth thus high demand for forest ecosystem for products and alternative land use; other religious beliefs relegating traditional beliefs to the background; poor comprehensive synthesis and documentation as literature have been scattered in different research publications.

Nevertheless, some scholars still believe in the existence of some traditional knowledge and practices among local communities fringing natural resources. To Hviding & Baines (1996), Marovo lagoon fishing methods are strongly underpinned by extensive body of environmental knowledge (traditional knowledge). Men can accurately predict the occurrence of fish spawning behaviour, women can easily tell the time of abundance and distribution of mollusks and crustaceans by observing the daily, lunar and seasonal rhythms.

Communities Perceptions of their Mangrove Forest Ecosystem

The local people in the study area have rich reservoir of knowledge and practices for the conservation of mangroves. Though, this knowledge may not necessarily harmonize with instituted knowledge or 'science', they can still serve as a useful guide in the formulation of management strategies that can really work. This is because their knowledge has been generated over the years through observations and practices while others have been passed on to them from generation to generation.

Communities' Pictorial Perception and Knowledge of their Mangrove Resources

There are a lot of resources obtained from the mangrove ecosystems ranging from fauna to flora that the communities are knowledgeable. They have been clearly exhibited pictorially as seen shown in plate 1.

Plate 1. Resource mapping of mangrove ecosystems in Ama Emissa River indicating the flora and fauna species. *Source*: field survey, March/April, 2007.

Communities Indigenous Knowledge on Uses/Benefits of Mangroves

In the Nzema-East district, mangroves are locally known as *'nateke'* whiles it is referred to as *'nsuduri'* in the Mfantseman district. In both districts mangroves are known to provide some benefits to the communities. Mangroves serve as habitat, nursery and spawning grounds for crabs, shrimps, lobsters, fishes and other animal species. There is evidence that mangrove forests are used as shelter and nursery grounds, as permanent habitat for some species, and as breeding grounds for some coastal species (Aksomkoae, 1993; FAO, 2007).

Mangroves serve as posts and poles for building houses and other shelter. Most buildings in mangrove-predominant areas like Azulenloanu in Nzema-East district, Emissano and Suprudo in the Mfantseman district are supported by mangroves. Elsewhere in Thailand, mangrove poles are used mainly for foundation piling, scaffolding and fish traps. In Matang, Malaysia, some 2000 ha of mangroves are thinned for the production of 3-4 million poles every year. In Indonesia, mangrove forests produce approximately 170,000 poles per year (Aksomkoae, 1993).

Rhizophora species (which is known as 'neteke' in Nzema East and 'bakabeng' in Mfantseman) were known to be sources of tannins. Tannins are extracted from its bark and used as dyes for clothing and fishing nets. Locally, the extraction is done by beating the bark several times until they become moist and loose fibre. The loose fibre is then mixed with sea water (or salty water) to form a solution (dye). The clothing or cotton fishing net is dipped in this solution for four (4) days for the tannins to fasten and strengthen it. For the fishing cotton nets the rationale was to strengthen and also the dyed nets served as baits for fishes. However, today, with the introduction of nylon nets for fishing, the use of mangrove tannins to dye fishing nets are underutilized. Similarly, tannin in Asia and the Pacific was only used by fishermen for dyeing their fishing nets. The use of tannin for this purpose has almost ceased also since nylon nets are now widely used. Aksomkoae (1993) reports that Latin American countries, however, continue to extract vast quantities of tannin from their mangroves, in particular from *Rhizophora* bark.

Within the study communities, mangrove wood is known to produce pleasant flavor when used for smoking. Hence, fishmongers use mangroves to smoke their fresh fishes in order to improve taste and appearance. Other village folks use mangrove wood as firewood for cooking. Mangrove wood is harvested in various communities in Nzema-East district, notably Old Bakanta and Ampain for the production of charcoal. The situation is not so crucial in the Mfantseman district. Although firewood

has traditionally been used for daily cooking by these communities, in recent years mangroves are converted to charcoal for both subsistence and commercial use.

Leaves of mangroves are known for their medicinal property. In Alabokazo in the Nzema-East district, mangrove leaves are used to relief pain. In Edumafa in the Mfantseman district, mangrove is used for treating hernia.

Communities Indigenous Ecological Knowledge on Mangroves

Species of mangroves along Ama Emissa and Amansure Rivers.

The mangrove species along the Ama Emissa River are of three kinds. The local people categorized them as 'bakabeng' (has stilt or prop rooting system, long propagules, in the past used the bark as dye. Which is a common characteristic of genus *Rhizophora* but the species is yet to be assessed. The second type is known as the male mangroves (has no prop rooting system, has red bark, leaves are ovate.) and lastly the female mangrove (no prop roots, has white bark, leaves slender with pores). The mangrove species along the Amansure River is known in the local dialect as 'neteke' which has a prop rooting system and long propagules, in the past also used the bark for dye. This latter description falls in line with that of 'bakabeng' around Ama Emissa River. The three types could be categorized as follows simply as:

Type 1: Characterized by many root entanglements (stilt/prop roots).

Type 2: Red veined leaves, ovate and having a common point of convergence, regarded as 'male' mangrove.

Type 3: White stem, slender leaves not having a common point of convergence, regarded as 'female' mangrove. It has no prop/stilt roots.

The three species described by the communities as the 'bakabeng or neteke', male and female mangroves could be associated with the description given by Hussein (1995) as *Rhizophora sp, Laguncularia racemosa and Avicennia germinans* respectively. FAO (2007) also identified two species of *Rhizophora* in Ghana to be *R. harrisonii* and R. *racemosa.* Thus with assistance from science the actual species within Nzema East and Mfantseman could be ascertained. Both *Laguncularia racemosa* and *Avicennia germinans* were also identified to exist within the coastal area of Ghana by FAO(2007) and their descriptions fit into the 'male' and 'female' descriptions of the local people.

Preferred environment and population trend

Mangrove grows well in brackish water or saline conditions. Respondents know this fact and generally agree that mangroves are plentiful and bigger in size at high salinity areas of the Amanzure River and Ama Emissa River than low salinity areas. Hence, mangroves in Azulenloanu (estuary community), Ampain (adjoining community), Old Bakanta (a coastal community) and New Bakanta all in the Nzema-East district are characteristically bigger in size than those in the other communities where the salinity of the Amanzure River is low. Mangroves in Emissano, an estuary community in the Mfantseman district are relatively bigger than that elsewhere. Within the study communities, field observation revealed that communities such as Narkwa and Edumafa, which are far from the sea, have less Nsuduri (mangroves) as compared to communities such as Kuntu, Asaafa, Suprudu and Emissano which are nearer to the sea. There are varied views about the trend of mangrove population in the various communities. While respondents in some communities think that the population has increased steadily over the past 10 years, others feel that it has reduced instead. These divergent views may both be true depending on the location of the respondents. In some communities, especially where mangroves grow bigger in size, people obtain their incomes from mangrove harvesting for domestic utilization or for sale, especially during the fishing lean season without replanting. Respondents from this side may observe a gradual drop in mangrove population. But this may not be the experience of respondents from communities where exploitation is minimal.

Phenology of mangroves – seed germination, flowering, fruiting, and dispersal

Phenological characteristics of mangroves include flowering, fruiting, propagule maturation and fruit maturity. Most of all respondents did not know that mangrove trees bear fruits and seed. Even, for the few respondents that claimed to have this knowledge, description about mangrove fruits and seeds differed. While some described mangrove as bearing brown fruit, others described its fruit as green,

bearing black seeds. Still, others view mangrove seed as green, long and slender; a few more described mangrove fruit as slender in shape with a brown tip.

In the Nzema-East district most respondents identified the following shown in the plate 2 as either fruits or seeds or both integrated into one structure.

Plate 2. Fruits and seeds of mangroves in the Nzema-East district

In the Mfantseman district, respondents identified the following shown in plate 3 as fruits and seeds of mangroves.

Plate 3. Fruits and seeds of mangroves in the Mfantseman district

Even though respondents may not be precise about description of mangrove fruit and seed, they know that they are either brown or green or both.

Most of the communities' respondents had no knowledge about the flowering dynamics of mangroves. Respondents in New Bakanta however offered between 15 and 17 years as time taken by a germinated seed to flower.

The local people were of the opinion that Amanzure and Ama Emissa Rivers serve as agents of dispersal for mangrove seeds which are situated in or close to them. During rainy season, the rivers overflow their banks, carrying some matured seeds while others stream away. When the rains subside, the rivers gradually refill their banks, often leaving behind the displaced seeds. Viable seeds germinate in suitable environment; thus mangrove population increases.

Respondents in both districts generally agreed that it does not take more than three (3) weeks for a viable mangrove seed to germinate under suitable conditions. Views expressed about length of time required for a germinated seed to grow to about a table-foot size (about 5 cm) ranged from 2 to 5 years.

Associated fauna and flora and their effect

In the Nzema-East district, prominent vegetation known to associate with mangroves is a timber species known locally as 'Nwele'. The communities claimed that the Nwele species has similar characteristics in terms of tannins with the Neteke (*Rhizophora sp.)* but is a hard wood and often used for railway slippers. In both study areas respondents observed that where there are mangroves, there are also raffia palms.

Generally, mangroves serve as breeding grounds for fishes and crabs as indicated in an earlier section. This follows then that they also associate with mangroves. This association is readily identified in all communities. At New Bakanta, respondents mentioned a shelled-fauna, locally called *'dobole'*, as living in symbiotic association with the roots of mangroves. Often, the *'dobole'*, (mollusc shell shown in plate 4) is accessed by first removing or cutting the mangrove. Isarankura (1976) cited in Aksomkoae (1993) identified four species of bivalves that are found in mangrove forests. Of these, *Crassotrea commercialis* was known to be of particular commercial importance and usually attached to Rhizophora roots.

Plate 4. Shelled-fauna, locally called *'dobole'*.

Communities Indigenous Knowledge on Mangroves Role in Environmental Stability

Knowledge about mangroves role in stabilizing the coastal environment was very low in the two sites. Even though mangroves serve some useful purposes for coastal communities, majority of them still view mangroves as of little value to their livelihoods. However, mangroves are known to play very crucial roles in stabilizing shorelines in coastal streams and estuaries by protecting them against tidal bores and soil erosion. In countries which are frequently attacked by strong winds such as the Philippines, Vietnam, Bangladesh and Australia, mangroves serve as a barrier against storms. In fact, it is believed that if the mangrove communities along the banks of estuaries and coastlines were disturbed, or destroyed, there would be no habitat or food to support the organisms in these areas. Furthermore, the loss of these mangrove-related ecosystems would disturb the natural ecological systems over a considerable area and result in large-scale economic loss and socio-cultural change in coastal communities.

In Mfantseman district, most people have perception that the mangrove ecosystem is a breeding ground for mosquitoes and it's of low economic benefits as compared to other land use system. In view of that large tract of mangrove land has been cleared for salt production by both local and foreign investors with the communities as field workers. Since salt production is seasonal, most often the people are out of work during the non-seasonal periods.

The important role that mangroves play in environmental stability was illustrated in Old Bakanta, a coastal community in the Nzema East District, on June 5, 2005. A site, previously occupied by mangroves, was converted to coconut plantations land use. Later, a sea surge followed by strong winds razed down the houses and vegetation now occupying the site. The mangroves served as breaks against strong winds from the sea; but their removal presented no defence for the communities.

Communities Indigenous Knowledge on Mangrove Durability

Respondents know that mangrove is a hard wood. However, once harvested (either dried or moist) it does not live long in soils. As a practice, to prolong its lifespan in soils, the local cover mangrove with polyethylene to slow down decomposition; especially when used as pole for housing and other shelter.

Communities Indigenous Knowledge on Mangrove Management

Cutting cycle and coppice ability

There were varied views expressed by respondents on the coppice dynamics of mangroves. Most of the respondents were convinced that mangroves can sprout again when cut, but depending on the age of the mangrove and which part of the mangrove is cut. Others remarked that when mangroves are cut at the aerial level, there is resprout but this should not be repeated within a year in order not to break the integrity of the plant. However, when coppiced at ground level, (less than 4 feet) resprout is not possible. To other section of the group met, mangroves can sprout again no matter where and how often it is cut. Only few shared no views at all since they claimed knowing nothing about it. Hussain (1990) however noted that *Avicennia germinans* regenerates and coppices well and can be managed under a coppice system.

Any preferred season for harvesting and why?

The respondents agreed that the ideal time for harvesting mangroves is the dry season due to the following reasons: (1) The Amanzure and Ama Emissa Rivers lose water and become safer to explore when harvesting mangroves; (2) Other wetland vegetation around the mangroves often dry out,

reducing entanglements; (3) Water in swampy areas often evaporates leaving the ground relatively stable to walk on; (4) Evapo-transpiration increases during the dry season, causing mangroves to shed leaves, thus making them more accessible; and (5) The dry season often is the fishing lean season when fishermen look for alternative sources of income; the use of mangroves is often their first option.

Generally, the rainy season (May – August) is ideal for harvesting some Amanzure River resources such as fishes but the dry season is preferred for harvesting oysters and other crustaceans.

Indigenous Practices for Management and Conservation of Mangroves

A strong traditional knowledge base for the protection of wetlands (natural resources in general) through indigenous management systems exists among coastal communities. Most wetlands and their resources have been protected and regulated in the past through varied traditional practices, depending on the beliefs of the traditional area that claims ownership (World Bank, 2005). Indigenous management practices, which give emphasis to socio-cultural values, can be accepted as means of regulating the utilization of mangrove resources. These practices involve customary laws or taboos, which determine rights to land and resource use. They also include the enforcement of sanctions for violation by the responsible authority, often the traditional ruler of the area. Traditionally, every river, lagoon or special water body has a 'god' or 'goddess' with its set of unique regulations. Though these rules and regulations are steeped in traditions, their main effect is to control resource use, which is generally observed by local populations (MLFM, 2007). For instance, the Amanzure River is locally viewed as a deity. The River is thought to be the abode of a number of powerful local 'gods'. It has a unique dark colour as a result of high concentration of humic acid. The local belief is that the color of the water is the result of an argument between the gods of the Amanzure River and another river. The Amanzure River therefore took the black colour to distinguish itself. In fact, its characteristic dark color invokes awe and fear in the people. It is viewed as a deep river and thus not explored during the wet season for fear of sinking to irretrievable depths. To explore the Amanzure River or exploit its resources including mangroves, in some communities, certain local customs are required to be observed. This is often carried out by the traditional authority of the community. Often, this requirement discourages people from harvesting mangroves. At Azulenloanu in the Nzema-East district, there is a traditional ban against the exploitation of fresh mangroves around the Amanzure River. Only toppled mangroves may be accessed. Penalty for an infringement attracts a fine of money and payment of sheep and drinks.

Sometimes, specific days are set aside as taboo days. For example, at New Bakanta, also in the Nzema-East district, people are not permitted to exploit the Amanzure River as well as its resources, including mangroves, on Thursdays. Failure to heed to this attracts a sanction and payment of four (4) bottles of Castle Bridge Gin. Similarly arrangement exists at Ekumfi Emissano in the Mfantseman District; Saturday is set aside as taboo day, in which inhabitants are not permitted to exploit the Ama Emissa River also viewed as a deity. It is believed that Ama Emissa River punishes offenders. The traditional authority in the communities similarly imposes sanctions on offenders.

Even though some of these management practices are reckoned helpful in mangrove management, they have become threatened and are likely to fade away with time due to changes in norms, social patterns and economic development. It is important to state also that such customs and sanctions do not necessarily exist in all communities. Hence, if there are any virtues associated with these traditional practices, they may apply only in few communities that enforce the regulations. Nevertheless, the activities of one community directly or indirectly affect the others. Destruction of mangroves in areas where these sanctions do not exist can indirectly affect communities with these traditional arrangements.

Conclusion

Critically assessing the communities perceptions of the mangrove forest ecosystems enabled the research team drew the following concluding thoughts under the seven thematic areas:

- The study communities have comprehensible pictorial perceptions and views of their mangrove resources as well as its uses and benefits.
- Ama Emissa River is endowed with three types of mangroves species namely *Rhizophora sp*. (Bakabeng), *Laguncularia racemosa* (male nsuduri) and *Avicennia germinan* (female nsuduri)

whilst Amansure River is endowed with Rhizophora sp ('Neteke') which calls for scientific interventions to assess the species types of genus Rhizophora in both sites.

- The communities have rich indigenous knowledge of the phenology of the mangrove tree. The only gap detected was the divergent views on the shape and colour of seeds and fruits as well as the flowering dynamics.
- Knowledge about mangroves role in stabilizing the coastal environment was generally low in all communities of Nzema-East and Mfantseman districts.
- There is no written down management strategies for the mangrove ecosystem except in few communities where the traditional authorities have oral norms or taboos that has kept the mangrove ecosystem sustainable.
- There are strong traditional knowledge bases for the protection of wetlands (natural resources in general) through indigenous management systems existing among coastal communities. This is because the two rivers are locally viewed as deities. The Rivers is thought to be the abode of a number of powerful local 'gods' or 'goddess'.

When it comes to uses to which they can be put, communities know mangroves quite well. At least, they have exploited them to satisfy their aspirations and to meet some of their basic livelihood needs. The resource is seen as always present and hence no serious attempt has been made to manage them well, either traditionally or scientifically. There is virtually no regulation to their utilization, except for pockets of traditional ban and sanction for some aspects of mangrove use in isolated communities. Elsewhere, the role that mangroves play in environmental protection is relegated to the background and mangrove sites are converted to other land uses. These factors have influenced the gradual degradation of mangroves and their resources in many areas. It is obvious that awareness about mangrove degradation and knowledge on their ecological functions are low. There is a need for awareness creation and sensitization that inform the public about mangroves ecosystem and its requirements, their uses and services and how to maintain them. These programmes should be aimed primarily at the people who live near the mangroves and depend on them for various needs.

The key recommendation made by the researchers is the need to document the rich indigenous knowledge and practices of mangrove conservation, utilization and management so that it could be used as educational material for awareness creation. The question that runs as a common thread through this paper how science could accommodate these traditional knowledge in order to manage challenging contemporary issues in natural resource management. This therefore presupposes that scientists should look out for a gleam for integrating traditional knowledge with scientific knowledge. How then can it be achieved?

The use of traditional knowledge in forest management foster rules based on tradition stronger and more community owned than formal rules. In spite of the many perceived defects of traditional knowledge, it can complement modern science when it is carefully matched with scientific data and applied in policies governing forest management. Neither science nor traditional knowledge knows it all, integration may be the best option.

The first step in documentation and blending of traditional knowledge and practices with scientific knowledge in Ghana-adapting IIRR five steps process.

1. Identify the problem or issue for which information is sought.
2. Working together with community members, record and briefly document all traditional knowledge (TK) available in the community relating to the problem, including what has been done in the past and what is done now. If no TK exists, it might be necessary to test, adapt and promote scientific knowledge.
3. If relevant TK does exist, local people and field workers can together discuss and screen their findings, looking for the most relevant TK information. Understand the reasons behind a particular practice or belief.
4. Test whether the TK can be improved. It may be possible to blend TK and scientific knowledge.
5. The improved TK can be promoted through information exchange and extension.

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TRADITIONAL KNOWLEDGE ON CONSERVATION OF SEED OIL, MEDICINAL AND DYES AND TANNIN PLANTS

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Abstract

The components and interactions of biodiversity supply people with ecosystem goods and services. Conservation of plants, especially endangered ones depend largely on the conservation of the ecosystem in which they occur. As a result, the issue of conservation of natural products has been the focus of many formal and informal discussions at national and international forums, seminars, workshops, conferences and congresses in the past few years. Traditional knowledge of conservation of these plants is currently threatened in rural communities by loss of traditional and cultural systems on conservation. Indigenous knowledge is created and sustained by local community members as a means to meet their needs for food, shelter, health, spirituality, and well-being. To contribute to the documentation of traditional methods of conserving plant species in Ghana, a survey was conducted in parts of Eastern, Ashanti and Brong Ahafo regions of Ghana to ascertain the traditional methods of conserving plant species which are important as seed oil, medicinal and dyes & tannin plants. In addition, literature was also gathered from desk studies of articles and policy briefs. Based on the study, the traditional methods of conserving the seed oil, medicinal and dyes & tannin plants included domestication, conservation of sacred plants, sacred forests, cultural forests and plants at grave sites, taboos, selective harvesting of plant parts and hiding information on the location and uses of some medicinal plants.

Introduction

Forests cover almost 25% of the world's land and are critical in meeting human needs for water, food, shelter, medicine, fuelwood, fodder and timber. They also provide a wide range of environmental services which mainly include biodiversity conservation, watershed protection, protection of soil, mitigation of global climate change etc (Hirakuri, 2003; Landell-Mills & Porras, 2002). In last several decades, deforestation and biodiversity loss became a common event throughout the globe. This phenomenon is much more frequent in developing countries like Ghana.

The key pervasive natural resource management issues in Ghana are land degradation and deforestation, and the loss of biodiversity associated with unsustainable harvesting levels in the high forest and in the savanna, compounded by inappropriate farming practices and annual wildfires. Also related are issues of lack of effective enforcement of institutional and policy framework for implementing ecologically and socio-economically sustainable management systems for high forest, savanna woodland and wildlife resources, in collaboration with local communities.

The issue of NTFP conservation and use has been the focus of many formal and informal discussions at national and international forums, seminars, workshops, conferences and congresses in the past few years due to their great potentiality for poverty alleviation (Hens, 2006; Ruiz Pérez, 2005; Belcher et. al. 2005; Arnold & Ruiz Pérez, 1999). They also create opportunities to development of forest based small scale enterprises (FBSSE) and it is widely recognized that, increasing their commercial value will contribute to an increased appreciation of forests, therefore contributing both poverty alleviation and forest conservation (Clay, 1992). Again exploitation of NTFPs is less ecologically destructive than timber harvesting and therefore provides a sounder basis for sustainable forest management (Peters et. al. 1989).

Contemporary discourse on natural resources conservation and development is dominated by three major paradigms: the Classic approach, the Populist approach, and the Neo-liberal approach (Blaikie

et al., 1997; Brown 2002). All three approaches see human and natural resources linkages differently. The *classic* approach considers people as threats to biodiversity.The *populist* approach stresses empowerment and participation of the local community as keys to sustainable conservation and development. The *neo-liberal* approach, which has been much in debate recently, recognizes institutions, policies, and markets as economic incentives to local people for sustainable biodiversity conservation (Adger et al., 2001). This emerging view of the neo-liberal approach also forms part of the "new conservation" dialogue (Hulme & Murphree, 1999) that advocates for people's participation in conservation through market-based approaches.

However, the neo-liberal approach or new conservation has been criticized by some scholars on two main grounds: First, the new conservation is seen as re-inventing the wheel of old-styled conservation that is still top-down rather than being democratic and participatory (Brown, 2003). Second, purely economic incentives, as envisaged in the neo-liberal approach, are considered inadequate and perhaps irrelevant from a community's perspective. For example, some writers and proponents of protection of the intellectual property rights for communities that have conserved biodiversity for ages argue that there has been a mismatch about the perceptions of incentives (or benefits) between conservationists and the community as a knowledge holder (Gupta, 1998; Brown, 2002). As a result, incentives in terms of pure economic forms are viewed as "too narrow," "too simplistic." and "potentially counterproductive" (Berkes, 2003).

Local communities in Ghana have a particular concept of nature which could contribute to the development of sustainable management practices, promoting biological and socio-cultural diversity. There is an increasingly comprehensive appreciation of this knowledge and biodiversity conservation projects have been more successful when local knowledge was considered. However, Traditional knowledge of NTFPs conservation and use is currently threatened in rural communities by loss of traditional and cultural systems on conservation, religious distractions and scientific dilemma.
In the past by our own pronouncements, actions and deeds, we've so much degraded traditional knowledge, mostly in herbal medicine. The present resurgence in having another look at traditional knowledge for the sustainable conservation and use of flora is a clear manifestation of our earlier arrogance.

More than three-quarters of the world's population rely on local knowledge systems to meet their medicinal needs, and at least half rely on local varieties and associated knowledge systems for their food supplies (Walsh, 2003). This knowledge is popularly known as traditional ecological knowledge (TEK) and may be defined as "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes 2000).

In the present study, we studied the transmission of traditional knowledge related to conservation of dyes & tannin plants, medicinal plants and seed oil plants as practice by a few southern Ghanaian communities namely, Kwapanyin, Asuboi, Kade, Mpraeso, Amangoase, and Konsua all of the Akan tribe. Whereas dyes & tannin plants are important for their colour in textiles, medicinal plants afford treatment of ailments and seed oil plants serve as food source. Having differing uses may inform the importance people attach to these plants. That is why the comparison between them could shed interesting information on their conservation methods.

Methodology

A survey was conducted in 6 communities from 3 regions in Ghana (Ashanti region: Kwapanyin and Asuboi; Eastern region: Kade and Mpraeso; Brong Ahafo region; Amangoase, and Konsua) to ascertain the traditional knowledge of conserving plant species which are important as seed oil, medicinal and dyes & tannin plants (NTFPs) from 124 respondents.

With the intention of carrying out this work, a formal presentation was initially made to the authorities of each community to request their consent to work in the area. In each community, ethnobotanical fieldwork was conducted by means of focused group discussions using semi-structured questionnaire to collect data where the details about the traditional knowledge on plant conservation, strengths and weaknesses of the traditional practice and documentation of the practice as well as the type of plant being conserved were recorded. Some respondents gave multiple answers. The interviewees'

personal data, such as gender, occupation and age, was gathered as well. Aspects related to the type of plant being conserved using traditional knowledge were also of interest.

The questionnaire returns were compiled using an excel spreadsheet to tally the answers to the specific questions posed. These tallies have then been input into graphs to highlight the responses. Where written answers have been given to certain questions, these have been collated into generic responses rather than listing every response verbatim.

Results and Discussions

In the present study we have found that traditional forest knowledge related to conservation practice is still transmitted by word of mouth through family dissemination over generations and there is the urgent need of documentation. Fifty eight percent (58%) of the respondents were of the view that the traditional knowledge should be documented. If documented, 80% of the respondents agreed that it would not affect their income but then the repository of the knowledge should benefit financially according to ninety three percent (93%) of the respondents (see Table 1 for survey results).

Table 1. Results of survey conducted in 6 communities from 3 regions in Ghana to ascertain views on traditional knowledge related to conserving plant species which are important as seed oil, medicinal and dyes & tannin plants. Results based on 124 respondents.

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
If the traditional knowledge is not documented, it will eventually be erased	36%	58%	6%	0%	0%
If the traditional knowledge is documented and made public, I will lose my income	3%	14%	3%	57%	23%
If the traditional knowledge be documented, I should benefit financially	60%	33%	7%	0%	0%
There is the need to review the traditional knowledge to suit modern trends	3%	55%	23%	19%	0%
Governmental laws are much more punitive than traditional laws	20%	54%	10%	13%	3%

The herbarium of the Council for Scientific Research into Plant Medicine (CSRPM) in Ghana with specimens of reported medicinal plants in Ghana, totals over seven hundred and fifty species. In 1994 it used 64149.50 kg of dry weight of plants and parts of plants to produce herbal medicines for the centre's clinic only. In 1995 the estimated value was 1,1924 kg or an increase of more than 200% (Sam, 1998). A clear manifestation of an urgent need for plant conservation!

According to 58% of the respondents (Table 1), there is the need to review traditional knowledge to suit modern trends. Although the incorporation of new practices and technology, which could lead to innovative processes, could also imply the loss of traditional forest knowledge, this could however allow for the integration of new and ancestral practices, generating hybrid knowledge as observed by Sears et al. (2007).

Traditional conservation methods may provide a less expensive protection than *in situ* and *ex situ* conservation methods. Some sacred plants and several plants found in sacred forests are examples of NTFPs conserved through traditional methods. Therefore, traditional methods are effective in conserving a large number of NTFPs. Conservation practices imply personal connections with nature

that might provide opportunities for learning and encourage the development of attitudes which are associated with the protection of the environment (Schultz et al., 2004). At present, there are fewer opportunities, especially for children, to spend time with and learn from parents, grandparents and others who are knowledgeable about conservation practices and beliefs (Berkes & Turner, 2006), in addition to the introduction of schooling into family life (Pilgrim et al., 2007).

In all the communities, traditional conservation practices included domestication, conservation of sacred plants, selective harvesting of plant parts, mix copping with cash crops, taboos and hiding information on the location and uses of plants. It was observed that most plants associated with taboos as conservation method were medicinal and dyes & tannin. This could be attributed to the reverence the people have for the plants curing them of their ailments, and in the case of the dyes & tannin plants, the unexplained coloured liquid that ooze out is mind boggling. Taboos were not regularly associated with edible seed oil plants, obviously to satisfy the basic need of hunger. Seed oil plants that had taboos associated with them were either poisonous or medicinal. Apart from dye-yielding property, some plants are also used traditionally for medicinal purposes (Hussein et al., 1997; Clinton, 1998; Wagner et al., 1989; Singh et al., 2005). That is not to say all medicinal plants had taboos associated with them. For instance the neem tree, a powerful medicinal tree had no taboos associated with its conservation.

According to 74% of the respondents, governmental laws are much more punitive than traditional laws (Table 1). Strengths of traditional knowledge on conservation included protection of river bodies and plants, provision of shade for food crops and serene environment. Weaknesses of traditional knowledge on conservation included secrecy, unnecessary fear put in people, potential benefits of some plants may not be known because they are not allowed to be explored. Because of this we might have lost important plant species beneficial to man in treating diseases and ailments. Plant species that could have acted as leads for the development of new and potent drugs and dyes might have been permanently erased.

While some people believed that traditional sanctions are severe and classified it as a strength of traditional conservation knowledge, others thought otherwise and classified sanctions as a weakness of traditional conservation knowledge and varied from community to community. Undeniably, modern trends and technology have questioned and violated some taboos, thereby weakening any associated sanctions. However, some taboos have stood the test of time. For instance for *Gnidia burchelii*, the conservation myth is that using it as firewood, calls for starvation, brings bad luck, causes mental illness and causes quarrels amongst the family. However, the biochemical reality is that the smoke emits poisonous substances that affect the mucous membrane.

Though in different regions of the country, all six communities are of the Akan tribe and no wonder they have very similar thoughts, perceptions and practices concerning traditional plant conservation. Plants mentioned by the respondents included *Pycanthus angolensis, Allanblackia paviflora, Khaya senegalensis, Rauwolfia vomitaria, Tetrapleura tetraptera, Acacia nilotica, Acacia mearnsii , Alstonia boonei.*

Conclusion

Due to the practices described above, the local people could conserve their plant resources for a long period of time. However, at present, because of increasing population and contact with 'foreign' people, who practice unsustainable life style, there is every threat for the genetic resources conserved by the local people until now. Traditional knowledge on conservation and use of non-timber forest products should be collected, documented and adopted as a basis for their management.

There exists a critical balance between Traditional knowledge and Scientific Knowledge. To upset this balance through unnecessary castigation on traditional systems of knowledge can have disastrous effect on many people. In order to preserve traditional ecological knowledge, it would be convenient to generate connectedness within networks and groups so as to encourage vertical and horizontal transmission of traditional practices among locals. Therefore, it could be useful to bring back these results to the rural people and to promote community participation activities tending to share traditional knowledge such as workshops, field trips and seed interchange. This could enable greater

integration between local and scientific knowledge, allowing for cultural and biological diversity. For this purpose, Integrated Conservation Method (ICM) consisting of traditional as well as scientific conservation methods should be seriously considered. In this way, investigations such as the present study could help by forming a bridge between local dwellers and extension agents who want to promote rural development. It is considered that being receptive to local people's traditional ecological knowledge is important in order to generate more efficient aid to rural communities, as well as fostering scientific culture.

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ETHNOBOTANY OF *PENTADESMA BUTYRACEA* IN BENIN: A QUANTITATIVE APPROACH

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Abstract

Pentadesma butyracea Sabine (Clusiaceae) is a multi-purpose tree that provides non-timber forest products (NTFPs). In particular, fruit kernels can be transformed into butter for cooking and cosmetics. Unfortunately, natural stands of *P. butyracea* are seriously threatened in Benin. A questionnaire was used to measure plant use knowledge for all parts of the species from 180 randomly selected respondents of two municipalities belonging to seven sociocultural groups: Nagot, Anii, Kotocoli, Waama, Ditamari, Natimba and Fulani. Four use values are presented: reported use (RU) value for each plant and plant part; plant part value (PPV); specific use (SU); intraspecific use value (IUV); and overall use value (OUV). After using a Principal Components Analysis, it seemed that Social groups that were living in the same geographical area shared similar values of *P. butyracea* parts. Nagot also have the highest use value for bark and root, two the most sensitive parts for the plant survival. Using intraspecific use value (IUV), the following uses of *P. butyracea* plant parts can be noticed. Leaves are commonly used to treat fever and to heal wounds. The young leaves are consumed like vegetable for their lactogenic effects. As for root and bark, they are used in stomach pain treatment and in menstrual cycle regularization. Flowers are especially known for their use in magico-mystics treatments. Pulp is used in pedicures care and constipation treatment.

Introduction

Common ethnobotanical methods have been criticized as “unscientific.” Data are often anecdotal and without multiple informants are not scientifically valuable (Johns et. al., 1990). In fact, the research objective of many early ethnobotanical studies was simply to document traditional botanical knowledge (Frei et al., 1998; Fernandez et al., 2003; Lykke, 2000, Giday et al., 2003). Prance et al. (1987) were the first used the term “quantitative ethnobotany” when they sought to present quantitative data on the use of trees by indigenous people and to quantify the value of these trees for conservation. Since the publication of the Use-Value index proposed by Phillips and Gentry (1993a, 1993b) (modified from Prance *et al*., 1987), similar approaches have been widely used by many different authors (Galeano, 2000; Gomez-Beloz, 2002; Kristensen & Balslev, 2003; Torre-Cuadros & Islebe, 2003; Albuquerque et al., 2005; Cunha & Albuquerque, 2006; Collins et al., 2006). Quantitative ethnobotanical studies have emerged that collect plant-use information in a consistent manner so it could be statistically analyzed intra- and interculturally (Gomez-Beloz, 2002), allow explicit, repeatable and systematic data collection, and a broader scope of potential variables. Indeed, quantitative techniques have been used in ethnobotany to compare the uses and the cultural importance of different plant taxa. Then, quantitative ethnobotany opens new doors in the field of ethnobotany in which workers are able to make inferences into other aspects of a culture and test hypothesis that are statistically bound (Phillips & Gentry, 1993a, 1993b). For example, questions about the influence of age (Phillips & Gentry, 1993b; Luoga et al., 2000; Lee *et al*., 2001), gender (Burton & Kirk, 1979), ethnicity (Adu-Tutu et al., 1979; Elvin-Lewis et al., 1980; Prance et al., 1987) or socioeconomic factors (Begossi et al., 1993; Maikhuri & Gangwar, 1993) on the use of plants within a culture can be addressed, quantified and statistically tested.

These analyses are of great scientific interest as they reflect cultural value systems, and they may also aid in the conservation of biodiversity (Byg & Balslev, 2001a).

For estimating plant importance based on local uses, three quantitative methods are described by Phillips (1996): informant consensus or informant-indexing; subjective allocation; and uses totaled. In informant consensus the relative importance of each resource is calculated directly from the degree of agreement among the different people interviewed concerning the use of the resource. For subjective allocation the relative importance of each use is subjectively assigned by the researcher. Uses totaled makes no attempt is made to quantify the relative importance of each use; numbers of uses are simply totaled by category of plant use, plant taxon, or vegetation type.

Numerous authors applied indices techniques, based on "informant consensus", (the most popular ones, Byg & Balslev, 2001a) to investigate the impact of exploitation of locally important resources, based on the supposition that however more important a resource is, the greater is the exploitation pressure placed upon it (Albuquerque et al., 2006) (e.g. Philips and Gentry, 1993a; Heinrich et al., 1998; Gomez-Beloz, 2002; Collins et al., 2006).

A member of Clusiaceae family, *Pentadesma butyracea*, is an evergreen tree. It is native to West Africa, and occurs in areas scattered from Guinea, Sierra-Leone and Côte d'Ivoire, Togo, Benin to the Democratic Republic of Congo, extending eastwards into Tanzania and Uganda, where it is cultivated. In Benin that is located at the discontinuity of the tropical forests zone so-called Dahomey-Gap (Jenik, 1994), its natural stands are limited to riparian forests stretching along the rivers, ecosystems that area endangered (Natta et al., 2002). *P. butyracea* is a multi-purpose tree and source of non-timber forest products (NTFPs) for many people in Benin. The main product harvested from *P. butyracea* is its almonds which are processed into butter. Its pulp is used to clean kitchen utensils whereas its wood is appreciated in carving and construction. Moreover, various products of *P. butyracea* are traded in Benin. Unfortunately, the species is found on the checklist of 62 priorities wild food plant species of South Sahara Africa recommended by the Forest Genetic Resources (SAFORGEN) organisation for conservation actions (Sacandé & Pritchard, 2004). Therefore, strategies should be developed and implemented for its sustainable exploitation.

One of the essential pieces of information for developing sustainable management strategies and actions for a species is the description of its current management including diverse local knowledge and uses associated to it. Indeed, by incorporating local knowledge and practices in the process of scientific research, new hypotheses can be developed for research experiments relevant to management (Henfrey, 2002). Some studies that tackled the traditional uses of the species reported that, its leaves, bark, and roots are used to treat diseases (Houngbédji, 1997; Sinsin & Sinadouwirou, 2003; Avocèvou, 2005). However, these studies just made a simple listing of uses of different parts of the species and this was done in only one region of the country (Bassila). Any studies did not address the question in other areas where the species presence was reported by Natta et al. (2003), for instance, Bassila and Natitingou regions, around Agbassa village and near Gbèssè village. The two former areas are the most important in term of individuals' abundance (unpublished data). Moreover, any intercultural comparisons of *P. butyracea* uses were not making between different sociocultural groups and yet Ghimire et al.; (2004) argue that understanding the heterogeneity of knowledge and practices within a given area is crucial to design management practices that build on the intricate links between knowledge, practices, and institutional context.

Our present study is intending to tackle a quantitative ethnobotany of *P. butyracea* by using a methodology adapted from Gomez-Beloz (2002). The overall aim of the study is to assess variation in knowledge relating to use of *P. butyracea* between the main social groups of Bassila and Natitingou areas that culturally differ. Specifically, the objectives of the study are fourfold: (1) to compare the main social groups from *P. butyracea* parts importance point of view; (2) to make an intra and interculturally comparison of specific uses of each *P. butyracea* parts.

Material and Methods

Pentadesma butyracea

Pentadesma butyracea, member of the Clusiaceae, is a large tree (15–20m tall) sometimes up to 25 m, with a diameter at breast height (dbh) of up to 100-150 cm. It has a straight cylindrical trunk, with horizontal and whorled branches. The bark is brownish with fissures presented in small longitudinal rectangles. The slash yields a thick yellow juice, which dries to a reddish gum. Its Leaves are pairs, ex-stipulate, simple, entire, oblong-obovate to oblong-oblanceolate, cuneate at base, shortly acuminate, 10-22 cm long, 3.5-7 cm broad, with numerous close parallel lateral nerves and pedicel

about 2.5 cm long. The leaves are streaked and spotted with resin glands; glandular canals on the under surface are visible by reflected light, and glandular dots are clearly visible in young and sucker leaves. Flowers of *P. butyracea* are large, yellowish white or whitish red. The petals are glabrous on the inside, with 5 stamen-fascicles and divided into 5 lobes. The sepals are very unequal, the inner as large as the petals, up to about 5 cm long. Ovary is gradually narrowed into the elongated style which is divided into 5 linear spreading lobes. Flowers are solitary or in cluster (2 to 6, exceptionally, 15). In Benin, flowering starts in September reaches its maximum in November (Unpublished data). The fruits are reddish-green, broadly ellipsoid and pointed, up to 11 cm broad and 15 cm long berries containing yellow flesh having an acid taste with several seeds embedded in it (1 to 15, exceptionally reach 25). The seeds are light brown, large with flattened sides and dark red embryos from which oil is extracted.

Study Area

The study was carried out in two districts: Bassila in Bassila region and Toucountouna in Natitingou region. Bassila district is located between 8°30' and 9°30' N and 1°00' and 2°30' E (Fig. 1), on a vast peneplain. Altitude ranges from 380 m to over 590 m above sea level. The district is part of the Sudano-Guinean transitional climate zone. The rainfall regime is unimodal. The rainy season occurs between May and October (113 rain days per year on average) with an annual total ranging from 850 mm to 1870 mm (ASECNA Benin, data from 1973 to 2006). The mean annual temperature varies from 25°C to 29°C (minimum 16–21°C, and maximum 28–37°C). According to ORSTOM classification (Georges, 1962), three types of soil can be distinguished: sandy ferruginous or silt-sandy soils, red-brown to brown-rusty ferrallitic soils and hydromorphic soils – whereby the last two types of soils are favourable to forest development.

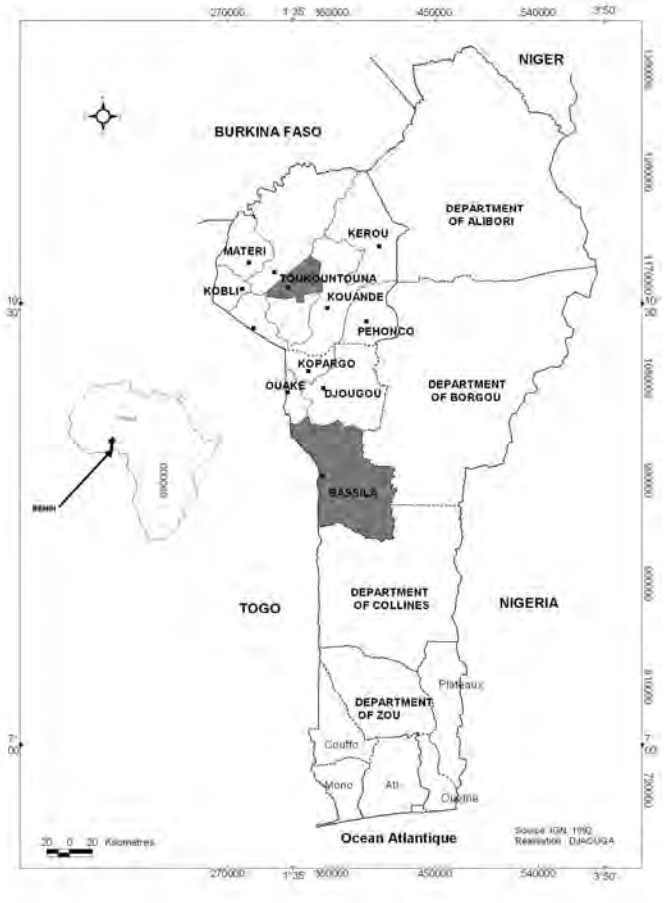

Figure 1. **Study areas (Bassila and Toukountouna districts) localisation in Benin**

Vegetation consists of riparian and dry dense forest, woodland, savannah woodland, tree and shrub savannahs, with some *Tectona grandis*, *Anacardium occidentale* and *Gmelina arborea* plantations (PRRF, 1998). Nearly half (2,437 km²) of the district area is covered by protected forests under management (Trekpo, 2003). The district has some 74,664 inhabitants living in 1234 households (INSAE, 2002). This population is essentially composed of Anii (38%[6]), Nagot (27%), Kotocoli (15%) and Fulani (10%). The local economy relies on subsistence agriculture, breeding and transformation of agricultural products and NTFPs (eg: *Vitellaria paradoxa, P. butyracea*, *Parkia biglobosa*, *Saba comorensis*, etc.). According to a report of the Ministry of the Interior, Safety and Territorial Administration (1997), Bassila district population is predominantly Muslim (82.4%). The other religious groups (catholic, Protestant, traditional, and others) accounts for only 17.6% of the population.

As for Toucountouna district, it is located between 10°20' and 10°45' N and 1°10' and 1°40' E (Fig. 1) in the Sudanian climate zone. It is also under the influence of the Atakora Mountains because landed between the East and West chains. Altitude ranges from 380 to over 590 m above sea level. The unimodal rainfall regime has a rainy season from April to October. The mean annual temperature varies from 24.1°C to 30.5°C (minimum 18–23°C, and maximum 25–38°C). Two main types of soil can be distinguished: tropical ferruginous or silt-sandy soils and silt-clayey soils with hydromorphic tendency because of Penjari river presence. Vegetation is dominated by savannahs with several typical species such as *Isoberlinia doka*, *I. tomentosa* but also *Adansonia digitata*, *Borassus aethiopum*, *Burkea africana* and *Danielia oliveri*. Vegetation is also consisted of riparian forests with *P. butyracea* as one of species.

The population of a size of 35,315 inhabitants (in 659 households) is mainly composed of Waama (52%), Ditamari (23%) and Natimba (18%). Here as in Bassila, agriculture is the main economic activity of Toucountouna households. However, breeding, agricultural products transformation and craft industry are not insignificant elements of the farms' economy.

Methods

Data were collected over six months (October 2006 to January 2007 and February to March 2008) We held meetings within each community before conducting interviews, to discuss research plans and request group permission to undertake work in the area and record elements of traditional knowledge. Information was gathered by means of interviews with informants by mean of questionnaire. After explaining our purpose, all interviews (n = 200) were conducted with the full willingness of the respondents, who were assured of anonymity to increase the chances that they would provide genuine answers (Henerson *et al*., 1987). Each person provided verbal consent. When all's said and done, in Bassila district, 55 Anii, 35 Nagot, 22 Kotocoli and 14 Fulani were interviewed while 40 Waama, 23 Ditamari and 12 Natimba were concerned in Toucountuna district. Interviews were made individually to prevent informants from being influenced by other informants' answers. Questionnaire consisted of two sections (basic demographics and plant-use knowledge detailing preparation, administration, and diseases treated) and was conducted in local languages with the help of known and trusted interpreters from each area. Interviews took 40–60 minutes. A pilot surveys that took place before data collection and during what questionnaire was tested (e.g. Luoga *et al*., 2000). The questions must indeed be formulated in a culturally appropriate and meaningful way and based on concepts that are not foreign to the cultural system of meaning**.**

During the interviews, we investigated ethnobotanical knowledge in terms of people's ability to identify *P. butyracea* and describe its plant parts uses. Each informant was shown freshly pressed leaves and fruit and almonds of the species. All informants were asked if they recognized the species and had a name for it. If the answer is yes, each informant gave the local name of the species in his mother tongue. We had before identified local names of the species in each spoken language of the study areas. Informants were also asked if the plant had medicinal uses, and if they personally used it. During interviews, indications of part of the plant used, method of preparation and route of administration were recorded.

As most of quoted uses were medicinal we used a categorisation developed by Cook (1995) and also used by Collins *et al*. (2006). Using medical conditions that affect a system of the Body, the disease are categorised as follow: Circulatory System Disorders (CIR), Digestive System Disorders (DIG),

[6] The number in brackets represents the percentage of each sociocultural group in the district population.

Genitourinary System Disorders (GEN), Ill-Defined Symptoms (ILL), Infections/Infestations (INF), Inflammation (IFM), Injuries (INJ), Metabolic System Disorders (MET), Muscular-Skeletal System Disorders (MUS), Nervous System Disorders (NER), Poisoning Disorders (POD), Pregnancy/Birth/Puerperium Disorders/Effects (PRE), Respiratory System Disorders (RES), Sensory System Disorders (SEN), and Skin/Subcutaneous Cellular Tissue Disorders (SKI). In additional to these diseases usage categories, other usage categories were used: magico-mystics, medico-religious (plants that are used to protect oneself from a spirit that might cause an illness and from curse throwing), construction (timber use in carpentry), cosmetics (as *P. butyracea*'s butter is used as cosmetic products and its pulp for chiropodist) and lactogenic effects, immune reinforcement and dentition at the newborn. Moreover, this categorisation was adopted to ease statistical analyses.

After collecting data with the help of a questionnaire, Gomez-Beloz has calculated the following indices:

1. Reported use value (RU): It is the total number of uses reported for each plant. Reported use values were broken down by number of uses reported for each plant part ($SRU_{[plant\ part]}$).
2. The plant part value (PPV): It is a value given for a specific plant part. It is equal to the ratio between number of total reported uses for each plant part and total number of reported uses for that plant: PPV = ($RU_{[plant\ part]}/SRU_{[plant\ part]}$).
3. The specific reported use (SU): It is the use as described by the respondent. The use descriptions have been simplified to facilitate analysis. The SU value refers to the number of times a specific reported use is reported by the respondent.
4. The intraspecific use value (IUV): It is the ratio of specific use and reported use for the plant part: IUV = $SU_{[plant\ part]}/RU_{[plant\ part]}$. The intraspecific use value allows the ordering of use importance within a specific plant part.
5. It is the ratio of specific uses (SU) and total number of reported uses (SRU) for the whole plant and is calculated as follows: (1) OUV = (PPV * IUV), (2) OUV = ((RU[plant part]/S RU) * (SU[plant part]/RU[plant part])), (3) OUV = (SU[plant part]/S RU). The overall use value (OUV) allows comparisons of uses within a group of plants and is used to compare use importance for this group of plants.

Let us note that apart from plant parts that are traditionally considered (leaf, fruit, flower, bark and root), we added young leaf (used specifically), root sucker, almond and butter.

Use values were calculated using the method of Gomez-Beloz described above. However, several modifications were added to Gomez-Beloz's method. At first, since we were working on one species, our study was concentrated on use values estimation. Secondly, unlike Gomez-Beloz who made a randomly sampling when choosing informants, we made a stratified one. Indeed, during the exploratory stage it was brought out the fact that people aged less than 22 years old did not known any uses knowledge of *P. butyracea* plant parts, apart from almonds processing into butter. Indeed relevant ethnobotanical and utilization information was held by more aged members of the society (Luoga *et al*., 2000; Lee *et al*., 2001). Therefore, informants were selected randomly among middle-aged and elderly people including traditional specialized healers, herbalists, women that involved in fruit harvest and almonds processing, etc. Thirdly, to compare plant parts importance and use diversity between sociocultural groups, we performed an analysis multivariate (principal components analysis: PCA) with calculated plant part values and a Kruskal-Wallis test was performed to compare mean Reported use value (RU) between social groups, what Gomez-Beloz did not.

Results

Reported Use Values of P. butyracea

P. butyracea reported use values varied from 33 to 129 with a mean of 58.57 ± 33.91, with the highest value for Anii and the lowest one for Natimba. The average of total uses for *P. butyracea* parts mentioned by each respondent of the different social groups is reported in table 1. When comparing total number of individually reported use responses for each group, there was a significant difference between the seven groups (K = 17.81 (df = 6) and a p-value of p = 0.007).

Plant Parts Value

The result of the principal component analysis (PCA) performed on plant part values (Table2) showed that the first three axes explained 89.52% of the observed variation. Therefore, only the first three

axes were used to describe the relationship between the plant part values of social groups (Table 3). Based on the correlations between the different variables and the three PCA axes selected (Table 3) the following variables were considered on the first axis (axis 1): Values of leaves, young leaves, flower, pulp, bark, root, root sucker, butter, fruit and timber. On the second axis (axis 2), the following variables were considered: values of pulp, almonds, bark, root, root sucker and timber. On the third axis (axis 3) the following variables were considered: values of young leaves, and butter.

Table 1. Mean number respondent's of reported use by social group.

Social groups	Mean number of reported use by each respondent
Anii	1.8 ± 1.3
Kotocoli	1.7 ± 1.0
Fulani	1.4 ± 1.0
Nagot	1.8 ± 0.9
Waama	1.9 ± 1.0
Ditamari	2.0 ± 1.0
Natimba	1.2 ± 0.7

Table 2. *Pentadesma butyracea* parts value

Social groups	*P. butyracea* parts value										
	Leaf	Flower	Pulp	Almond	Bark	Root	Timber	Butter	Young leaf	Fruit	Root-sucker
Anii	0.155	0.039	0.047	0.000	0.256	0.178	0.000	0.000	0.326	0.000	0.000
Kotocoli	0.098	0.024	0.073	0.000	0.244	0.098	0.000	0.000	0.439	0.024	0.000
Fulani	0.182	0.030	0.061	0.030	0.242	0.091	0.000	0.000	0.333	0.030	0.000
Nagot	0.132	0.038	0.075	0.057	0.358	0.208	0.019	0.019	0.000	0.075	0.019
Waama	0.247	0.000	0.014	0.041	0.205	0.137	0.068	0.233	0.000	0.000	0.041
Ditamari	0.447	0.000	0.021	0.000	0.213	0.085	0.106	0.064	0.000	0.000	0.043
Natimba	0.206	0.000	0.088	0.000	0.118	0.088	0.000	0.471	0.000	0.000	0.000

Table 3. Correlation between plant parts value and canonical variables

	Factor 1	Factor 2	Factor 3
Leaves value	**-0.86984**	0.25277	-0.20636
Young leaves value	**0.58033**	-0.44709	**-0.63805**
Flower value	**0.93238**	0.15511	-0.23777
Pulp value	**0.62370**	**-0.50286**	0.46812
Almonds value	0.29745	**0.73056**	0.43828
Bark value	**0.68350**	**0.69686**	-0.16137
Root value	**0.54044**	**0.59601**	0.18818
Root sucker value	**-0.68746**	**0.71058**	-0.02466
Butter value	**-0.52962**	-0.41520	**0.71973**
Fruit value	**0.71140**	0.48398	0.29639
Timber value	**-0.79060**	**0.56042**	-0.19240

Following the first two axis 1, social groups, were able to be divide into four categories (Fig. 2):

- G_1: Ditamari and Waama social groups that were characterized by high value for leaves, root-sucker, butter and timber;
- G_2: Natimba social group that were distinguished by high value for butter.
- G_3: Anii, Kotocoli and Fulani social groups that were characterized by high value for young leaves, pulp, bark and root;
- G_4: Nagot social group that were characterized by high value for bark and root.

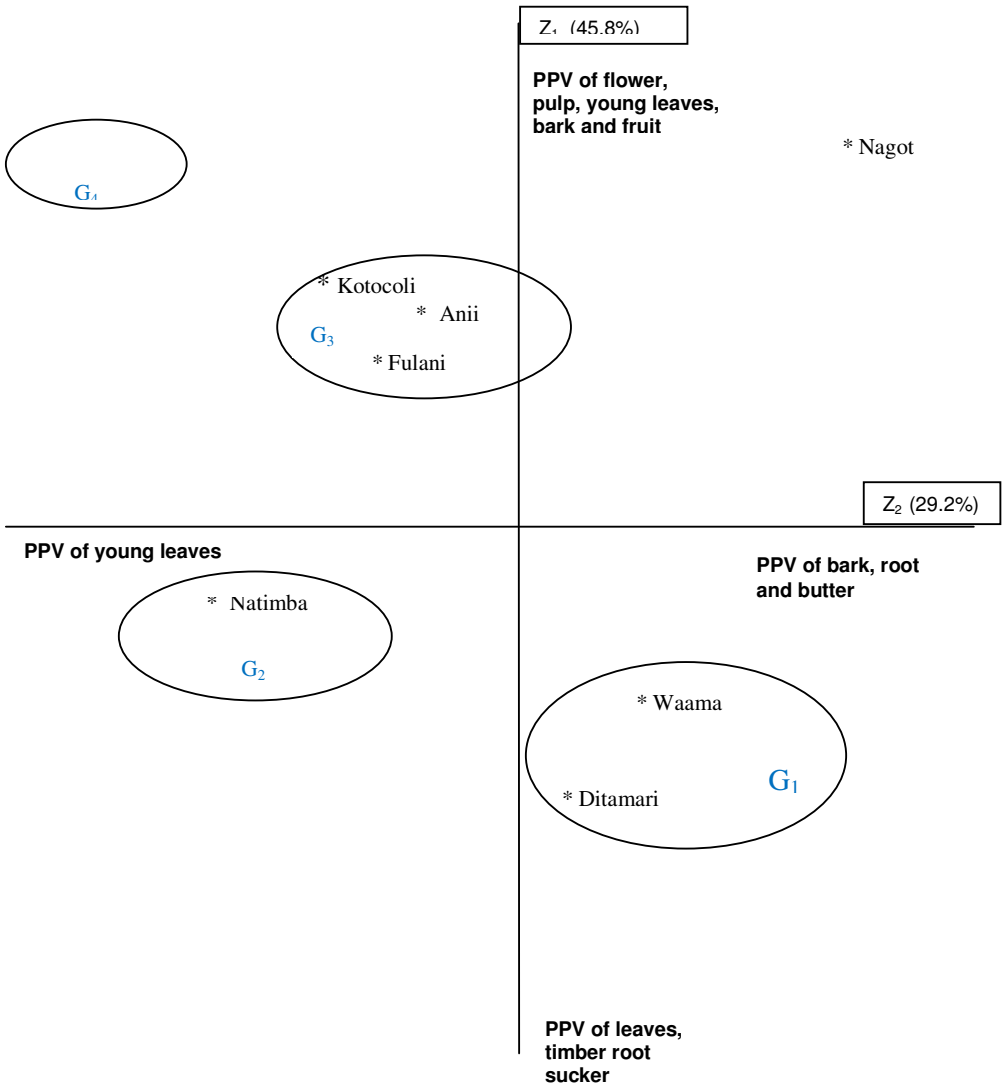

Figure 2. Social groups' categorisation according *P. butyracea* plant parts use values taking into account the first two axes. * represents the site of social groups in the axes system.

However, in general, social groups that were living in the same geographical area shared similar *P. butyracea* parts values. It was the case of Anii, Kotocoli and Fulani in Bassila district and Ditamari and Waama in Toucountouna district. This social groups discrimination with the first two axes (axis 1 and axis 2) was similar to those presented by the axes 1 and 3.

Intercultural Convergence of Specific uses of P. butyracea parts

Bark was reported most often to cure digestive system disorders (with 90% of stomach pain) by the Anii, Nagot, Waama and Ditamari respondents with respective IUV equalled to: 0.303, 0.316, 0.267 and 0.300. Concerning the other social groups, bark was reported most for infections (69.5% of malaria), genitourinary system disorders (78.3% of irregular menses) and circulatory system disorders (57.1% of anaemia) treatments by respectively Kotocoli, Fulani and Natimba respondents with IUV equalled to 0.400, 0.250 and 0.500. Nagot also have the highest use value for bark and root, two the most sensitive parts for the plant survival.

As regards roots, it was reported for digestive system disorders (67.6% of stomach pain) treatments the Anii, Waama and Ditamari respondents with respective IUV equalled to 0.435, 0.700 and 0.500. Genitourinary system disorders (68.7% of irregular menses) were reported cured by root by the Kotocoli, Nagot and Fulani respondents, IUV equalled to 0.750, 0.455 and 1.00 respectively.

Leaves specific uses were more diversified among social groups than bark and root. Indeed, apart from their use in wound healing (especially male circumcision wound healing) by the Waama and Ditamari groups with respective IUV equalled to 0.444 and 0.429. Leaves were also used in digestive system disorders treatment by the Kotocoli and Fulani respondents, IUV equalled to 0.750 and 0.333 respectively. Young leaves use was reported only by the Anii, Kotocoli and Fulani respondents, all living in Bassila district, for their lactogenic effects, immune reinforcement and dentition at the newborn. The IUV were 0.833, 0.944 and 1.00 respectively.

As regards pulp, it was reported for cosmetics uses instance its use in chiropodist and local soap preparation by the Kotocoli, Waama and Ditamari groups, IUV equal to 0.667, 1.000 and 1.000 respectively. Because of its tartness, pulp was also reported for digestive system disorders treatment such as bloated stomach and constipation by the Nagot and Fulani respondents with respective IUV equalled to 0.750 and 0.500.

Processing of *P. butyracea* almonds into butter was a common practice for all social groups, in the two districts, mainly for consumption. That is why we did not report this use. It was also the case the species' timber use in carpentry. However, butter is particularly indicated by the Waama, Ditamari and Natimba respondents for cosmetics uses instance local soap preparation (IUV = 0.941, 1.00 and 1.00 respectively). In the same way, timber was reported by the Waama and Ditamari groups for oral hygiene. (IUV = 1.00).

Flower use was limited to Bassila district social groups and reported for various specific uses: such as lactogenic effects (Kotocoli and Fulani, IUV equal to 1.000), digestive system disorders treatment (Anii and Nagot, IUV equal to 0.400 and 0.500) and magico-mystic uses.

Root-suckers were particularly reported by Toucountouna social groups for oral hygiene (IUV = 1.00).

Almonds use was indicated for various and diversified specific uses for ill-defined symptoms treatment, having full of pep, digestive system disorders treatment, muscular-skeletal system disorders, respiratory system disorders and inflammations.

Whole fruit use was limited to few social groups and did not present any convergence concerning specific use. In the Kotocoli group, whole fruit was reported for magico-mystic uses whereas in Nagot group, it was mentioned in digestive system disorders, genitourinary system disorders, ill-defined symptoms treatment and magico-mystic uses. As for Fulani, whole fruit use was reported only for genitourinary system disorders treatment.

Discussion

The results of our results of present study highlighted the parts of the species local people are likely to most use and also categorised the main social groups according to the plant parts importance. The Natimba respondent group mentioned the lowest average of total uses for *P. butyracea* parts. This result can be explained by the specialization of the Natimba group in magico-mystics practices while the Waama and Ditamari are recognized for their ability in diseases treatment in Toucountouna district (field data).

Analysing *P. butyracea* parts importance, differences were observed between the social groups. Their cultural difference may explain the different knowledge levels; different ethnic groups have their own ideas about which plant parts can be used for what purpose (Kristensen & Lykke, 2003). Moreover, different communities may develop unique plant knowledge as they are exposed to diverse environments, ailments, and cultural practices (Leonti et al., 2003).

In general, social groups were divided into four categories according to the geographical areas where they are living. This result would mean that with time, social groups that are living together exchange their knowledge. These knowledge exchanges can occur through friendships, inter-ethnical marriages, etc. Local knowledge can indeed combine the insights of ancestral knowledge, practical experience, the knowledge of other neighbouring local peoples, regional scholarly traditions, and scientific or official knowledge (Nesheim et al., 2006) acquired through, for example, agricultural extension officers, (Gadgil et al., 2000; Dhillion & Gustad, 2004).

IUV was used to measure the species parts importance for specific uses. Relative to a specific use, the highest value of IUV of a plant part is the specific use for that this part is most reported by respondents of each social group. High value of IUV generally indicates therefore a certain consensus in the use of the part for the specific use in question within the social group. When for several social groups indicate, a given plant part presents the highest value of IUV is high for a specific use, this cross-checking can be synonymous of reliability of a disease treatment. The reliability of the disease treatment is all the greater when IUV of the plant part for a specific use is high for social groups that are not living in the same geographical area. This comparative method allows the selection of indigenous medicinal plants parts for phytochemical and biological/pharmacological studies.

IUV is also useful in determining the cultural importance of a particular plant part for a social group in a specific usage category. For example, the Ditamari group have an IUV = 0.429 for *P. butyracea*'s leaves that they use to bandage wound after circumcision a biennial ceremony. Circumcision is for this group an act that is deeply well established in its tradition because it is tied to the initiation of the young man (up to 20 years old).

During the study, we had wanted to assess the present-day usage of *P. butyracea* products by the different sociocultural groups by measuring the quantities harvested or consumed (e.g., Houghton & Mendelsohn, 1996). In so doing, we would have made a difference between past and actual use and knowledge of uses, contrary to most ethnobotanical studies that assume implicitly that informants' answers are representative of present-day usage of plant products (Byg & Balslev, 2001b). Combination of the species parts quantities harvested or consumed and of the resource availability would give information on the species conservation status. Unfortunately, this was not possible for two main reasons. Firstly, the use of some plant parts is seasonal (e.g. flower, whole fruit, young leaves) and may be greater at a particular time of the year. Secondly, as the study was concerned only one plant species, the time which has elapsed between two uses was long (several months or years), especially when the informant is not a traditional specialized healer. Therefore, it was difficult or even impossible for us to follow uses and quantify the plant parts used without conducting more in depth studies of respondent *P. butyracea* use over a prolonged period of time. Although this study does not attempt to calculate harvest rates for any of this species parts, it does address issues of the species use simply by looking at what plant parts are used for various activities.

Conclusion

Pentadesma butyracea is a multipurpose tree that is used in various ways by Bassila and Toucountouna districts people. A quantitative ethnobotanical approach close to informant consensus allowed allocating a value to each species part. Social groups that are living in the same geographical area shared similar value of the species parts. Several parts of the species were most reported for the same specific use by different social groups (high value of IUV), even if these groups were not living in the same geographical area.

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TRADITIONAL ACCESS AND FOREST MANAGEMENT ARRANGEMENTS FOR BEEKEEPING: THE CASE OF SOUTHWEST ETHIOPIA FOREST REGION

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Abstract

Forest beekeeping is an ancient form of forest exploitation in south west Ethiopia. The practice has continued to the present with a gradual evolution in beekeeping technology and resource access and management arrangements. The aim of the present study is to study traditional forest management systems for sustainable forest honey production. The study was carried out in southwest Ethiopia in three districts with variable socioeconomic and land-use conditions; these are reflected in a variety of beekeeping management conditions and interactions between forest and bee resources. Both primary and secondary data were collected for the study. Primary data was collected through household interview, group discussions, expert interviews and observations. The collected data were analyzed through SPSS, spreadsheet and logical explanation. The studies reveal that there four types of tenure for hive hanging trees. With the exception of the so-called kobo-forests, natural forests are mainly free access lands, while home gardens are mainly privately owned land. In all the systems hives and bee colony are private properties. Communities routinely make decisions about access over common property and have clear traditional conflict resolution mechanism on honey colony, honey tree or kobo lands. Traditional beekeepers use the forest for hive construction, hive hanging, pollen source and fumigation. The interaction of trees and honey bees is well maintained by the traditional beekeepers to sustain their hive products. Moreover, the conservation potential of the traditional system is very promising and can help improve the success of modern forest management practices in the region.

Introduction

Forests have been the place where first form of honey collection, technically called feral honey hunting(honey from hallow large trees) obtained (Crane, 1990). And it is in the forest and agroforest system that major advance in hive technology is also registered. Existing management system is the result of the long evolution in technology and social arrangements for beekeeping and bee habitat (Crane, 1990).

Forest management for beekeeping has been an ancient practice in Ethiopia (Girma, 1998). It involves colony management, hive management, forest productivity improvement and regulatory issues to sustain forest utilization for beekeeping products. The interaction of bee and forest management in the forest of south west Ethiopia has passed through several phases of beekeeping technology development. And this intricate relationship has continued even in contemporary intermediate and high teck. beekeeping technologies (Hartmann, 2004).

Forests provide an essential environment for bees, protect hives and provide materials for hive construction. Trees are also major sources of pollen, nectar and plant tissue (Svensson, 1991; Momose et al, 1998; Kato & Kawakita, 2004). Similarly bees pollinate forest and improve ecosystem productivity. Local peoples are also part of the interacting system whereby they contribute to the conservation of the forest by protecting from outside illegal poachers and improving the forest productivity through controlled utilization, purposeful regeneration and/or species selection (Wiersum, 1997). Management of forest by human may also have negative impact on the normal relationship if it leads to the reduction of the pollinator population or the foraging forest is depleted (Kearns et al, 1998).

Traditional forest managers for beekeeping are well aware of the consequences and have several arrangements suitable for specific local context to avoid adverse effects in the forest and bee colony. However, the customary system is nested within or in conflict with de jure property right system. In spite of the collisions, there are still several forms of customary tenure arrangements for forests/trees used in beekeeping. The present study investigates the diversity of traditional access arrangement to and management of forests for sustainable beekeeping in the forest regions of south west Ethiopia.

Materials and method

The study area

The study area is located in Southwestern Ethiopia in the Southern Nations, Nationalities and regional state. The study was conducted in the Sheko district of Bench Maji Zone and in the Masha and Andracha districts of Sheka zone. Two sites were selected in each districts. Shimee and Shiyta from Sheko, Yockchichi and Chengecha from Andracha and Beto and Bada fro Mash districts. The study area lies in the latitude range of 6^0 45'- 8^0 N and longitude $34^0$10'- $35^0$40' E.

Masha and Andracha districts are the wettest part of Ethiopia where rain may fall every month, but most of the rain falls between March and November. At Masha (the capital of Sheka) the mean annual rainfall is about 2215mm. The mean monthly temperature ranges between 14.3-15℃ (Kumlachew and Taye, 2003). At Sheko, the altitude is lower, a corresponding decrease in rainfall and an increase in temperature observed.

In Ethiopia there are five different types of honey bee races one of which is endemic. Each race occupies distinctive agroecological locations (Amssalu, 2002). The races and their location are *Apis mellifera jemenitica* in the northwest and eastern arid and semiarid lowlands; *A. m. scutellata* in the west, south and southwest humid midlands; *A. m.bandasii*, in the central moist highlands; *A. m. monticola* from the northern mountainous highlands; and *A.m.woyi-gambell* in south western semi-arid to sub-humid lowland parts of the country (Amssalu et al, 2004).

Ethiopia is also one of the worlds' largest honey producing nations (10th in the world and first in Africa) and fourth largest wax producer owing to the huge bee resource base which intern is the result of agroclimatic and floral diversity of the country. There are about 10 millon bee colonies and an estimated 24,000m3 of honey produced annually (Girma, 1998, Amssalu, 2002; Pol, 2002; Hartmann, 2004) According to (Amssalu et al, 2004), the bee race of the study area is *Apis mellifera scutellata* and it is one of the highest honey producing areas in the country.

Friis(1992) classified the forests of south western Ethiopia as transitional rainforest, broadleaved Afromontane forest and riverine forest. This forest region is considered floristically diverse compared to other parts of the country (Tamirat, 1994), and contains over 107 woody species belonging to 84 genera and 41 families (Yeshitila and Taye, 2003). However, deforestation is taking place at alarming rate due to agricultural expansion and rising private investment ventures. Part of the forest has been leased and there is still a growing interest in investment on the remaining parts of this forest (Yeshitila & Taye, 2003).

The land uses of the area includes forest (18.1%), bush and shrub land (8.5%), grazing (26.8), cultivated land (30%) and the remaining 16% used for several other purposes including private tea and coffee plantations (Amssalu, 2002). Beekeeping is practiced in both forest and non forest land (Amssalu, 2002).

According to CSA (2004), the total population of Masha-andracha is 65, 949 and that of Sheko is 50, 039. The study area has several ethnic groups with specific and common economic and political history. They reside adjacent to each other and in mixed patterns of settlement. The major ethnic groups which are reported as indigenous are Sheka (Sheka and Manjo tribes), Majingir, Sheko, and to some extent Meinit and Bench. There are also Amhara, Tigre and Oromos recently settled by government programs and/or random immigration.

Data collection methods

For this research both primary and secondary data were collected. Primary data were collected using household interview, group discussion, Observation and expert interviews.

The majority of the data for this study were collected based on semi structured questionnaires. Open ended and closed questionnaires were used for sixty-four pragmatically selected from six sites of the three districts of the study area. Households were selected systematically to accommodate variability in age, number of hives possessed, management condition, agroecology and ethnicity. These factors helped in analyzing variations and similarities among the different households and respective management conditions. In addition to households beekeeping and forestry experts were also interviewed.

In addition to semistructured interview, in-depth group discussions were made for more than three hours at each location. Checklists were used to guide the discussion. The major participants were elders and opinion leaders and representatives of the average beekeepers. But the number of participants gradually increasing in most of the cases as uninvited farmers also took part of their own initiative. Development agents and local administrators selected original group participants.

Issues addressed by this method were dynamics of beekeeping, in-depth discussion of land and tree tenure dynamics from past to present interms of access, ownership longevity, inheritance and dispute management. Related issues that were raised during the discussion and that have universal relevance to that community were also discussed. Group interview helps to view phenomena from different perspectives and serve as crosschecks for consistency of data collected by other methods. It also help to evaluate the extent of impact or occurrence of an issue/phenomena that is raised by some individuals but missed by most respondents, and hence appeared less prominent during averaging out.

The above data collections were also supplemented through direct observation of the beekeeping practices and the forest bee interaction system. it was made in a form of transect across the landscape. During this time, direct observations, informal interviewing and discussion with peoples on the transect line were also made. Observation helps to collect special information that might be skipped intentionally or unintentionally during interviews.

Data Analysis

Data were analyzed both statistically and logically. Microsoft-excel and statistical package for social sciences (SPSS) were used to systematically record and analyze the empirical data and to put in to frequencies, tables and figures. Collected qualitative and quantitative data from group discussion and observation were analyzed through logical reasoning, explanation, comparison and interpretation of management interactions. The results from various methods were compared to check consistency.

Result and discussion

The role and management of forest for beekeeping

Honey production practices in the study area are heavily dependent on trees and other forest products. trees are the source of fodder, it is a nesting place, the sum of raw materials for hive production and covering obtained from, trees and shrubs also serve for smoking and fumigation of hives. It protects bees from adverse climatic factors and moderation of temperature extremes through shading, reduce susceptibility for pests and theft and to some extent from vermin. All the interview farmers except one agreed forest (in this case an area with trees) is crucial for beekeeping. Asked about type of tree, frequency of use and level of priority, several tree species were listed out and the tree they put at higher priority also found to be used by the majority of the traditional beekeeper. Based on the respondents view *Schefeleria abysinica*is the most preferred tree forage for bees. It produces a white flower most abundant at appropriate height for bees. Similarily *Aninjeria adolfi-friederici* and *Euphorbia abyssinica* are ranked the most important hive hunging/placing and hive construction trees respectively. The criteria for placing hive is a big size with sufficient branching strarting some 10meters above the ground and that is capable of carrying honey and bees without breakage. So strength, branching and reasonable highiet are the requirements. Hive construction preference vary from place to place but the most important criteria is workability and lightness in weight.

On the basis of household interview and field observation tree management practices found to vary across land use zones of the survey sites. Tree planting entirely limited to home yard in Masha Andracha but in Sheko especially Shemee areas, tree planting practiced both inside and outside of

the home yard in the form of woodlots. But it is still in reasonably closer area for control and also to use for several purposes.

Further from home yard and adjacent woodlots, farm fields occupy the dominant niche. Trees are purposefully maintained in this niche. These trees are protected and tended and receives close protection by the land owner. Little planting activity observed. Trees in his niche in most cases belongs to the owner of the land, except in some cases where tree kobo owner claim entitlement. Trees in communal grazing land are mostly communal property unless it is honey tree. If it is honey tree and someone has ownership right, even if its location is in communal and, it receives better protection.

The land use zone, next to farmland and grazing land, is occupied by disturbed natural forest. Trees in disturbed or relatively undisturbed forest if it is not known hive tree could not be managed well and little protection made. But forests under kobo holding, although it occupy the remotest niche relative to the previous zones, it will be fairly protected, trees tended to grow as good hive hanging tree. Climbers, deformed trees that they think will compete or divert the proper growth of the hive tree will be cut and small promising trees promoted. They also reported that during tree felling for hive construction or honey harvesting, maximum care will be taken to protect young potential trees from damage.

Non-kobo forests are found relatively far from residential areas but may or may not be far from kobo forest. There is no tending practices involved for trees or the forest at large. Beekeepers reported that except few people who engage in felling big trees for lumber most of the community want its preservation. In any case this is the forest where little protection and sense of ownership reflected, even if state is known as its protectorate.

Forest Tenure arrangements for beekeeping

Data from household interviews and group discussions clearly revealed the presence of large variation in tenure arrangement across land use types and from site to site. The arrangements of land and tree tenure for honey production can be approximated into four major types. These are free access to use hanging tree, temporary tree tenure, tree tenure and forest land tenure for beekeeping. The arrangements vary as a function of regions (from Masha to Sheko) and across landscape (from home garden to the remote forest areas) of the same regions. But variations are not clear cut in all its characteristics.

Free access: is a type of arrangement where a person can put/hang his hive at any forest, tree or land and some other person can do the same on the same land or tree at the same time without any precondition. In some cases, there is several hives of different people on the same tree. Thus, only their hive and the colony inside that could be regarded as owned by someone. The rest of the resources freely accessible “common property” and any one coming from that community could be legible to make use of it. As a result, more than one person reported to hang on the same tree if he found the tree as suitable. This type of arrangement is very common in the disturbed forest areas of Sheko. It also found in far and inaccessible forest zones of all districts where there is less honey production stake so far and if the land has no owner with respect to honey production or other land use practice. Those lands are free from the respondents’ perspective but it is known that it is under the de jure ownership of the state.

Temporary tree tenure/communal ownership: Beekeepers reported that, in this type of arrangement, the tree upon which a beekeeper hanged his hive will be under his wnership so long as his hive stays there for any length of time. Once his hive is removed for so any reasons he can not claim for ownership and any body who is interested for such specific tree can replace the ownership just by putting his hive on. These areas are communal by de facto while state owned under de jure tenure system. This type of arrangement is mainly found in Sheko. In shemee, although indigenous people assert that hive tree ownership still respected. It is found that there is no common understanding of the rule because there are several new settlers and youngsters who started beekeeping and does not know the indigenous local rule. The latter group assumes that hive hanging constrained by skill and time other wise they believe they can do on any tree they believe appropriate. But it is reported that indigenous people hang their hive far from residential area and have their own separate hive sites but not claimable as own land. They said that before the Derg regime, land surrounding the hive tree is under the ownership of the hive tree owner.

In Shiyta, the system is dissolving and there is no responsible body to exercise the previous rules. So, by common understanding, they agree that a hive hanging trees remain under the ownership of the hanger if the hives ones removed any person can hang on it and continue his possession as far as his hive is there. But there are other exceptions. If the tree on which the hive is perched on found on the hive owners' cropland, coffee forest or other legally owned land the tree will remain at the hands of the land owner without restriction. Thus, in this latter case, the tree ownership was more secured. But the increase in number of right and length of use is the result of cropland ownership and does not attributable to beekeeping ownership ideals. In any case, it has offered more ground to use for beekeeping.

Tree tenure: in this case the tree on which one has ever been used for hanging hive belongs to the hive owner not only with hive presence but also with possible extension after he removed his hive. In this form of arrangement, unlike the previous forms, trees are the owner of the hive and could remain under his entitlement for future use for hanging. And there is a right to exclude or protect from others. But if the owner totally ceased tending the tree, cleaning around and hanging hives for longer period, ownership of trees could end and be shifted to other peoples. And not only tending but also he needs to make known by his neighbours or other peoples that he is still practicing. Because it is mentioned that in case of disagreements there has to be witnesses. Otherwise elders cannot know all property ownership distribution throughout the village and only by the help of witnesses that they (elders) will help resolve the conflict.

Another situation is that, when a person gets older and has no and has no male successor, other peoples will ask his consent to use his trees and most often he will allow them. But if he refused to transfer to other person, it will stay under his ownership for several years or even decades. The number of years to which ownership claim sustain reported to be dependent on the powerfulness of the person or his relatives apart from the local rules. Thus, if he is less powerful, it is likely that ownership will lost shortly and vice-versa. This system is practiced in sites where there is no ownership right for the land to which the honey tree is found. It is mainly practiced in grazing lands, non kobo natural forest. With respect region, this system is more dominant around Chegecha, also around Yockchich and Bada. In the latter two, it is reported that kobo land system still surviving but with tighter tension from youngsters, non indigenous farmers and outside stakeholders.

Tree and land tenure: This form of arrangement is found in forest kobo and homegardens. But in the case of homegarden and crop land entitlement to land stem from other land use system and beekeeping is subsidiary. Thus only in kobo land that land ownership exercised as a result of beekeeping for beekeeping purpose. In the arrangement locally called "kobo" the trees and forest land distinctly bounded (and known by the community, local elders, clan leaders and at least by some of the local community as bounded) and owned by respective heirs. It is a tenure system which bases on ancestral claim and strongly based on this principle in case of conflict resolution. The system works even crossing federal state administration and any person from Southern state could have kobo holding in Oromia state and vice versal. Adjacent owners will always negotiate in case of disagreements. And only when they are unable to solve by themselves that they will take the case for elders. It will be often resolved by elders and clan leaders at last. Only few cases reported to pass this step and reach at legal administrative bodies. Local government administrations also often solve cases by consulting elders or taking them (elders) as testimony to make a final decision. In kobo system, it is mentioned that trees are properly managed and promising trees that could be a good nest tree will be tended and protected from damage. Beekeepers remove less vigorous trees to avoid competition on potential hive hanging tree that grows tall and straight. Climbers, although, favoured for their flower provision, could hinder straight growth of hive hanging trees. In this situation they will remove the climbers or lianas. Maximum protection is made to avoid damage on standing trees while felling trees for hive making or other purposes. Beekeepers noted that kobo forest close to access roads and home yards are more susceptible for poachers and they reported as difficult to control.

According to the group interview result forest (land) kobo exists in Masha and part of Andracha and reported to exist in Sheko only in the past. Across the landscape, kobo land is far from residence but this time as residences expanding and closer to forest they showed us that the kobo land is a few kilometer distant from Yockchichi but still remote in the case of Beto. In all areas where land ownership entitlement claimed, because it is their homegarden, crop land and/or coffee field, trees and hives found there belong to the land owner.

Exceptions have been also identified. For example if some one cleared a certain area and possess the land, it does not have the right to exclude the ancient kobo owner from using trees unless they mutually agree to do so with some sort of compensation. More over, If there is common vicinity and if formerly one of them used to use the tree for hanging, it still belong to him and theoretically allowed to hang. But the latter reported to be constrained to implement practically as bees will frequently sting the neighbour and could urge to stop hanging there. Trees both in crop land and home yards of such type are normally not allowed for the hive owner to fell it. Because they said honey tree is not to fell, for that purpose the land or home yard owner has equal right. Thus, there are some complexities, but it is successfully administered through the auspices of trust and common understanding.

Resource use conflict management

Respondents listed several types of disagreements in using trees and forest land for honey production. But two of them are the most important. The first is that arise among beekeepers and the second that could arise between beekeeper and other land users. In the first case, disputes mainly occur when a beekeeper knowingly or unknowingly hang on other person trees. From the interviewed households about 20 respondents have been quarreled with other beekeepers. The sources of the conflict and resolution mechanisms are reported to be different. They have listed about ten different types of conflict sources. These are hanging on other hive tree, boundary conflict in kobo land, felling of tree from others kobo land or ones honey tree, dispute of ownership entitlement over tree or land, competition for single tree which has no owner before, harvest conflict because two person have been using same tree for hanging, killing of neighbours' livestock by bees, fell the branches of hanging tree as the tree is found in home area of the non hive owner, hanging hive on others farm land without consent and honey theft. In Masha, the problems are more of boundary conflict in Andracha hanging tree conflict in Sheko, less conflict reported. Most of the cases arise from the first two weredas.

As for resolution, most of these handed to and managed by local leaders, only two cases taken to kebele administration while three other cases solved by mutual agreement of the contesting parties. When conflict arouse, local elders often try to know whose ownership long years ago and use it as a hint to infer the current owner, especially if the claimants are young and less known as whether he possess the respective lands or not. Thus, if elders or clan leaders know that it is owned by father of the claimant it is automatically given for him and who his father has no ownership right will be considered as breacher of the regulation and will be warned not to raise such type of contest again.

The second type of conflict arises from contesting use of the forest for honey production and other land uses. The most frequently raised of such type is the conflict between honey producers and tea and coffee producing entrepreneurs. This is still a conflict area as it is beyond the local capacity and still remained deadlock. There are also conflicts that

arise from fuelwood and other forest product extractors, mostly Manjo tribes and beekeepers. This is solved easily through edir (a local institution) and local elders. In this case the beekeeper always has the authority to check the act as far as he saw the wood collector and found disastrous for his practice. So it is often less significant problem. Another conflict arise with beekeeper and illegal loggers who want to extract valuable timber trees like *Aninjeria* and *Cordia* that are hive hanging trees or trees in kobo land. In this case, problems mostly solved by legal procedures.

Conclusion

Honey production and administration of related resources heavily relied on the local rules, common understanding and arbitration by local elders as well as the will of residents to be abided by these rules. Honey trees and hive hanging sites have various forms of arrangements. These variations are a function of districts; location within districts and also the level of frequency and management beekeeper invest on the honey tree or land. If a farmer ceases to use a land for long time, ownership privilege could be lost. Trees found in home garden and kobo land have high degree of ownership than other locations.

Beekeeping has three levels/hierarchy of ownership. The first is the right to own bee colony. One can claim ownership of bee colony found in his own hive irrespective of the location where it is found. And ownership for bees will end immediately as it leaves the hive for any reason and no right for swarming bees. The second is ownership of honey tree/hive hanging tree. Honey tree ownership has some room for youngsters without predecessors compared to koboland, in a sense that, the chance of

claiming entitlement for emerging young trees is equal for all individuals of the community. As a result degeneration and unacceptability of rules is found more prominent in kobo land than tree

kobo. In this case trees are private property while land is communal. But, unless supported by other source of ownership, honey tree ownership alone does no guarantee tree uses other than for beekeeping. The third is ownership for beekeeping land. This form of tenure ensures the owner to use all trees growing in the kobo land and transfer the title to his heir for beekeeping purpose.

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IDENTIFICATION PARTICIPATIVE DES ARBRES HORS FORET PREFERES PAR LES POPULATIONS LOCALES DANS LA PROVINCE DU SANMATENGA AU BURKINA FASO

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Abstract

In Burkina Faso, little is known about the needs and priorities of local people concerning multiple-use trees. This hampers implementation of sustainable and participatory agroforestry development programmes. The present article describes the results of an ethnobotanical study carried out in collaboration with the villagers of Dem and Wedse in the Sanmatenga province. Using the ethnobotanical use-value method, the aim of the study was to record the uses of trees outside forest and to determine which of them are preferred by the villagers by category of plant use. The 6 categories included: food, medicine, construction, commerce, technical and fuel. The results showed that tree species can realistically be classified according to informants' preferences, and that the highest diversity of uses was found within the medicine category. This research project is helping to ensure that the needs of local people are taken into account in policy making and decisions for sustainable use and management of plant resources.

Resume

Au Burkina Faso, les besoins et les priorités des populations locales en matière d'arbres à usages multiples sont peu connus, limitant ainsi la mise en œuvre d'un développement agroforestier durable. L'article présente les résultats d'une étude ethnobotanique effectuée en collaboration avec les villageois de Dem et de Wédsé, dans la province du Sanmatenga. L'étude qui utilise la méthode de la valeur d'usage ethnobotanique avait pour objectifs d'identifier les utilisations des arbres hors forêt et de déterminer ceux qui sont préférés par les villageois. Six catégories d'utilisation de plantes ont été prises en compte et comprennent: l'alimentation, la médecine, la construction, le commerce, l'artisanat et l'énergie. Les résultats montrent qu'une classification des espèces selon les préférences des informateurs est réaliste et que les utilisations liées à la médecine traditionnelle sont dominantes. La présente recherche contribue à intégrer les besoins des populations dans les sphères de décision concernant l'utilisation et la gestion durable des ressources végétales.

Introduction

Malgré l'importance des arbres dans les pays sahéliens, la dégradation des écosystèmes agroforestiers est de plus en plus perceptible, surtout à partir des années 70 au cours desquelles la région a connu de grandes sécheresses (Boffa, 2000). Pour contribuer à réduire cette dégradation, les informations sur l'environnement ainsi que les valeurs sociales et financières attachées aux forêts et aux arbres devraient être collectées en collaboration avec les acteurs locaux (Gregersen et al., 1995; Cunningham, 2001). Cependant, les préférences de ces acteurs sont peu connues et l'identification de leurs besoins et priorités représente un exercice parfois difficile (Sheil & Liswanti,

2006), limitant ainsi la mise en œuvre d'un développement agroforestier durable dans les pays comme le Burkina Faso.

On peut distinguer des valeurs d'usage direct, des valeurs d'usage indirect et enfin des valeurs d'option ou d'existence attachées aux forêts et aux arbres. Comme toutes les valeurs ne peuvent être quantifiées à travers les prix, d'autres mesures peuvent se fonder sur les fonctions des forêts et des arbres (Gregersen et al., 1995; Pearce, 2001). La détermination de la valeur d'usage des arbres peut se faire par l'utilisation de méthodes ethnobotaniques qualitatives (Gautier, 1994) ou quantitatives (Prance et al., 1987; Philips & Gentry, 1993; Höft *et al*., 1999; Albuquerque et al., 2006; Theilade et al., 2007). L'application des méthodes quantitatives peut reposer sur l'utilisation de scores permettant de cerner les valeurs des espèces ligneuses pour les populations locales (Lynam et al., 1994; Martin, 1995; Cotton, 1996).

Au Burkina Faso, les espèces préférées par les populations locales ont été déterminées par des méthodes ethnobotaniques qualitatives (Guinko, 1984; Bognounou, 1987; Nacoulma-Ouédraogo, 1996). Ganaba et al., (1998) ont étudié les préférences des populations en bois d'énergie dans les provinces du Séno et du Yaga, tandis que Ouédraogo et Belem (1998) ont déterminé les espèces pour lesquelles les populations locales souhaitaient une amélioration génétique. Dans la province du Boulgou, dans le centre du pays, Mertz et al., (2001) ont identifié à l'aide d'enquêtes ethnobotaniques quantitatives les espèces alimentaires consommées par les populations. Kristensen et Lykke (2003) ont défini les utilisations et les préférences relatives aux arbres de savane dans la partie septentrionale, en pays gourounssi. Des recherches ethnobotaniques dans le Sahel burkinabé) ont été menées en vue d'identifier les espèces préférées par les populations (Lykke et al., 2004). Des études ethnobotaniques similaires n'ont pas été effectuées dans la province du Sanmatenga.

Dans cette province du Sanmatenga et dans les villages de Dem et de Wédsé en particulier, les arbres dont la plantation est encouragée sont généralement proposés par le service forestier ou les techniciens des organisations non gouvernementales. En considérant l'importance de l'approche participative qui place les populations locales dans les prises de décision en matière de développement (Chambers et al., 1989; Musnad, 1996), il apparaît nécessaire de mener une étude d'identification des espèces préférées des producteurs dans cette partie du pays.

Centrée sur les arbres rencontrés dans les champs et dans les jachères, l'étude avait les objectifs suivants: (a) identifier les différentes utilisations faites des arbres hors forêt, (b) déterminer les espèces préférées par les paysans des deux villages.

Zone d'etude

L'étude a été menée dans les localités de Dem (commune de Kaya) et de Wédsé (commune de Korsimoro), situées dans la province du Sanmatenga (figure 1). La pluviosité moyenne annuelle varie de 500 à 600 mm. Le type de végétation est la savane arborée ou arbustive avec quelques galeries forestières. Dans les terroirs villageois, la densité d'arbres est assez faible (50 arbres au km2), le tout pouvant être assimilé à des «arbres hors forêt» tels que définis par Bellefontaine et al., (2001). La densité démographique est de l'ordre de 40 à 50 habitants au km² et, par conséquent, une forte pression, humaine et animale, s'exerce sur les terres. Le village de Dem comptait en 1998 (soit une année avant l'étude), 1846 habitants et celui de Wédsé 467. Les Mossis cultivateurs et les Peuls éleveurs sont les deux principales ethnies rencontrées. Les conflits agriculteurs éleveurs, même s'ils existent, ne sont pas exacerbés dans la zone. Dans l'ensemble, les systèmes de production reposent sur l'agriculture pluviale et les principales productions comprennent *Sorghum bicolor* (sorgho) et *Pennisetum americanum* (petit mil), cultivés couramment en association avec *Vigna ungiculata* (niébé).

Methodologie

Avant de commencer l'étude, un inventaire des arbres et des arbustes des deux terroirs villageois et une réunion avec 30 personnes dans chaque village a permis de retenir 27 espèces dans chaque localité. Les arbres sont parfois distants l'un de l'autre de 1 à 2 km, ce qui induit des déplacements journaliers moyens supérieurs à 5 km avec chaque informateur local pour l'appréciation des 27 espèces. Faute de moyens de locomotion, le nombre d'informateurs a été limité à 10 dans chaque village, au risque d'avoir un échantillon à la limite de sa représentativité statistique.

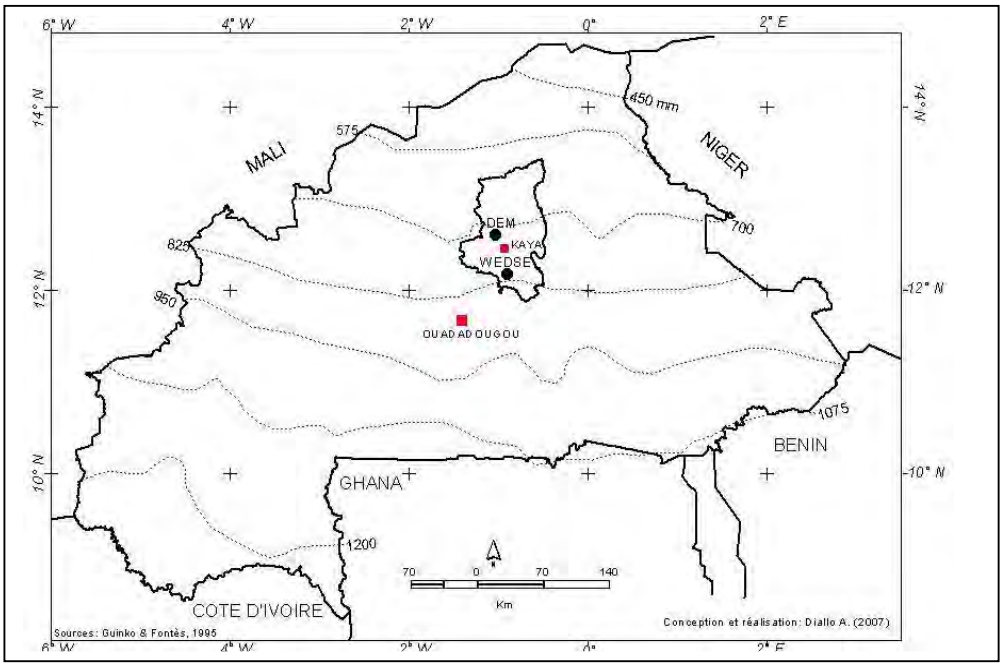

Figure 1. Localisation des villages de l'étude, Dem et Wédsé, province du Sanmatenga, au Burkina Faso.

Les 20 informateurs sélectionnés ont été recommandés par les chefs de village. Dans chaque village, 7 hommes et 3 femmes, âgés de 36 et 78 ans, ayant des connaissances particulières dans le domaine de l'utilisation des espèces ligneuses, ont pris part à l'étude (Vieux, vieilles, tradipaticiens, accoucheuses traditionnelles, pépiniéristes). Les définitions des diverses parties de plantes leur ont été rappelées avant de décrire les catégories d'utilisations. Une plante ou une partie de plante est employée soit pour obtenir un co-produit à usage direct (ou parfois indirect), soit pour tirer profit d'un service. Le co-produit peut comprendre le fruit, la pulpe du fruit, la graine, la feuille, le bois, etc. Le service peut être lié à l'ombrage, à l'ornementation, au potentiel fertilisant ou à l'utilisation de la plante dans les rites. Ces co-produits ou ces services permettent de déterminer des utilisations, qui peuvent être regroupées en catégories. La catégorie d'utilisation est l'ensemble d'utilisations de même nature. Les six catégories d'utilisations de plantes retenues sont l'alimentation, la médecine, la construction, le commerce, l'artisanat et l'énergie.

Le recensement des utilisations des espèces a été réalisé à l'aide d'interviews semi-structurées et chaque informateur a été interviewé séparément pour ne pas influencer les autres. La notation de l'arbre par chaque informateur a été faite à l'aide d'une fiche prétestée. Des conversations informelles avec la population ont permis de préciser certaines informations liées aux utilisations antérieures des plantes. Ces informations ont été enrichies par des visites de marchés et des observations dans les paysages agraires.

Le jour de l'interview, les questions posées étaient les suivantes: reconnaissez- vous cette plante? Quelles utilisations faites–vous d'elle? Pourquoi? Quels organes ou parties de la plante sont utilisés? (Racine, tige, feuilles, fleurs, fruits, graines, sève ou autre partie)?

Après cette série de question, l'étape suivante a consisté à la notation de l'arbre.

A l'intérieur de chaque catégorie, chaque espèce a été évaluée à l'aide de scores ((Prance et al., 1987; Philips & Gentry, 1993; Sheil & Liswanti, 2006) allant de 0 à 1,5. La note 0 correspond à une espèce non utilisée; 0,5 est attribué à une espèce occasionnellement utilisée; 1 est affecté à l'espèce utilisée régulièrement; 1,5 est le chiffre maximal correspondant à une espèce préférée. Pour chaque espèce, quand les six catégories d'utilisations sont considérées, la valeur d'usage ethnobotanique totale varie de 0 (minimum) à 9 (maximum). Le pourcentage d'utilisations faites des plantes au sein de la catégorie d'utilisations a été calculé en multipliant le nombre d'utilisations recensées dans cette catégorie par cent divisé par le nombre total des utilisations recensées dans toutes les catégories

d'utilisations. Le calcul de la valeur d´usage ethnobotanique des espèces a été effectué à l'aide de la formule suivante définie par Philips et Gentry (1993) :

$$VUET_S = \frac{\sum VUE_{is}}{N}$$

Où $VUET_s$ est la valeur d´usage ethnobotanique totale de l'espèce *s. VUEis* est la valeur d'usage ethnobotanique de l´espèce dans chaque catégorie d´utilisation; elle s'obtient en faisant la la somme des valeurs d'usage ethnobotaniques de l´espèce *s* dans les différentes catégories d´utilisation. VUE_{is} est la valeur d´usage ethnobotanique de l´espèce considérée *s* selon l´informateur *i* et *N* est le nombre total d´informateurs ayant évalué l´espèce *s*.

Dans cette étude, une espèce est dite «préférée par les informateurs» lorsque la somme des scores attribués à l'espèce est supérieure ou égale à 3, quand toutes les catégories sont prises en compte. Le test Mann-Whitney a été utilisé pour apprécier la différence existant dans la classification des espèces (en fonction de leur valeur d'usage ethnobotanique) selon les villages. La difficulté rencontrée pour trouver assez d'informateurs dans chaque groupe ethnique (cas des Peuls) et le fait que les forgerons soient assimilés à des Mossis ne nous ont pas permis d'analyser les données en tenant compte de l'appartenance au groupe ethnique, de l'âge et du sexe des informateurs. Cela n'entache en rien les résultats, dans la mesure où la similarité ou la différence existant entre les villages en matière d'espèces préférées est l'objectif principal de l'étude. Afin d'apprécier la relation entre la valeur d'usage ethnobotanique et le nombre d'utilisations des espèces, des courbes de régression ont été générées et les coefficients de corrélation linéaire de Pearson estimés. Les données ont été analysées à l'aide des logiciels Excel 2003 et Minitab 13.31.

Resultats

Utilisations faites des espèces

Au total, 262 utilisations ont été recensées. Les utilisations reconnues dans les deux villages dans la catégorie alimentation sont au nombre de 9 et représentent 3% des utilisations citées. Ces espèces produisent des fruits et parfois des feuilles comestibles, sauf Bombax costatum qui produit des fleurs utilisées dans la préparation de sauces. La catégorie médecine contient le plus grand nombre d'utilisations (178), représentant 68% des utilisations citées. Toutes les plantes mentionnées sont utilisées pour les soins de santé humaine. La catégorie construction représente 2% des utilisations citées et six utilisations différentes ont été recensées. De même, six utilisations différentes ont été identifiées dans la catégorie commerce, représentant 2% des utilisations citées. Les 59 utilisations reconnues dans la catégorie artisanat représentent 23% du total des utilisations. La catégorie énergie comprend quatre types d'utilisations et représente 2% des utilisations mentionnées. Toutes les espèces sont utilisées comme bois de feu, à l'exception de *Stereospermum kunthianum* (dont la fumée donnerait des vertiges). (Figure 2).

Parties et organes collectés ou utilisés

Le bois et les tiges de toutes les espèces sauf *Adansonia digitata* sont utilisés soit pour faire du feu, soit pour la construction ou l'artisanat. Il faudrait mentionner l'utilisation des tiges de *Boscia senegalenis* pour sucrer les aliments en lieu et place du sucre industriel. La collecte des feuilles est pratiquée par les éleveurs qui émondent les arbres fourragers pour l'alimentation du bétail. Les arbres qui subissent les émondages pastoraux comprennent entre autres *Khaya senegalenis, Pterocarpus erinaceus, Faidherbia albida, Balanites aegyptiaca* et *Acacia seyal*. Dans la catégorie médecine, la récolte des écorces (qui concerne toutes les espèces sauf *Guiera senegalensis*) est plus fréquente que celle des feuilles et des racines. L'écorçage est largement répandu chez *Khaya senegalensis, Sclerocarya birrea, Pterocarpus erinaceus, Balanites aegyptica, Bombax costatum.* L'extraction des racines pour la préparation des médicaments concerne notamment *Ziziphus mauritiana, Ximenia americana, Combretum micranthum.* L'importance des parties et organes ou produits utilisé se présente comme suit: écorce (53%), feuilles (25,5%), racines (11,5%), fleurs et fruits (3,5%), tiges (3%), tapinanthus ou plante parasite des arbres (2,5%), gomme (0,5%).

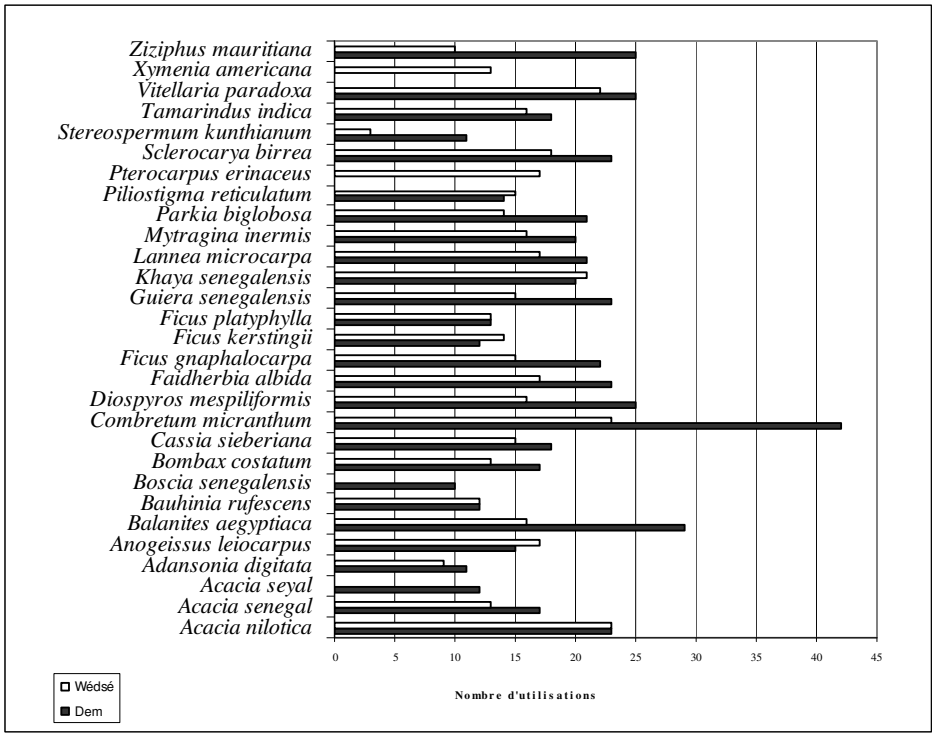

Figure 2. Nombre d'utilisations faites des espèces dans les villages de Dem et de Wédsé

Valeur d'usage ethnobotanique des espèces

Le tableau 1 présente les espèces et leur valeur d'usage ethnobotanique correspondante ainsi que leur rang. Les espèces préférées (celles dont la VUETs est supérieure à 3) sont : *Vitellaria paradoxa, Parkia biglobosa, Khaya senegalensis, Faidherbia albida, Diospyros mespiliformis*, *Combretum micranthum, Balanites aegyptiaca, Tamarindus indica, Acacia nilotica, Ziziphus mauritiana, Bombax costatum* et *Lannea microcarpa* pour le village de Dem. Les préférences du village de Wédsé sont orientées sur *Vitellaria paradoxa, Khaya senegalensis, Lannea microcarpa, Parkia biglobosa, Acacia nilotica, Sclerocarya birrea, Diospyros mespiliformis, Combretum micranthum, Faidherbia albida, Balanites aegyptiaca et Tamarindus indica* pour le village de Wédsé. Quand toutes les catégories d'utilisations des espèces sont considérées, le test de Mann-Whitney (au seuil de 95%) montre que l'appréciation de la valeur d'usage ethnobotanique totale des espèces préférées ne diffère pas selon le village ($p = 0,426$). Le test montre que la perception de l'importance des espèces ne diffère pas d'un village à l'autre au sein des catégories alimentation ($p = 0,367$) et commerce ($p = 0,9$). Une différence d'appréciation des plantes s'observe dans la catégorie médecine ($p = 0,0001$), artisanat ($p = 0,001$), construction ($p = 0,014$) et énergie ($p = 0,02$).

Relation entre la valeur d'usage ethnobotanique et les utilisations des espèces.

A Dem et à Wédsé, la valeur d'usage ethnobotanique est corrélée de manière significative au nombre d'utilisations des espèces (respectivement $r = 0,55$, $p = 0,003$ et $r = 0,68$, $p = 0,000$) (figure 3). La valeur d'usage ethnobotanique permet par conséquent, pour ces deux terroirs, d'approcher de manière satisfaisante le nombre total d'utilisations.

Discussion

Prédominance des utilisations liées à la pharmacopée humaine

Les résultats de l'étude montrent, d'une part, l'importance des arbres hors forêt pour les populations locales et, d'autre part, ils révèlent leurs besoins en co-produits forestiers. En particulier, l'étude fait ressortir le rôle prépondérant des utilisations liées à la pharmacopée humaine dans les terroirs villageois. Ce dernier aspect suggère que la disponibilité des produits issus des plantes et servant

dans la préparation des médicaments devrait être accrue à travers la culture des plantes médicinales. Mais, dans ce cas, il faudra vérifier les propriétés curatives réelles des coproduits cités, car nous n'avions fait que répertorier des utilisations décrites par nos informateurs.

Tableau 3. La valeur d'usage ethnobotanique totale

Espèce	Dem		Wédsé	
	($VUET_s$)	Rang	($VUET_s$)	Rang
Acacia nilotica	3,5	9	9	5
Acacia senegal	2,05	20	30	23
Acacia seyal	1,3	25	Non recensée	
Adansonia digitata	2,94	13	2,65	14
Anogeissus leiocarpus	2,72	16	2,85	13
Balanites aegyptiaca	3,55	7	3,2	10
Bauhinia rufescens	1,89	21	1,27	26
B. costatum	3,22	11	2,6	15
Boscia senegalensis	1,78	23	Non recensée	
Cassia sieberiana	1,67	24	1,55	22
Combretum micranthum	3,67	6	3,4	8
Diospyros mespiliformis	3,89	5	3,45	7
Faidherbia albida	4,22	4	3,35	9
Ficus kerstingii	1,22	26	1,3	25
Ficus platyphylla	1,83	22	1,35	24
Ficus sycomorus subsp *gnaphalocarpa*	2,44	18	1,8	20
Guiera senegalensis	2,16	19	1,8	21
Khaya senegalensis	4,78	3	4,4	2
Lannea microcarpa	3	12	4,11	3
Mitragyna inermis	2,91	14	2,3	18
Parkia biglobosa	4,88	2	4,10	4
Piliostigma reticulatum	2,66	17	2,35	17
Pterocarpus erinaceus	Non recensée		2,4	16
Sclerocarya birrea	2,89	15	3,6	6
Stereospermum kunthianum	0,72	27	0,2	27
Tamarindus indica	3,55	8	3	11
Vitellaria paradoxa	7,05	1	6,3	1
Ximenia americana	Non recensée		2	19
Ziziphus mauritiana	3,39	10	2,95	12

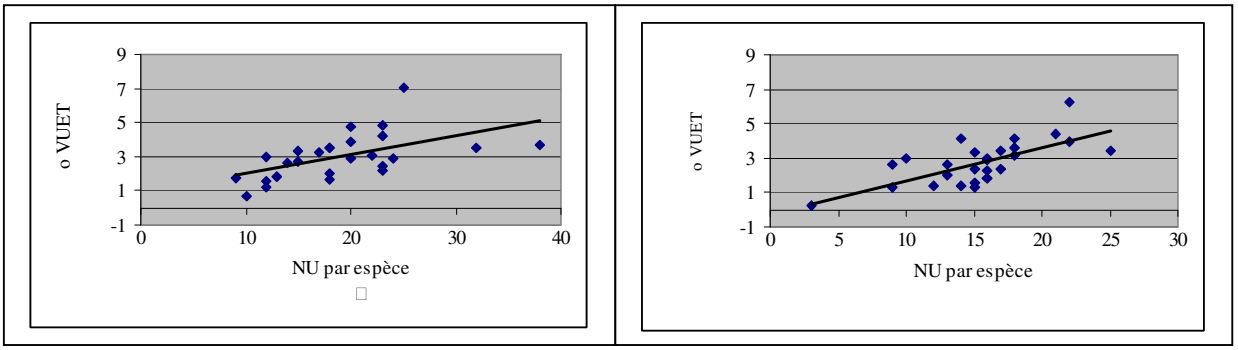

Figure 3. Corrélation entre la valeur d'usage ethnobotanique et le nombre d'utilisations des espèces à Dem (à gauche) et Wédsé (à droite)

Conservation des espèces

Si les produits des arbres sont largement utilisés, le mode de collecte des parties ou d'organes pourrait poser des problèmes de pérennisation des ressources de base, comme c'est le cas de l'extraction des écorces, des racines et de l'écimage répété des arbres. D'autres alternatives pour la satisfaction des besoins en médicaments des populations devraient être recherchées.

Des espèces telles que *Khaya senegalensis, Faidherbia albida, Pterocarpus erinaceus, Bombax costatum, Vitellaria paradoxa etc.* bénéficient de mesures de protection prévues à l'article 21 du décret du 4 Juillet 1935 puis l'arrêté n°2004-09/MECV, du 07 juillet 2004. Lorsque l'on compare l'extraction presque démesurée des produits issus de ces espèces, dans les deux villages, et les vœux de la législation forestière, alors on doute de l'efficacité de cette dernière. En effet, il parait comme si les paysans n'ont jamais été associés à l'élaboration de ces lois de protection des espèces.

A l'échelle des villages, les résultats pourraient servir à la formulation de lois régissant l'utilisation et la conservation des arbres, à la planification de l'utilisation des terres, notamment dans l'élaboration des schémas d'aménagement du terroir, en ce sens que certaines espèces préférées pourraient être ainsi épargnées lors de la construction des habitations ou la création des infrastructures rurales (routes, écoles, etc.). Mais, dans ces cas, la collaboration avec les populations locales est indispensable, car elles sont des alliés pour la conservation des espèces (Lynam *et al*., 2004; Sheil & Liswanti, 2006).

Pour certaines espèces, cette conservation pourrait se faire en tirant profit de leurs mécanismes naturels de régénération tels que le drageonnage (Bellefontaine, 2005; Belem, 2008).

Limites de la méthode de la valeur d'usage ethnobotanique

Les résultats obtenus à travers l'application de la méthode de la valeur d'usage ethnobotanique devraient être appliqués avec prudence, car cette méthode ne distingue pas les utilisations passées des utilisations présentes et potentielles des espèces. Ces utilisations évoluent assez rapidement et ne sont donc pas définitives. De même, l'importance accordée à une plante précise à travers une utilisation donnée est relative car dépendante de plusieurs facteurs dont: (a) le savoir et le savoir-faire des populations en relation avec les plantes et les co-produits, (b) la valeur commerciale des co-produits (opportunité de marché local, régional et international), (c) la disponibilité des co-produits et des espèces sources, (d) les politiques et législations gouvernementales régissant l'exploitation des produits et leur commercialisation.

Du point de vue de la conception des catégories d'utilisations des plantes, on gardera à l'esprit que l'on peut procéder à une ségrégation plus fine des espèces en considérant l'utilisation finale des co-produits qui sont liés à la partie ou à l'organe utilisé construction des masques, vannerie, tannerie, teinture, utilisations sacrées, traitement de la dysenterie, fertilisation des sols etc.).

Les résultats de la présente recherche pourraient être complétés par une estimation de la nature et de la quantité des produits récoltés dans les champs et dans les jachères durant au moins une année entière. Cela permettra d'estimer la valeur des produits en unités de mesure (volume, poids, monnaie) et de disposer de données sur les disponibilités et les variations saisonnières de ces produits.

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ETHNOBOTANY AND UTILITY EVALUATION OF FIVE COMBRETACEAE SPECIES AMONG FOUR ETHNIC GROUPS IN WESTERN BURKINA FASO

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Abstract

In Africa, local communities depend on forests and plants for their daily needs including goods and services. This paper describes ethnobotanical knowledge of five Combretaceae species in western Burkina Faso. Information was obtained from semi-structured interviews, personal conversations with local experts and specialists in plant uses and direct observation. Data was collected in four Villages among four ethnic groups. A total of 150 specialist male and female respondents were involved and 400 users were interviewed. The data were analyzed with generalized linear models with Binomial Errors and Principal Component Analysis. The results showed that people in the same village share more ethnobotanical knowledge than between ethinic groups ($P = 0.019$); gender and age of informants were not determinant factors. This indicated that ethnobotanical knowledge are also influenced mainly by socio-cultural factors related to ethnicity. *Combretum aculeatum* and *Combretum micranthum* are moderately valued as food. *Anogeissus leiocarpus* and *Combretum micranthum* were observed to be utilized for different purposes by the indigenous people. All species were found useful for fuelwood, pharmacopoeia and forage. The stems of the species are the most used while flowers and fruits were marginally used. The present study emphases the importance of the five Combretaceae species as a highly valued resource. However, their exploitation has impact on their sustainabiltiy. Therefore, appropriate management strategies should be developed jointly by the local communities and external support groups, to integrate the valuable local knowledge about the species in order to secure sustainability of their uses.

Introduction

In Africa, local communities depend on forests and plants for their daily needs including goods and services. These needs are principally food, medicine, firewood and construction material for houses, grain storage and containers, fodder for animals, shade, soil fertilization or reclamation, ornamentation and practices of rituals and customs (Belem et al., 2007; Kristensen & Balslev 2003). The indigenous communities of the region have learned to use the bio-resources around them for various purposes that is often ignored. The collection of useful ethnobotanical evidence requires some preliminary understanding of the structure of a knowledge system itsef, including how knowledge may vary in both spacial and temporal terms (Cotton, 1996).

A frequent use of wild plants and a communication of knowledge from generation to generation give people a profound knowledge of plant resources in the local environment. Practically all local people can give information about a variety of useful species, and many have priorities for natural resource use and management practices (Lykke, 2000). Local societies therefore harbor important information on valuable plants and it is necessary to document these resources to provide more complete information on the value of tree species and help management and conservation strategies. Although there are many studies on forest use among indigenous peoples in the Burkina Faso (Nacoulma/Ouédraogo, 1996; Arbonnier, 2002; Thiombiano, 2005), there has been little work on ethnic group difference in knowledge of plant uses and how this vary spatially.

Traditional medicine based on phytotherapy may complement and offer alternatives for disease control, in particular for poor household. More studies are needed to describe the traditional know-how, but also of the medicinal plants themselves. In this study, we examined the ethnobotany and uses of five dry forest Combretaceae species (i.e. *Anogeissus leiocarpus* (DC.) Guill. & Perr. *Combretum aculeatum* Vent., *Combretum micranthum* G. Don, *Combretum nigricans* Lepr. ex Guill. & Perr., and *Pteleopsis suberos*a Engl. & Diels) distributed in the four phytogeographical units in Western Burkina Faso.

Methodology

Study sites location

The study was carried out in four villages Belehede (14° 06' N and 1°12' W), Ouahigouya (13° 32' N and 2° 22' W), Diouroum (12° 58' N and 3°08' W) and Pâ (11° 35' N and 3° 14' W) located in the western part of Burkina Faso (Figure 1). The country has a primary tropical climate with two very distinct seasons: a unimodal rainy season with mean annual rainfall varying from 300 to 1200mm. Phyto-geographically, the study sites are located in the following sectors defined by Fontès and Guinko (1995).

Belehede is located in the North Sahelian sector. The average mean annual rainfall varies between 400 – 500mm. The number of rainy days per year varies between 30 and 40 days. The vegetation is characterized by Saharian and Sahelian woody and grass species. Among the species of interest *C. aculeatum, C. micranthum* and *A. leiocarpus* were present. The population is constituted of the native ethnic groups of Fulsé, Fulani, Sonraï, Bèla and migrant group essentially Mossi. The dominant production methods are traditional subsistence farming systems with cereals (such as sorghum, millet) and animal husbandry.

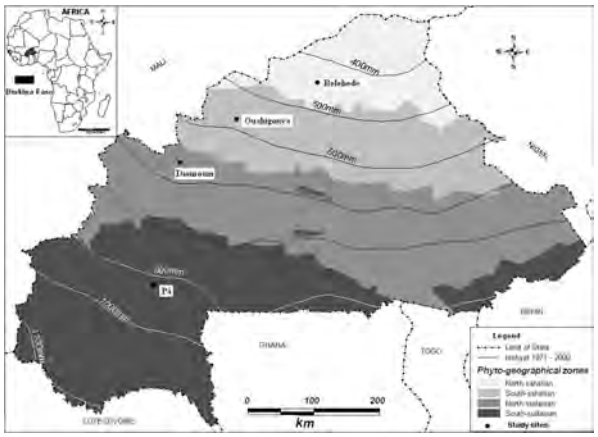

Figure 1. Location of study sites

Ouahigouya is located in the South Sahelian sector. The annual rainfall varies between 500 – 600mm. The number of rainy days per year varies between 40 and 50 days. The vegetation is characterized by Saharian, Sahelian and some Sudanian species. The common species of interest found were *C. aculeatum*, *C. micranthum*, *C. nigricans*, *A. leiocarpus*. The population is constituted of native ethnic groups of Mossi (farmers) and Fulani (breeders). The dominant production methods in the study area are traditional subsistence farming systems with cereals (such as sorghum, millet) and animal husbandry. Several income generating activities such as market gardening and trading are common.

Diouroum is located in the North Sudanian sector. The annual rainfall varies between 600 – 700mm. The number of rainy days per year varies between 40 and 70 days. The vegetation is characterized by Sudanian and some Sahelian species. All the study species were present. The population is constituted essentially of ethnic groups of Samo and Marka; their livelihood is based on traditional subsistence farming systems with cereals (such as sorghum, millet, and maize) and animal husbandry.

Pâ is located in the South Sudanian sector. The annual rainfall varies between 800 – 900mm. The number of rainy days per year varies between 70 and 90 days. Among the species of interest *P. suberosa*, *C. nigricans* and *A. leiocarpus* were present. The population is constituted essentially of the ethnic group of Bwa and migrant group essentially Mossi (farmers). The dominant production methods in the study area are traditional subsistence farming systems with cereals (such as sorghum, millet, and maize) and animal husbandry.

Ethnobotanical survey

Information was obtained from semi-structured interviews, conducted as described by Cotton (1996), personal conversations with local experts and specialists in the use of the local natural resources, direct observation as described by Etkin (1993), and by reviewing studies reported in the literature. To perform the ethnobotany and utility evaluation of the five Combretaceae species among the ethnic groups of Fulsé, Mossi, Samo and Bwa, a two-step investigation procedure was used in the villages of Belehede, Ouahigouya, Diouroum and Pâ. First, a purposive sampling method was used to select 150 specialist informants corresponding to 30 informants for each of the five species of interest. The numbers of selected respondents were proportional to the number of villages where the species are present. The specialist interviewed included indigenous healers who treat illness using plant medicine, plant medicinal hawkers, medicinal plant retailers, livestock breeders and medicinal plant collectors. To minimize potential biased response most interviews were arranged by village leaders familiar with local conditions and who could communicate with indigenous communities. A complete explanation of the objectives of the research was made in an effort to obtain that individual's consent to participate in the interviews and data collection procedures. We also made clear that we were independent researcher with no affiliation to forestry authority. In each village, respondents to the questionnaire were men (head of household) and women all over 37 years old, assuming that people who satisfied these conditions were sufficiently qualified to provide accurate information regarding the uses of the species. Care was taken to interview a representative combination of informants with respect to geographical position of the household within the different village. The questionnaire addressed to each informant included local name(s) and plant parts used and therapeutic indications. The interviews were conducted by the first author with the help of translators during the dry season where farmers and breeders are less occupied. Each of the interview lasted about 30 minutes and was carried out in the informants' local language e. g. Fulsé, Fulfulde, More, San, Marka, or Bwamu.

Secondly, in each locality, 100 informants knowledgeable about different uses of plants, were randomly selected ensuring that sociological variables such as age, gender, occupation, education are not biased in favor of any of one social group. Informants were interviewed individually with the aid of local assistant. A total 400 informants were interviewed individually about their own uses of the species. The questionnaire used was composed of a semi-structured information sheet containing: personal information and informants' different uses the species of interest.

Statistical analysis

The data were analyzed with generalized linear models with Binomial Errors (Crawley, 2005). The locality, the gender, species, plant parts and the use type were treated as categorical fixed factors. The statistical analyses were performed with the R statistical package (R Development Core Team 2007). The gplots package was used to draw the graphics. Species-use and plants' parts-use matrices were derived based on the number of informants who mentioned a species, and Principal Component Analysis (PCA) was then carried out on the resultant matrix to summarize the major patterns in the variation (McCune and Mefford, 1997; Höft. et al., 1999). PCA is an unsupervised ordination technique that enables the low-dimensional representation of multivariate data, allowing the data to be explored visually in two dimensional correlation biplots. PCA was performed on untransformed, centered and standardized species data using the software package CANOCO 4.5, and the ordination diagrams were drawn in CANODRAW (ter Braak & Smilauer, 2002).

Results and Discussion

Knowledge distribution

The qualitative knowledge about how plants are used varied significantly between villages (d.f. = 3; $\chi 2$ = 9.9; P = 0.019) while no significant knowledge variation was found with respect to informants gender and age (d.f. = 1; $\chi 2$ = 0.1; P = 0.8) indicating that people in the same village share similar

ethnobotanical knowledge than between villages (Kristensen, 2004). Highly significant knowledge variation was found with respect to species and plants part used ($P < 0.001$). The different parts of the plant were indicated used for different purposes. The relationships between the species and the uses of their different parts, such as their fruits, stems, branches, and flowers, were examined by a PCA based on a plant parts use-category matrix (Figure 2A). The eigenvalues for axes 1 and 2 of the PCA were 0.494 and 0.310 respectively, thus these Principal Components explained 80.4% of the total variance in the data. PCA axes 2 and 3 had low eigenvalues (0.191 and 0.004 respectively) and therefore were not further considered. Stems and branches appeared to be the most frequently used plant parts.

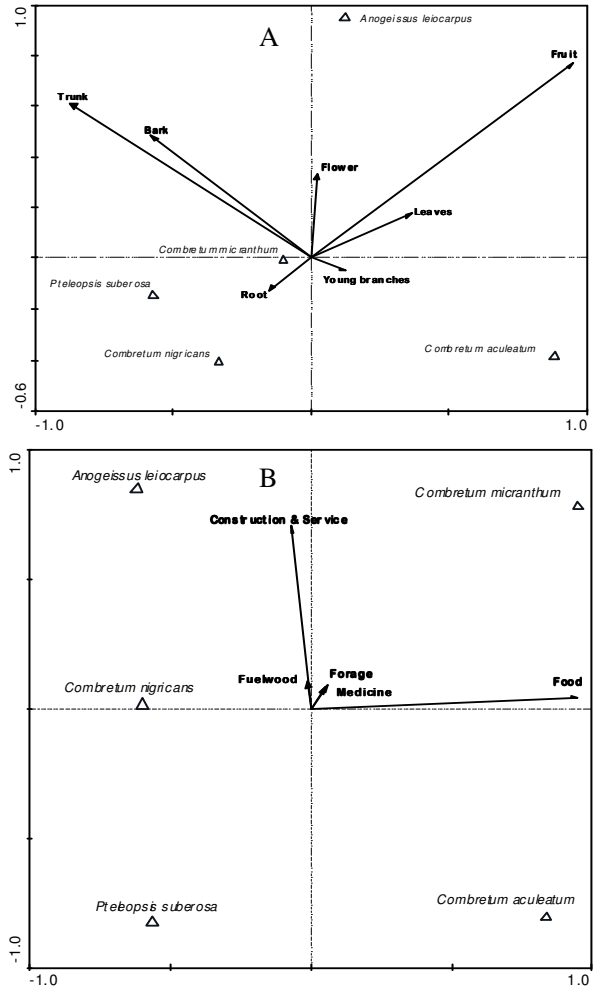

Figure 2. Principal Component Analysis of plants parts used in relation to species (A) and species uses categories (B).

Table 1. Ethnobotanical knowledge of five Combretaceae species among local people

Species	Uses					
	Medicinal	**Energy**	**Food**	**Construction**	**Handicraft**	**Forage**
A. leiocarpus	Malaria (Le., Ba.)	Fuelwood		House	Furniture	Cattle (Le.)
	Diarrhea (Ba.)	Charcoal		Cabin	Agric-tools	
	Hemorrhoid (Ba., Ro.)			Hut	Dyeing	
	Hypertension (Le., Ba.)			Open shed	Tanning	
	Dermatosis (Ba., Yb.)			Garret	Cosmetic	
C. aculeatum	Malaria (Le., Ro.)	Fuelwood	Edible fruit	Fence	Dyeing	Cattle (Le., Fr.)
	Diarrhea (Ro.)					
	Mentruation (Ba.)					
	Bilharzia (Le., Ro.)					
	Dermatosis (Ba., Ro.)					
C. micranthum	Malaria (Le., Ba., Ro.)	Fuelwood	Leave infusion	House	Furniture	Cattle (Le.)
	Diarrhea (Le.)		Root infusion	Cabin	Basketwork	
	Hemorrhoid (Ba., Ro.)		Fruit infusion	Hut	Agric-tools	
	Ulcer (Ro.; Fl.)					
P. suberosa	Malaria (Ba.)	Fuelwood		House	Furniture	Cattle (Le.)
	Diarrhea (Le.)			Cabin	Basketwork	
	Hemorrhoid (Ba., Le.)			Hut	Agric-tools	
	Ulcer (Ba., Ro.)			Garret		
C. nigricans	Malaria (Ba.)	Fuelwood	Gum	House	Handicraft	Cattle (Le.)
	Diarrhea (Yb.)			Cabin	Furniture	
	Cough (Yb.)			Hut	Agric-tools	
	Asthenia (Ba., Le., Ro.)			Open shed	Dyeing	

Ba.= Bark; Br.= Branch; Fl.= Flower; Fr.= Fruit, Le = Leave, Ro.= Root; Yb.= Young branch

Use categories

Six categories of plants uses were identified: food, forage, construction materials, fuelwood, handicraft and pharmacopoeia (Table 1). The species preferences of the local communities were examined by means of a PCA based on a use-category matrix, which included use types such as food, medicine, fuelwood, wood carving, house construction, poles, and fodder (Figure 2B). The eigenvalues for PCA axes 1 and 2 were 0.623 and 0.357 respectively, thus Principal Components 1 and 2 explained 97.9% of the total variance in the data. The third (0.019) and the fourth (0.001) axes showed low eigenvalues, and were not further considered. *A. leiocarpus* has no use in human feeding, but far away, its young stems were used by the Bwa ethnic group as salt substitute. The fruits of *C. aculeatum* are edible. The people of Belehede call it the peanut of shepherd because when

shepherds are hungry in bush, they eat sometime its fruits. But it must be consumed moderately because great consumption provokes dizziness. The consumption of the infusion of the leaves, the roots and the fruits of *C. micranthum* is well known among population; its active principle is also well known by both local and scientific populations (Kerharo & Adam, 1974; Karou et al., 2003). The gum of *C. nigricans* enters in the food preparation of some people. No ethnic group reported the use of *P. suberosa* in human alimentation as revealed by the PCA. All the species are used as source of fodder but there was some preference depending of the species, the part of the plant, the locality and the season. This could be related to the phenological pattern of each individual species and the change in phytochemical compound (Salisbury & Ross, 1992). In the dry season when there is almost a complete absence of pasture, the fruits, leaves and twigs of *C. aculeatum*, *A. leiocarpus*, *C. micranthum* and *P. suberosa* constitute the main source of forage by domestic livestock. At the onset of the rainy season, the young leaves of *A. leiocarpus*, *C. aculeatum*, *C. micranthum* and *C. nigricans* are useful for fulfilling livestock protein and energy requirement as reported by Le Houérou (1980).

All studied species were found useful for fuelwood even though some preference varied among ethnic groups. Usually people prefer *C. nigricans* and *A. leiocarpus* for fuelwood or charcoal production. It is forbidden to use *C. aculeatum* wood as fuelwood in Songhai ethnic group (Ganaba et al., 1998). The wood of *C. micranthum* is the most useful in the zone of Ouahigouya because of it availability.

The plants are natural pharmacy for local people which have limited economic means to buy modern medicine (Anonymous, 2006). More than 40 diseases could be treated by using product from the studied Combretaceae species. They are all known efficient against malaria. *A. leiocarpus* is known efficient against 23 diseases, *C. aculeatum* against 22, *C. micranthum* against 14, *P. suberosa* against 13 and *C. nigricans* against 5. The species and the plant part used for healing a disease varied from one locality to another. *C. micranthum* is registered in the French CODEX 1937, and it known active principle to prevent and cure malaria (Perrey et al., 2004). Practically paludal zone people may use it as tea in their alimentary regime.

Knowledge about construction materials concern cabin, hut, grain storage and containers, open sheds, fence and permanent houses roof construction. *C. aculeatum* is not useful for that. *A. leiocarpus* and *C. micranthum* can resist against xylophages and endure for many years. *A. leiocarpus* is widely known useful in the construction of permanent houses and *C. micranthum* in the construction of nomad huts (Ganaba et al., 2005). The wood of *C. nigricans* and *P. suberosa* are useful occasionally as construction materials but they don't resist against xylophages.

Handicraft is used here in opposition to industrial. *C. micranthum* is known as an excellent material for furniture (bed, chair, table, stool, shelf and basket) confection. It is also useful in agricultural tools handle confections (pickaxe, axe, hoe, knife and poultry nest) and in the confection of plant protection fence. *A. leiocarpus* is also useful in furniture (bed, stool, chair, table and gate) and agric tool confection but it is well known in dying, tanning, sculpture and cosmetic. *C. nigricans* and *P. suberosa* are useful for furniture and agric tool confection but the items are not lasting. The gum of *C. nigricans* is useful in dying, tanning and cosmetic. The bark of *C. aculeatum* is also useful in dying.

Local populations are more or less dumb in ethnobotanical knowledge concerning the usefulness of species in traditional religion and magic rite. However, it is known in the Fulsé ethnic group of Belehede that the wood of *C. aculeatum* is useful to grill sacrifice meat. In the Bwa ethnic group of Pâ, the bark of *P. suberosa* is useful to tie the ritual masks at the beginning of rainy season. Most people reported having learned about specific plant-uses from their parents (specifically, fathers). Several mentioned learning from neighbors.

Valuation of the species uses

The exploitation of the species for fuelwood among informants is very important (Figure 3a) and varied significantly between species (d.f. = 4; $\chi 2 = 136.29$; $P < 0.001$) and between ethnic group (d.f. = 3; $\chi 2 = 43.97$; $P < 0.001$). Except *C. aculeatum*, all the species are exploited by all informants. *C. aculeatum* is used occasionally because of the size of the wood, the presence of thorn on the wood, its smoke and some traditional and religious reasons.

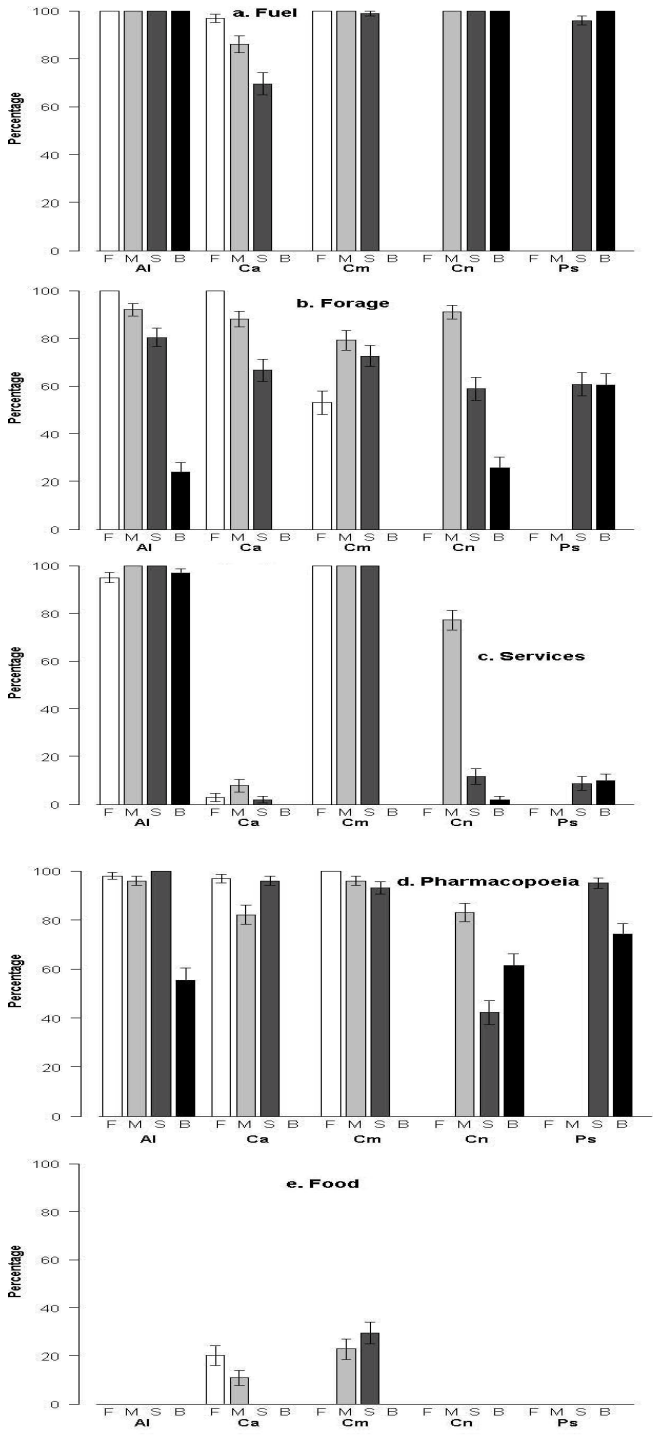

Figure 3. Percentage of respondents (Fulsé-F; Mossi-M; Sonraï-S; Bwa-B) per use categories in relation to species.

The exploitation of the species forage among the informants is important (Figure 3b) and displays significant difference between species (d.f. = 4; $\chi 2 = 49.10$; $P < 0.001$) and between ethnic group (d.f. = 3, $\chi 2 = 246.4$; $P < 0.001$). The exploitation of *A. leiocarpus*, *C. aculeatum* and *C. nigricans* decreased with the latitude gradient confirming the change of the value of the forage usefulness from species to species and from place to place. The Mossi and the Samo ethnic groups exploit *C.*

micranthum forage more than the Fulsé ethnic group. *P. suberosa* exploitation is the same among Samo and Bwa ethnic group.

The exploitation of the species among informants for different services (construction, furniture, agric tool, handicraft, traditional rite) is very important for *A. leiocarpus* and *C. micranthum* (Figure 3c) and displays significant difference between species (d.f. =4; $\chi 2 = 1442.50$; $P < 0.001$) and between ethnic group (d.f. = 3, $\chi 2 = 124.29$; $P < 0.001$). *C. nigricans* is more exploited for services by Mossi compared to Samo and Bwa ethnic group. *C. aculeatum* and *P. suberosa* are exploited for services by few informants.

The exploitation of the species for pharmacopoeia is very important (Figure 3d) and displays significant difference between species (d.f. = 4; $\chi 2 = 43.97$; $P < 0.001$) and between ethnic group (d.f. = 3; $\chi 2 = 153.1$; $P < 0.001$). This result shows how plants are useful in pharmacopoeia of local populations which have limited economic means to buy western medicine.

The exploitation of the species for food is very low (Figure 3e) and displayed significant different between species (d.f. = 4; $\chi 2 = 131.85$; $P < 0.001$) and between ethnic group (d.f. = 3; $\chi 2 = 41.14$; $P < 0.001$). Few informants use *C. aculeatum* and *C. micranthum* as food (Figure 3e). *C. micranthum* is a multi-purpose species extensively used in sahelian region where the leaves are used as tea (Arbonnier, 2002). Despite the well known active principle of *C. micranthum* (Bassene, 1985; Nacoulma-Ouédraogo, 1996; Perrey, 2004) informants do not drink this tea frequently as it is the case in Senegal, Niger and Mali.

Conclusion

The present study emphases the importance of five Combretaceae species as a highly valued resource that need prioritization in management strategies. Planting trees and active management, like protection of individual trees or periodical protection resource, however, is not part of Fulsé, Mossi, Samo, Bwa traditions and is not generally thought of as a possibility. Therefore, local people need ideas and support to establish new management and land tenure practices, that can assist the role of traditional systems when it comes to ensuring a rational use of woody plants. Nevertheless, local people's profound knowledge and clear-cut opinions on use-preferences, general ecological conditions and vegetation dynamic are crucial element for producing culturally and ecologically rational management strategies.

Acknowledgements

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THE PLIGHT OF INDIGENOUS AND TRADITIONAL KNOWLEDGE IN HEALTH CARE USING HERBAL MEDICINE IN REMOTE AREAS OF SOUTH-WESTERN UGANDA

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Abstract

Uganda is one of the few countries that lie astride the equator with a lot of natural resources (flora and fauna) that have over time been utilised by indigenous people for survival. Through all this, accumulation of knowledge for sustainable conservation, harvest, processing and utilisation has formed a big bank that can be harnessed in knowledge transfer. This paper will treat and analyse the skills used in herbal medicine conservation, harvesting, processing and utilisation in the Bwindi Impenetrable forest, south western Uganda. Bwindi forest is a home of half of the world's mountain gorillas *Gorilla gorilla berengei*. Uganda is rich in biodiversity in the ten different national parks and several forest reserves as wild germplasm banks that can give a baseline for applied ingredient separation of prioritized medicinal plants and associated I&TK. There are 30,000 to 70,000 food and medicinal plant species world wide and only about 6,300 plant resources are used as food and medicine in Africa. Worldwide herbal medicines are used by 82%. The world's 36,000 plant species has 90 plant species represented in modern medicine products of which over 70% come from the tropical regions. In this manner, this paper will analyze the abundant wealth of indigenous and traditional knowledge of medicinal plants of Uganda. The World Health Organisation (WHO) estimates the present demand for medicinal plants to be about US$14 billion and this is projected to increase to US$5 trillion by the year 2050. Adding value to the plant products has potential to benefit communities involved in production, processing, marketing and utilisation. The overall objective of this project is to improve production, processing, and commercialisation of plants that have nutritional and medicinal functions for improvement of livelihoods and wealth creation for rural people with limited income in Africa and beyond learning from the Bwindi forest example. Bwindi forest was one of the very first areas used to test out the multiple use concept design in conservation and non timber forest products utilisation. Uganda is endowed with rich biodiversity of plants that have social, economic, and environmental functions that is not fully exploited. The high level of indigenous knowledge can put the healthcare system into good shape if well intentioned studies exploit this vast knowledge base. This can be achieved through value addition, flora restoration and improving on biodiversity conservation. In addition, priority concern as demonstrated through Poverty Eradication Action Plan (PEAP) and Plan for Modernization of Agriculture (PMA) in poverty alleviation emphasizes the need for the critical management and use of the environment and its natural resources. The only hurdle will lie on health seeking behaviour and promotion of new natural products as opposed to the new life style of synthetic products. This calls for change of school curriculum and incorporation of I&TK for a better future of nature around us and livelihood. Applied research work in medicinal plant products will therefore act as a springboard to realize and harness this potential.

DIVERSITY AND ETHNOZOOLOGICAL STUDY OF SMALL MAMMALS IN VILLAGES OF THE PENDJARI BIOSPHERE RESERVE IN NORTHERN BENIN

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Abstract

Research on conservation of wildlife in reserves in Benin has focused on large mammals due to their appeal for hunting, tourism and related uses. To fill this gap information on small mammals this study aims to assess the diversity and ethnozoology of small mammals at the border of Pendjari Biosphere Reserve (PBR). In this purpose, some semi-structured dialogues and interviews based on questionnaire allow us to establish relationship between small mammal and humans in PBR. Villages were chosen on the basis of socio-cultural group and their proximity and access to resources. Twelve (12) villages of three socio-cultural groups were considered and thirty people (hunters, farmers, and park guards) were surveyed in each village. A total of 43 species of small mammals were inventoried according to local perception. Small mammals constitute an important food resource in the study area except (a) those having nauseous secretions and (b) those which represents a totem for some social clans. Eleven species were listed as priority foods. Small mammals are used for medicinal purposes to treat belly aches, incurable wounds, earaches, sexual impotence and abscess. Some species such as squirrels are threatened because of their negative effect on domestic poultry and on crops such as corn, sorghum and rice**.** The domestication of some species, the grass-cutter and the hare, are frequently requested as is the creation of locally managed poultry farms which could reduce the dependence of local populations on small mammals thus ensuring their conservation.

Introduction

Local knowledge on wildlife species may exceed scientific knowledge. It is being increasingly recognized as valuable for improving scientific understanding, conservation programs and management practices (Berkes et al., 2000; Moller et al., 2004; Williams & Baines, 1993). However, factors such as demographic expansion and widespread poverty, characterized by unemployment, few local economic opportunities and dependency on limited natural resources are the main reasons for the overexploitation, habitat degradation and over-hunting of wildlife in emerging countries from the tropical zone (Shackleton et al., 2002). This aspect is not important in a world-wide view, but may be crucial for local village communities in tropical countries, especially in wide areas of the African moist tropics, where local people living in the poor condition. Therefore, scientific data is needed to develop a strategic management and conservation plan for the remaining natural resources that also contributes to local livelihoods. The majority of wildlife data in Benin concerns large and endangered mammals (Akpona, 2004). In contrast, wildlife species that are small, nocturnal or less appealing to eco-tourism are less documented, but are equally if not more important for local use (Mensah et al., 2007; Amoussou 2003; Di Silvestre et al., 2003). However vigorous surveillance measures developed in protected areas increasingly discourage poaching of large animals. Hunting of small mammals has increased due to their ease of transport (because of their size) without being stopped by park guards (Lamarque, 2004). Thus, the lack of scientific data on the utility of the small mammals for the survival of the local populations of the Pendjari Biosphere Reserve (PBR) limits the actions of durable conservation. In this purpose this study aims to fill this information gap by determining the specific richness of small mammal species in the villages of PBR, assessing the relationship between the human and small mammal populations that either support or threaten their conservation.

Methods

Study Site

This study was conducted from August through October 2007 at the Pendjari Biosphere Reserve. This protected area is located in the Atakora district of north-western Benin, at latitudes of 10°30' and 11°30' North and the longitudes of 0°50' and 2°00' East (Fig 1). The Reserve is characterized by a sudanian climate type with seven months of dry season and 1,000 mm of annual precipitation. In the periphery of PBR the landscape is dominated by fields and fallows. Cultivated crops are amongst others: rice, yams, maize and cotton, the latter requiring intense use of pesticides (Djibril 2002). The savannah in the buffer zone is also used for grazing cattle and intensively collecting firewood.

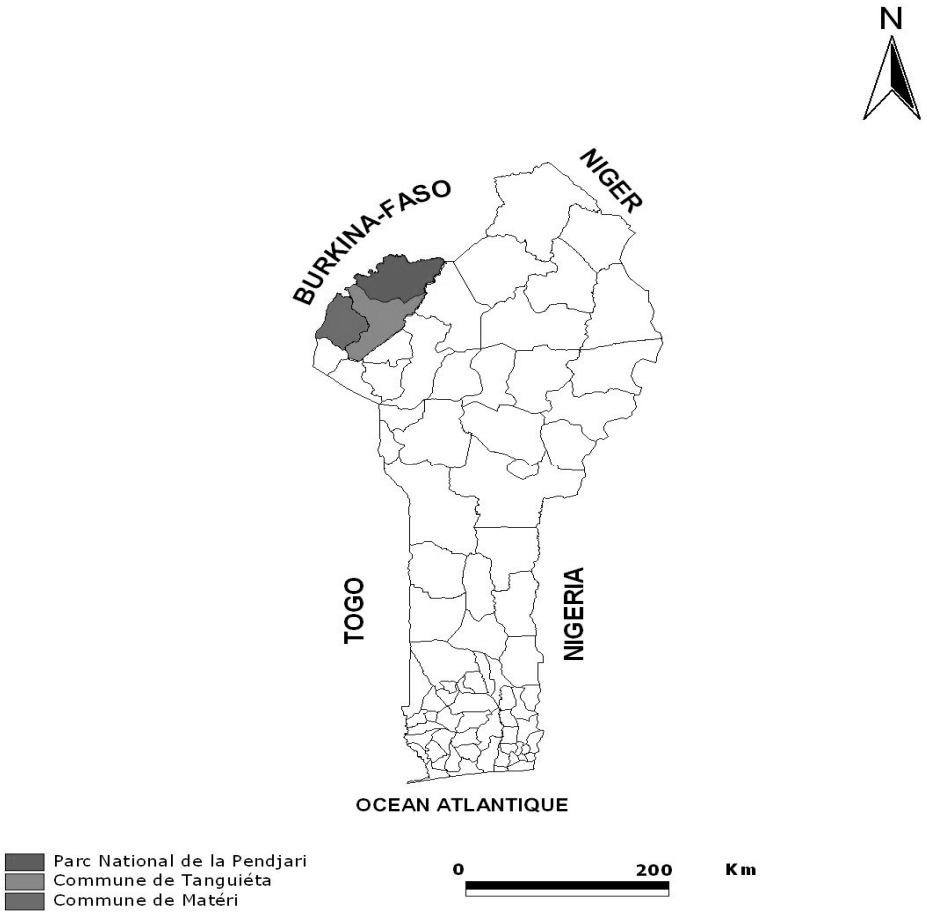

Figure 1. Location of the Pendjari Biosphere Reserve in northern Benin.

Study design and data collection

For the purposes of this study, small mammals included all species having at least the size of a grass-cutter (*Thryonomys swinderianus*) (overall length: 40-80 cm; Weight: 7 to 10 kg) were chosen according to the small mammal definition of Lamotte and Bourlière (1975) which says that this fauna category includes all mammals whose weight or size is less than the hare (3-5 Kg) or the marmot (6-10 Kg). Twelve (12) villages of three socio-cultural groups (Wama, Gourmantché, Byali) were considered (Déléké Koko, 2005) and thirty people (hunters, farmers, and park guards) were surveyed in each village. Local perception on the diversity of small mammal species was determined by the formation of focus groups in each village and by using the list and picture of assumed species in this study site. This list was established by using several wildlife guides (Heymans, 1985; Kingdom, 1997);

De Visser et al., 2001; Mensah et al., 2007). The analytic method of Prance (1991) following whether the consensus is raised (frequency of nomination raised), whether a species exists and is well known by the populations was investigated. The small mammal trapping techniques across the twelve villages was subjected to Correspondence Factorial Analysis (CFA) by using SASv8.2 software. Also the small mammals species determine by local perception were regrouped in 4 classes by realizing the numerous classification analysis. We calculated the percentage of each variable such as the favourite species in the feeding, medicine, and totem species.

Results and discussion

Diversity and observation period of small mammal according to the local populations' perception

A total of 43 species of small mammals were inventoried in the sampled villages of PBR. The dendrogram analysis (Fig 2) shows that the grouping of small mammals in 4 classes (A: species observed between 0 and 1 year; B: species observed between 1 and 5 years; C: species observed between 5 and 10 years; and D: species not observed in the last 10 years) generate a value of R^2= 0.772. This indicates that the quarter of the relative information to the species is lost after this regrouping. However, this retained R^2 value is sufficient to clear the big tendencies as for the description of the four classes. The species which compose each are:

A: *Xerus erythropus* (e_{19}); *Thryonomys swinderianus* (e_{21}) ; *Cercopithecus aethiops* (e_5); *Lepus crawshayi* (e_4); *Atelerix albiventris* (e_1); *Rattus rattus* (e_{25}); *Cricetomys gambianus* (e_{43}); *Galerella sanguinea* (e_9); *Crocidura spp* (e_{42}); *Heliosciurus gambianus* (e_{36}); *Avicanthis niloticus* (e_{18}); *Mus haussa* (e_{28}); *Procavia capensis* (e_3); *Tatera guinea* (e_{22}); *Genetta tigrina* (e_{16}); *Cricetomys emini* (e_{33}); *Ichneumia albicauda* (e_{10}); *Lemniscomys striatus* (e_{34}); *Hylomyscus alleni* (e_{35}) *Gnenetta genetta* (e_{17}); *Funisciurus leucogenys* (e_{41})

B: *Atilax paludinosus* (e_{11}); *Galago senegalensis* (e_2); *Protoxerus stangeri* (e_{26}); *Lemniscomys zebra* (e_{32}); *Heliosciurus rufobranchium* (e_{37}); *Steatomys jacksoni* (e_{23})

C: *Uranomys ruddi* (e_{20}); *Myomys derooi* (e_{27}); *Mastomys spp* (e_{30}); *Herpestes ichneumon* (e_7); *Malacomys longipes* (e_{29}); *Lophuromys sikapusi* (e_{31})

D: *Felis libyca* (e_8) ; *Ictonyx striatus* (e_{14}); *Mellivora capensis* (e_{15}); *Graphiurus lorraineus* (e_{38}) ; *Mandinia binotata* (e_{13}) ; *Funisciurus substriatus* (e_{40}) ; *Graphiurus naggtglasi* (e_{39}).

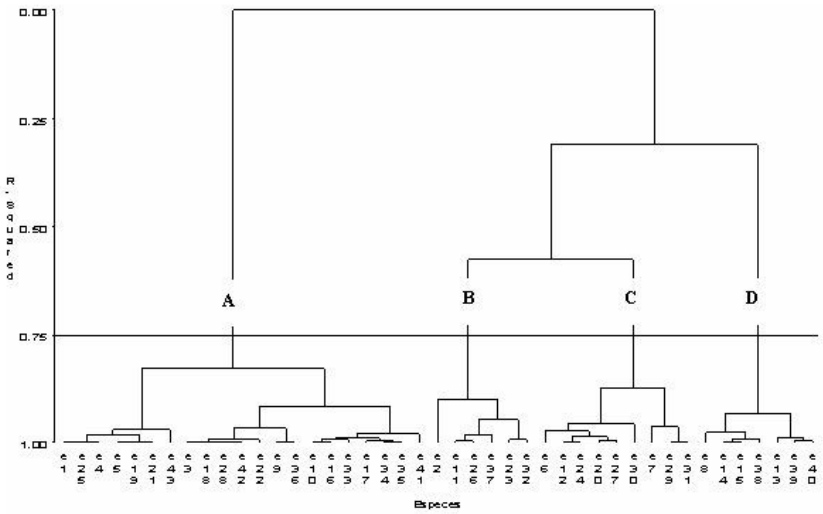

Figure 2. Dendrogram of the regrouping of small mammals the species according to their period of observation.

Most local populations (79.3%) resident in the twelve villages have indicated that the small mammals species were less abundant. Moreover, the opinions of the local populations didn't differ (χ^2 = 2.28, p

> 0.05) between villages sampled or socio-cultural groups. The growth and poverty levels of the local population are factors that aggravate this situation. Some studies have shown that the hunting for subsistence means can provoke a non lasting exploitation of game, and even when human density is weak, the hunters can eliminate some species of fauna by slowing reproduction (Fitzgibbon et al., 1995).

Economic feeding and medicinal importance of the small mammal's species

The small mammals in the sites of survey have a very weak economic importance since the species are more often consumed rather than sold. Not all species are sold. The grass cutter *Thryonomys swinderianus*), the hare (*Lepus crawshayi*), the gambian rat (*Cricetomys gambianus*) and the ground squirrel (*Xerus erythropus*) are the most frequently sold. The prices of transfer vary according to the species and their size. Thus, grass cutter are sold for between 4 and 6 $, the hare costs 1 to 1.5 $ and the Gambian rat and the ground squirrel cost respectively 0.5 to 0.7 $ and 0.1 to 0.2 $. Favourite species of small mammals by the local populations have been identified following the Friedman test (Fig 3). The grass cutter was the most appreciated species (χ^2 = 360.8, p <0.05), followed by the hare, the mongoose, the genet, the rock hyrax and the ground squirrel. The main reasons to explain this preference were that these species were current and easy has to find in dry season (60.5%) and because their meat was very good (39.5%). Small mammals are used for medicinal purposes to treat belly aches, incurable wounds, earaches, sexual impotence and abscess. It is thus likely that hunting activities have remained sustained, especially given that small game in Benin represents most of the bushmeat intake, to be used either for food consumption (Codjia & Assogbadjo 2004; Assogbadjo et al., 2005) or as pharmacopoeia (Tchibozo & Motte-Florac 2004) or fetish items.

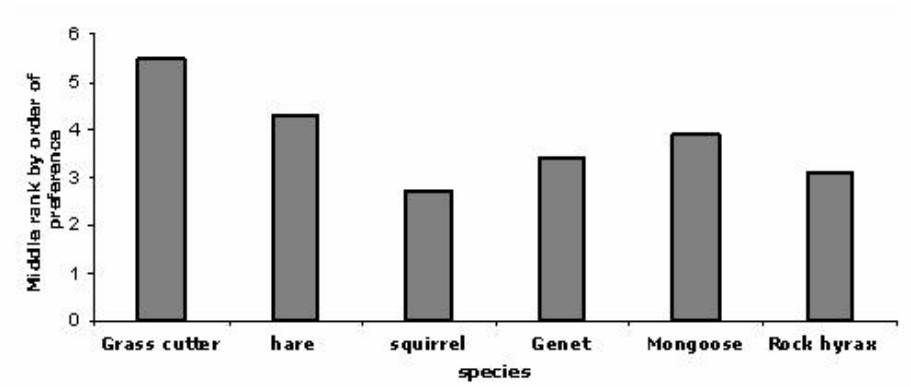

Figure 3. Middle rank, by order of preference, of the different species of small mammal used in alimentation determined with the Friedman test.

Socio-cultural values

Some species of the small mammals benefit from an exceptional statute of conservation in the riparian villages. In the past various socio-cultural groups developed beliefs, myths and legends around these small mammals' species, which allowed them to become socially forbidden and flavorous their conservation. Thus, the striped grass rat (*Lemniscomys striatus*) as totem is a concern to close to one third of the populations investigated because it represents a totem for all a socio-cultural groups (Gourmantché). This confirms the results of the studies of Mensah *et al*. (2007) on the rodent of the PBR. This totem species is followed by the ground squirrel (*Xerus erythropus*) with 11.6% having it for totem, the hare (*Lepus crawshayi*) for 7.2% of the sampled individuals, the galago (*Galago senegalensis*) for 6.3%, the hedgehog (*Atelerix albiventris*) for 2.3%, the Gambian rat (*Cricetomys gambianus*) for 2.1%, the genet (*Genetta spp*) for 1.7%, and the zorilla (*Ictonyx striatus*) for 1.3%. The Spotted necked otter (*Lutra maculicollis*) as totem only concerns 0.7% of the population surveys (Fig 4). Moreover, the observation of noctual species is presumed for the bad luck. Therefore, all of the species locally known to have a noctual behaviour are not hunted during the day time (67%

of interviewees). Among those small mammals you have mainly *Ictonyx striatus*, *Mellivora capensis, Cricetomys emini,* and *Cricetomys gambianus.*

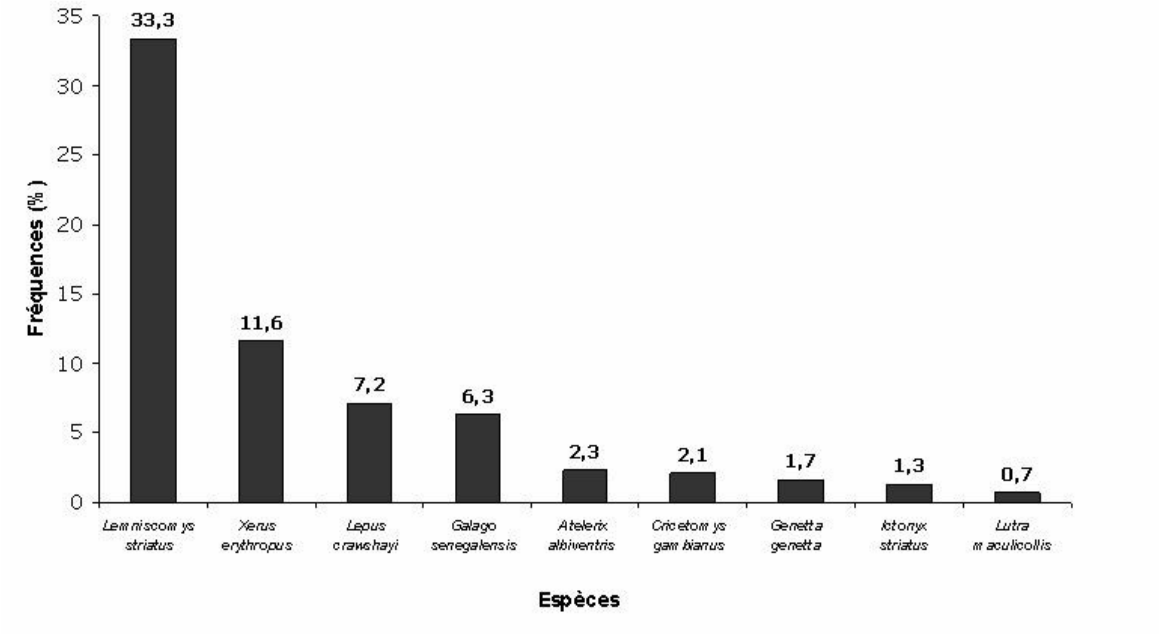

Figure 4. Small mammal species of special social significance (as totems) to local populations.

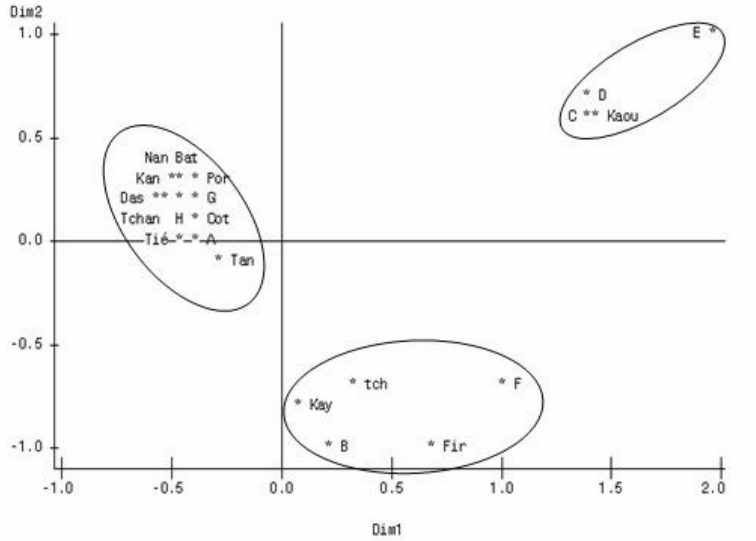

Figure 5. Correspondence factorial analysis of small mammal trapping technigues among villages studied.

Hunting techniques of small mammals according to the villages sampled

Most of the usual hunting and trapping methods are not very selective; the small mammals are caught according to their frequency of occurrence. Some factor such as crop destruction increases the hunting pressure on the small mammal. Squirrels are threatened because of their negative effect on domestic poultry and on crops such as corn, sorghum and rice**.** Although a large proportion of the

trapping techniques consist of using dogs and sticks, each village investigated also had specific trapping techniques of the small mammal readily identifiable from the correspondence factorial analysis (Fig. 5).

The second axis of variation (vertical axis), with an eigenvalue of 0.242, permits to show that Birikiri (Bir), Kayarga (Kar), Tchatingou (Tch) and Firou (Fir) villages usually use the gun (F) and trap to jaw (B) for the capture of the small mammal. The first axis of variation (horizontal axis), with an eigenvalue of 0.469, separated Kaoubagou (Kao) form Tanougou (Tan), Batia (Bat), Tchanwassaga (Tchan), Tiélé (Tié), Kané (Kan), Nanébou (Nan) and Dassari (Das). With the positioning of the trapping techniques on this axis, Kaoubagou (Kao) is the only village which usually uses the traditional trap such as trap to cable (C), trap in bow (D), and trap to the mice (E) for the small mammals capture species. Whereas in the negative side of this axis we notify that trapping techniques such as the stick use (A), dogs use (H) and excavation of the terriers or holes (G) are more often used in Tanougou (Tan), Batia (Bat), Tchanwassaga (Tchan), Tiélé (Tié), Kané (Kan), Nanébou (Nan) and Dassari (Das). Thus, the villages far from the BRP like Birikiri, Kayarga, Tchatingou and Firou use the most destructive technique of hunting compared to the nearer villages. This is translated the effort of conservation by this reverse manager. The hunters of Kaoubagou remain those of the only village of the sample which are attached to the tradition with the presence of three traditional traps. It is also the only sampled villages where a king exists and where the society is attached to an ancestral tradition of conservation. So, the usual hunting and trapping methods are not very selective, and most small carnivoran species are caught according to their frequency of occurrence.All the hunters interviewed were poachers but this illegal status was forced on them by the necessities of life. Moreover, the scarcity of rangers makes it practically impossible to take control of the hunting activities in Biosphere Reserve of Pendjari. Such an uncontrolled harvest of game could become a serious threat for the local small mammal population. At present, however there are not enough data available on population density of all the species to assess the hunting impact on wildlife. The large number of species hunted and the presence of a few species that are heavily hunted (6 species) could be imputed to the richness of mammal fauna in the area, but at the same time, to a small population density of each species.

Argument for the small mammals' conservation

Small mammals bush meat consumption by the population of the PBR constitutes a food complement, not the essential of protein in the food because it isn't available in sufficient quantity according to the interviewees. Further more as many other urban and local communities in West Africa, the populations still consume wild game, as food tradition (Madzou & Ebanega, 2006). It presupposes that if the forestry administrator of the PBR is able to propose adequate alternatives for consumption of small mammal bush meat, local populations would be more susceptible to reduce the pressure on the remaining small mammals and this can allow the growth of their population. Most of the people living in the sampled villages suggested activities such as the domestication of grass cuter (*Thryonomys swinderianus*) and the hare species (*Lepus crawashayi*). Others interviewees also suggested installation of poultry farms which must be ruled by the local populations. Anyway, it is important to conduct a meticulous selection of the species of small mammals, based on the knowledge of their biology, before initiating this kind of micro-projects. For instance, an experimental work achieved in Benin by Heymans & Mensah (1984); Baptist & Mensah (1986) and in Nigeria by Tewe and Ajayi (1982) showed that the grass cuter and the gambian rat (*Cricetomys gambianus*) can be ranched and produced in the environment of the village without too many difficulties. However, for the success of these micro-projects some questions require to be taken into account. It concerns:

- the development and the transfer of technological knowledge (such as the conduction of ranch, the food, the care given to the animals, the illnesses and their treatment...) to the populations;
- the development of production methods little expensive, concerning the captivity life and the animal feeding;
- the setting up of framing and follow-up system of the local populations once these activities are installed.

Acknowledgements

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DEGRADED FORESTS IN PROTECTED LANDSCAPES: PROSPECTS FOR BIODIVERSITY REHABILITATION IN URHONIGBE FOREST RESERVE, EDO STATE, NIGERIA

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Abstract

The state of biodiversity within the 48 forest reserves in Edo State has witnessed a far greater decline during the past 20 years than the rest of the 20th century put together. Urhonigbe Forest Reserve (lat. 5°57'59"E & 5°59'31"N and long. 6°05'38"E & 6°06'45"E was constituted in the early 1920s. The crescent shaped protected landscape, located on the southern fringe of Edo State, covers an area of 30,791 ha. The remaining 306ha forest re-growth is contained in Experimental Plots, Permanent Sample Plot (PSP 82) and Strict Nature Reserve (SNR 3) established by Forest Research Institute of Nigeria in 1954 and 1956 respectively. Shell Petroleum Development Company of Nigeria (SPDC) developed the first Biodiversity Action Plan (BAP) Project for 2 Forest Reserves located in Edo State, Nigeria; through their listing in the World Conservation Union (IUCN) categories 1-1V Protected Areas. Twenty three communities straddle Urhonigbe Forest Reserve. BAP implementation activities revealed monumental landscape degradation and attendant decline of biodiversity. The study revealed that, given sufficient recovery threshold, rehabilitation efforts can redress the palpable ruins across the landscape, particularly if project actions are scaled-up to encourage full-scale participation; while local knowledge repositories are integrated into project implementation schedule.

Introduction

Since the Rio de Janeiro environment conference in 1992, many concerned scientists have expressed serious fears about the spate of biodiversity loss in forested landscapes across the globe. However, the destruction of forests is continuing at unprecedented rates, bringing about wholesome changes to landscapes, loss of biodiversity, and often, the long term ruin of some people's livelihood (Levang, *et. al*. 2007). 'The Akwé: Kon Voluntary Guidelines affirms that the world's biological diversity is in custody of most indigenous people who live in areas where the vast majority of world's genetic resources are found and their cultures and knowledge are deeply rooted in the environment on which they form a part' (Secretariat of CBD, 2004).

The literature is replete with information that forest dependent communities follow age-long farming and land use practices; thus making polyculture (arable mixed cropping) the main traditional strategy for diet diversity, income generation, production stability, minimization of risks, reduced insect and disease incidence, efficient use of labour, intensification of production with limited resources and maximization of returns under low levels of technology (Warren, 1992; Altieri, 1987).

Despite the fact that traditional forest-related knowledge (defined as 'a collection of resident innovations, ingenuity, cultural beliefs, practices and norms that have accumulated and evolved over time', relates with local communities' traditional lifestyles relevant for the conservation and sustainable use of biodiversity; Linden (1991) contends that much of this knowledge is at as much risk of being eroded as is the case of biodiversity. The paper examines how forest related knowledge and extant conservation practices in target communities can shore up ecosystem rehabilitation efforts in Urhonigbe Forest Reserve.

Status of Biodiversity in Protected Areas in Edo State

For a very long time the livelihood system of forest dependent communities in the south-south region of Nigeria (comprising Edo, Delta, Rivers, Bayelsa and Akwa-Ibom States) was driven by

subsistence/biomass based agricultural practices (Isikhuemen & Uzamere, 2006). However, in most of the States, particularly Edo, forest management and timber exploitation predate the delineation of protected areas into Game Reserves, Forest Reserves, Biosphere & Strict Nature Reserves and National Parks. Historically, of the total land area designated protected area in Edo State (Fig. 1), about 45% was covered by rainforests. But by the end of the 20th century, both the size and integrity of forests in the 48 protected areas spread across Edo State (Lat. 5°45' & 7°N and Long. 5° & 6° 52'E) were significantly altered; thus the size of forest estate declined from 576, 944ha (29% at the time of constitution in the early 20th century) to 361, 304.02ha or 18.7% while the quality overly reduced by 75% by December 2007 (Azeke, 2007).

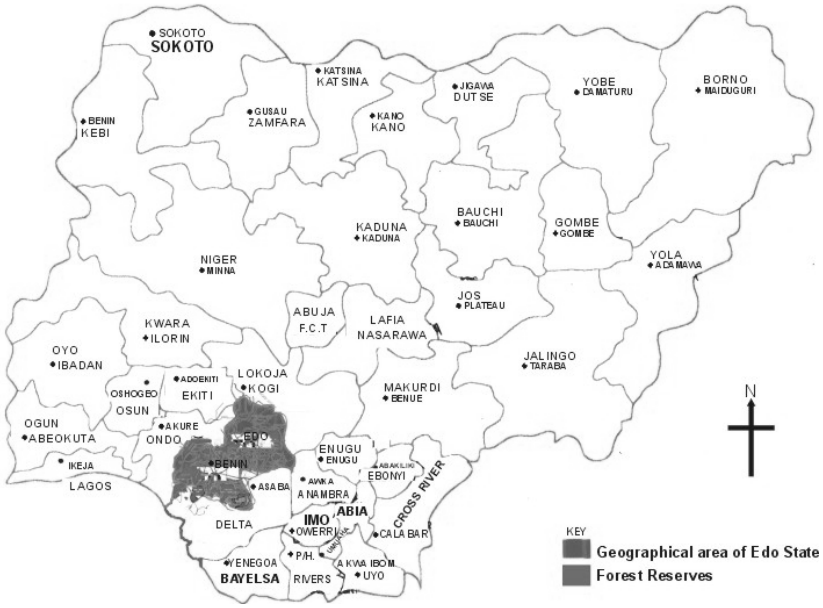

Figure 1. Map of Nigeria showing Edo State and Forest Reserves

Recent study (Isikhuemen, 2005) conducted in PSP 82, Urhonigbe Forest Reserve revealed serious and wide spread anthropogenic damage across the entire landscape. The fragile rainforest ecosystem is palpably at its lowest ebb, given the preponderance of residual trees/shrubs carrying damaged, deformed or ill-formed boles and/or crowns in the residual secondary regrowth forests. Of the One Hundred and Ninety trees/shrubs recorded in 39 families during the study, *Hylondendron gabunense* (Caesalpinioideae) and *Annoniduim mannii* (Annonaceae) ranked first and second on Importance Value Index (IVI) scale respectively (Table 1) contrary to earlier findings by Bada (1984).

Table 1: Most Important Species and Families in PSP 82 in Urhonigbe Forest Reserve.

Species			Families		
Taxa	1999	2001		1999	2001
Hylodendron gabunense	44.64	43.55	Caesalpinioideae	56.01	56.18
Annonidium mannii	42.99	40.74	Annonaceae	42.25	39.21
Diospyros suaveolens	13.32	14.61	Ebenaceas	19.19	20.98
Strombosia grandifolia	11.59	11.35	Euphorbiaceae	19.00	20.28
Allanblackia floribunda	9.87	9.18	Olacaceae	17.76	17.22
Rauvolfia vomitoria	9.46	12.38	Apocynaceae	17.03	20.06
Pausinystelia johimbe	8.35	7.96	Meliaceae	15.81	16.25
Tetrochidium sp.	7.73	6.67	Rubiaceae	13.71	14.02
Guarea cedrata	7.00	7.16	Guttiferae	11.82	10.16
Gosswelerodendron sp.	6.42	6.75	Ulmaceae	11.21	10.85

Note: Important Value Index (IVI) – total for all species = 300; for all families = 300

Source: Isikhuemen (2005)

Biodiversity Action Plans

But for the recently published National Biodiversity Strategy and Action Plan, not much studies have been carried out with respect to traditional forest-related knowledge or biodiversity conservation; and more importantly, on the linkage between the two phenomena in Nigeria. A cursory assessment of Nigeria's 21st century biodiversity status would reveal the critical state of degradation of Nigeria's most vulnerable ecosystems.

However, at the turn of the century, the Shell Group undertook the publication of a set of guiding principles on biodiversity known as 'the Shell Group Biodiversity Standard'. To further strengthen her commitment to respect the 'protected area' concept Shell came out with more clarification and made additional commitments to garner support for public understanding in her resolve to: (a) stop exploration or development of oil and gas resources within national heritage sites; (b) upgrade best/operational practices in IUCN Category I-IV protected areas and (c) report her activities in IUCN category 1-1V protected areas and put in place action plans for the effective management of protected areas while providing skills, sustainable livelihoods and explore options for sustainable financing (SPDC, 2007).

The Biodiversity Action Plan (BAP) Project for two Forest Reserves in Edo State Nigeria - the first ever private sector interventionist participatory programme put in place to address the twin problems of declining biodiversity and devastating poverty among rural communities - came into being because Shell Petroleum Development Company (SPDC) has foot prints in the two forest reserves classified under category I-IV in the IUCN data base on protected areas. Shell Company's resolve to prop up global efforts in biodiversity conservation, stem local extinction and tackle other environmental problems associated with externality, necessitated the BAP project.

The formation stages of Urhonigbe Forest Reserve (UFR) BAP project comprised suits of stakeholders meetings syndicated along age, gender, community headship and occupational divide; culminating in the alignment of priorities, actions and plans which were thereafter subjected to several technical reviews within the purview of the International Petroleum Industry Environmental Conservations Association (IPIECA) BAP Guidelines (SPDC, 2006). At the commencement of implementation in April 2007, the Urhonigbe Forest Reserve BAP project - now in her second year of implementation - witnessed several conservation and livelihood support actions in tandem with the implementation strategies.

Location and Description of Urhonigbe Forest Reserve

Urhonigbe Forest Reserve is located within Lat. $5^{\circ}57'59''$ & $5^{\circ}59^{1}\ 31''$ N and $6^{\circ}05'38''$ & $6^{\circ}06'45''$ E and on south-eastern border of Edo State (Fig. 2). Lying astride 5 communities, the crescent shaped forest reserve with a far-flung 'cap' to the west has 18 other communities of Edo extraction in the north, east and western fringes. The forest reserve has River Ethiope and a host of communities in Delta State to the south.

With mean annual rainfall of 2300 mm, the forest reserve like others in the moist forest zone of Edo State experiences bi-modal rainfall distribution pattern; peaking in July and September, respectively. The mean relative humidity is 84%, rarely falling below 80% while minimum and maximum temperatures range from 23^{0}C to 36^{0}C. The soil is characterized by distric nitrisols, otherwise called Benin sands (FAO/UNESCO, 1988; Oguntala & Soladoye, 2000). More than 90% of the entire landscape is bereft of the original high forest vegetation characterized by the *Gossweilerodendron–Guarea-Hylodendron-Khaya/Entandrophragma-Diospyros* association that gave timber resource from this part of southern Nigeria the much talked about imperial preference (Redhead, 1971; Bada, 1984; Egbo, 1985; Sayer *et. al.*, 1992; Isikhuemen, 2005).

Presently, fire climax and grass communities that now dot the landscape with occasional farm fallow/re-farming vegetation; thus the only forest and/or semblance of forest stand now exist in the Permanent Sample Plot (PSP) 82 and Strict Nature Reserve (SNR) 3 established in 1954 and 1956 respectively by the Forest Research Institute of Nigeria (FRIN). These experimental plots were established 'to conserve adequate samples of undisturbed vegetation types and endangered plants in perpetuity in order to preserve a wide genetic diversity existing within the natural forest to serve as a reservoir for the collection of plant materials at all times'.

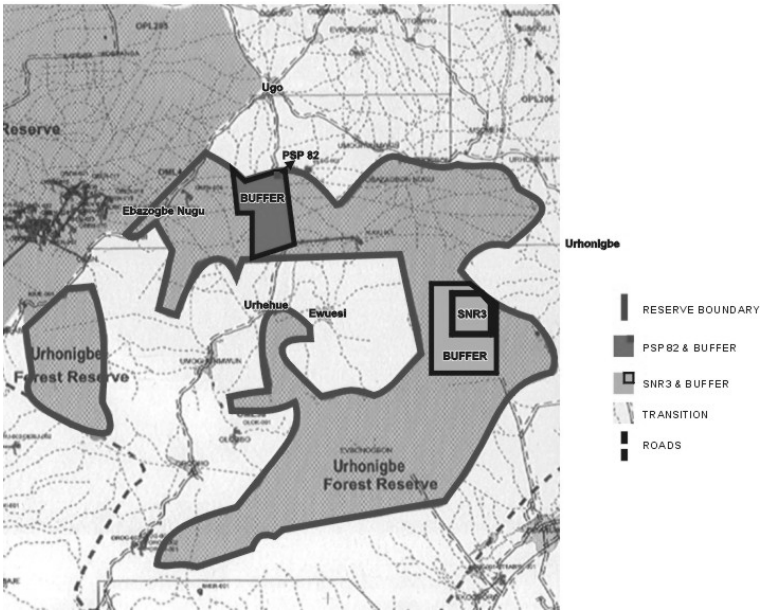

Figure 2. Map of Urhonigbe Forest Reserve showing five focal communities and Camu

Methods

Data Collection and Analysis

Two rapid appraisal methods, namely, key informants and group interviews (Blumefeld, *et al*., 1993; Holtzman, 1993), were used to elicit information from respondents in 5 communities between March and April 2008. The criterion for community selection was proximity to one or the two core zones - Strict Nature Reserve (SNR) 3 (close to Evboesi and Urhonigbe communities) and Permanent Sample Plot (PSP) 82 (having Ugo, Obozogbe Nugu and Urhehue as peripheral communities). Each respondent was pre-informed through the Grass-root Consultative Committee (GCC) representative and/or Forest Management Committee (FMC) members in each community before the actual interviews took place.

Two Thousand One Hundred and Twenty Four (2124) farmers and sundry users of forest resources (Table 2) interact with or have potential need for and/or interest in the areas straddling 11km perimeters of PSP 82 and 12km perimeters of SNR 3. Questions raised in 4 thematic areas - influence of lunar and seasonal rhythms on game animals, phenology and regeneration potentials in plants, classification/naming systems, as well as farming/cropping systems - were presented to 50 respondents comprising 24 farmers, 8 hunters, 6 timber contractors/itinerant loggers, 7 NTFPs gatherers/herbalists and 5 elders/traditional rulers, as well as 4 serving foresters/retirees, using 2% sampling intensity. Information obtained were sorted and compared across locations while validation of species' names was done using Keay (1989). Analysis was carried out with simple descriptive statistics.

Table 2. Distribution of Resource-users among focal Communities

Users	Communities					Total (%)
	Urhonigbe	Evboesi	Ugo	Urhehue	Ebazogbe Nugu	
Farmers	452	449	439	337	262	1939 (91.29%)
Hunters	8	6	9	5	2	30
Loggers/Timber Contractors	4	3	4	1	2	14
Others	28	29	30	33	21	141
Total (%)	492 (23)	487(23)	482 (23)	376 (18)	287 (14)	2124

Source: Edo State Ministry of Environment (2007)

Results and Discussion

Biodiversity Action Plan Project

In consonance with the stated objectives of SPDC/NCF/Edo State BAP project, several operations that have been carried include: 'enactment of biodiversity laws, biodiversity surveys, community profiling, community-based forest management structures, delineation of conservation area management units (Core, Buffer and Transition zones), awareness building in focal communities, organization and training of user-groups, sign posting, establishment of livelihood support and incentive driven enterprises, disbursement of revolving micro credit loans to individuals in focal communities, nursery development and planting out in the field'.

Lunar and Seasonal Rhythms and Game Animals

Respondents spoke in one accord that most animals hunted for game follow seasonal and lunar rhythms as evasive strategy to play safe in the hands of hunters and steer clear of snares placed on their tracks. But the lure of fruits for which animals have special liking creates exception to this claim. Porcupine *(Artherurus sp.)* is known to be hunted freely when fruits of *Hannoa klaineana* and *Allanblackia floribunda* are available in the wild. However, the prevalence of cheap Porcupine meat in the market between December and February is ascribed by respondents (71%) to the bitter *Hannoa* seed which is common forage for the animal when in season.

System of Nomenclature

Redhead (1992) described the Benin tribe in Nigeria as a people having a high reputation for intimate knowledge of forests and its products. For instance, the name 'Uguekpoki', meaning 'lid' or 'closure' derives from the widely held notion among local peasants that the cavity formed on the forest floor, following death or removal of *Hannoa klaineana* tree, often ensnares unsuspecting forest users to their untimely graves. Special plants like *Okoubaka aubrevillei* and *Hannoa klaineana* have names fashioned in relation to the myth that trail them. There is a general belief among local communities that unless there is permission through appeasements by rituals no one gets close to *Okoubaka aubrevillei* which is claimed to be the king of the forest. The suggestion that plants possess unique characteristics (e.g. allelopathy) that control niche differentiation and interspecific association did not significantly change respondents' view point; rather they contended that *Myrianthus arboreus* is the only species with express permission to grow around the magic plant. The erstwhile well organized knowledge system among Benin people is not unconnected with the use of special features or characteristics of plant, animal, vegetation, and soil for their nomenclature.

While lauding the method of naming trees using a well-developed binomial system; Hide (1943) revealed that taxonomists could not properly classify *Guarea* hence the initial placement in the genus *Trichillia*; but the Benin were quite clear and appropriately placed the taxa among the congeners. The status of *Guarea* congeners as well as Crested hornbill *(Trapicranius sp)* and Parrot *(Pisttacus erithacus)* in the wild (Table 3) suggests that the trees, including several others not listed in the table, might have been selectively and unsustainably logged resulting in loss of habitat and consequent migration of the associated terrestrial avifauna; or the latter might have been over hunted to the present critical level of population. As panacea to restoring forest ecological functions, a significant number of respondents requested incentive driven regeneration interventions that transcends protected landscape conservation and management; but cautioned that 'mystic plants' should be accorded special conservation refuge, separate from the multiple use forests. Many authors (Myers et al, 2000; Wilson, 2002) have emphasized diverse landscape rehabilitation and forest conservation approaches that look beyond area or location specific strategies.

Plant Phenology, Fecundity and Regeneration Potentials

The frequency of sighting, calls, chirps, as well as droppings and footprints of both sedentary and migratory animals around matured forest trees often signify flowering and fruiting season; same is applicable to the domesticated wild relatives of fruit trees and medicinal plants in home gardens. Most rainforest species tend to be prolific but poorly represented among natural regeneration in the forest floor (Isikhuemen, *op. cit.*). When the views of respondents were sought on the probable reasons why most plants which flower copiously end up with very few individuals among the populations in the forest floor, they attributed it to the existence of male/female syndrome among wild relatives. They surmised that male plants are known to produce lots of flowers that abort before or after fertilization, while female plants successfully complete flowering and fruiting cycle.

Table 3. Some Flora and Fauna with Ecological, Socio-economic, Cultural and Medicinal values.

Scientific Name	Common Name	Local Name	Status in the wild	Remarks (% score)
Flora				
Hannoa klaineana	G/Obeche	Uguekpiki	few	mystic death cavity (87) lure for porcupine (71)
Allanblackia floribunda		Izokhaen	few	porcupine's delicacy (84)
Guarea cedrata	White Guarea	Obobo nofua	very few	white feature
Guarea thompsonii	Black Guarea	Obobo nekhui	very few	black feature
Okoubaka aubrevillei		Akoebisi	very few	mystic plant (91)
Nauclea diderrichii	Opepe	Ovbiakhe	few	small pot
Tetrapluera tetraptera		Ighimiakhie	few	sorrow evasion
Myrianthus arboreus		Ihieghe	abundant	neutralizer (64)
Irvingia spp.	Bush mango	Ogui	few	dual relatives
Glyphea sp.		Uweriontan	abundant	squirrel's cane
Afromomon spp		Ehiendo	few	Benin pepper
Dacreodes edulis		Orumu	few	dual relatives
Dennetia tripetala		Ako	very few	dual relatives
Thaumatococcus	Wrapper	Ebieba	few	dual relatives
Fauna				
Artherurus africanaus	Porcupine	Okhaen	few	fruigivore
Cephalophus spp	Antelope	Uzo	few	nocturnal & diurnal
Cricetomys gambianus	Giant Rat	Ofiotor	abundant	burrower
Cercopithecus mona	Monkey	Egi	few	diurnal forager
Trapicranius sp	Crested hornbill	Ukhuokhuo	very few	dispersal agent (63)
Pisttacus erithacus	Parrot	Okhue	very few	cultural regalia (71)
Thryonomys sp.	Cane rat	Evuo-ato	few	nocturnal & diurnal

Farming and Cropping System

The methods of farming and cropping system prevalent in BAP project target communities, whose livelihoods have been sustained by the age long traditional subsistence agriculture, have remained unchanged. The steady decline of the period between rotations is attributable to the increasing number and the frequency of cropping and use of fallow land by farmers. Local peasants have used accumulated traditional knowledge to nurture preferred tree species (e.g. *Spondias mombin, Amphimas pterocarpoides, Baphia spp, Newboldia laevis, Blighia sapinda* and *Eribroma oblonga*) both in the wild and home gardens, for multiple end uses, including restoration of soil fertility. Kindt, et al., (2008), recommend landscape planning within remaining natural fragments, if biodiversity conservation is one of the objectives of diversification efforts.

Conclusion

After 18 months of commencement of field activities in the SPDC/NCF/Edo State BAP project, there appears to be great manifestations of success. Despite this, the constraints posed by wide spread depletion in seed and seedling banks, prevalence of derelict individuals in the residual forests, abundance of fire climax floral communities across the entire landscape as well as palpable apathy exhibited by community members, call for more serious attention and involvement by focal communities and other stakeholders. Findings on traditional forest related knowledge has brought to the fore the necessity for carrying the campaign of Biodiversity rehabilitation beyond the frontiers of protected areas through scaling-up. Traditional forest related knowledge is therefore a fundamental

ingredient for the rehabilitation of biodiversity and ecosystems in degraded landscapes using a community-based approach.

Recommendations

1. The scope of the project should be enlarged to incorporate establishment of traditional knowledge repositories e.g. home gardens in communities.
2. The myth surrounding species like *Okoubaka aubrevillei* as well as the active ingredients(s) contained in the seed of *Hannoa klaineana* that confer bitter taste on the meat of Porcupine should be scientifically investigated.
3. BAP activities should be scaled up beyond the confines of protected areas Edo State.
4. The current landscape rehabilitation programme should be given adequate boost by government and other stakeholder.
5. The incorporation of agro-ecological and incentive-driven farming practices in BAP project is imperative.

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Appendix I

International Conference on Traditional Forest-Related Knowledge and Sustainable Forest Management in Africa

ERATA Hotel, Okponglo-East Legon Accra, Ghana

15-17 October 2008

Programme

15 October 2008

Technical Session I: *Agro-Forestry and Ex-Situ Conservation*

Chair: **Dr. Joseph Cobbinah**

9.00-9.15 **Hugues A. Akpona *et al.*** - *Traditional botanical gardens as a tool for preserving plant diversity, indigenous knowledge and last threatened relic forest in Northern Benin.*

9.20-9 .35 **Denis. J. Sonwa *et al.*** - *Traditional knowledge developed by farmers to overcome pest and diseases constraints inside cocoa agroforest of southern Cameroon*

9.40-9.55 **K. Wala *et al.*** – *Traditional agroforestry systems in Togo: Variability according to latitude and local communities.*

10.00-10.15 **Raphaël Njoukam *et al***. - *Dans l'Ouest-Cameroun, les paysans ont conservé les arbres dans leurs champs, pendant que l'Etat laissait brûler ses réserves*

10.20-1035 **Edem A. Eniang & M. Balehegn** - *Assessing indigenous knowledge for evaluation, propagation and conservation of indigenous multipurpose fodder-trees towards enhancing climate change adaptation in northern Ethiopia*

10.35-10.50 **Ebenezer Owusu-Sekyere** - *Traditional knowledge on tree characteristics and use for agroforestry in Ghana*

10.55-11.20 **General Discussion**

11.45-13.20 ***Opening Ceremony***

Opening Prayer

Introduction of Chairman

Chairman's Remarks by **Dr. A.B. Salifu**, Director-General, CSIR-Ghana

Welcome statement by **Prof Alfred Oteng-Yeboah**, African Co-ordinator, IUFRO-Task Force on Forest TFK.

Statement by **Dr. John Parrotta**, USDA and Global Co-ordinator, IUFRO-Task Force on Forest TFK

Statement by **Dr. Michael Kleine**, IUFRO Headquarters, Vienna

Statement by FAO Regional Representative for Africa

Statement by Guest of honour, **Prof N.A.Kotey**, Chief Executive, Forestry Commission, Ghana

Keynote Speech by **Hon. Esther Obeng Dapaah**, Minister, Ministry of Lands, Forestry, and Mines, Ghana

Closing remarks by Chairman

Vote of Thanks

Closing Prayer

Technical Session II: *Non-timber forest products*

Chair: **Dr. Kwame A. Adam**

14.30-14.45 **Alice Bonou *et al.*** - *Endogenous knowledge on non-timber forest products in northern Benin*

14.50-15.05 **Gérard N. Gouwakinnou et al**.- *Indigenous knowledge and uses of Sclerocarya birrea (A.Rich.)Hochst. (Anacardiaceae) by rural population around W. National Park in Karimama, Benin*

15.10-15.25 **A.B.Fandohan et al**.- *Endogenous knowledge on tamarind (Tamarindus indica L.) in northern Benin*

15.30-15.45 **Vodouhê G. Fifanou et al.** - *Estimating local values of vegetable non-timber forest products to Pendjari Biosphere Reserve dwellers in Benin*

15.45-16.00 **N'dri Marie-Therese Kouame**- *Food trees and spontaneous lianas of the zone of semi-deciduous forest (Center-West of Cote d'Ivoire): Flore of the species met, consumed organs and food values*

16.25-17.00 **General Discussion**

Technical Section III: *Societal Perspectives on Traditional Forest Knowledge*

Chair: **Dr. Doris Mutta**

17.05-17.20 **Elisabeth Johann** - *What we can learn from history: the present role of commons in managing the environment - a case study from Austria*

17.35-17.50 **Mauro Agnoletti** - *Introducing traditional knowledge in Sustainable Forest Management: the guidelines developed for the Ministerial Conference on the Protection of Forest in Europe*

17.55-18.10 **William Mala** - *Local conceptualization of nature, forest knowledge systems and adaptive management in southern Cameroon*

18.15-18.30 **Dominic Byarugaba & R.F. Nakakeeto** - *Indigenous knowledge (IK) and conservation attitudes on biodiversity outside of protected area systems in Uganda: Igara county scenario*

18.35-18.50 **A.J. Afolayan & L. Kambizi** - *The impact of indigenous knowledge system on the conservation of forests medicinal plants in Guruve, Zimbabwe*

18.55-19.30 **General Discussion**

16 October - Field excursion to Kakum National Forest

17 October 2008

Technical Session IV: *Forest Management*

Chair: **Dr. William Mala**

9.00-9.15 **Kwame Asamoah Adam** - *Some Ghanaian traditional practices of forest management and biodiversity conservation*

9.20-9.35 **Doris Mutta *et al.*** - *Traditional knowledge systems for protection of Kaya forests*

9.40- 9.55 **Lucy Amissah** - *Indigenous fire management practices in Ghana*

10.00-10.15 **Youssoufa Bele & C. Jum** - *Local people and forest management in Cameroon*

10.20-10.35 **Mercy Derkyi** – *Influence of traditional knowledge on the management and conservation of forest ecosystems in Ghana.*

10.35-10.55 **General Discussion**

Technical session V: *Ethnobiology*

Chair: **Prof. A.J. Afolayan**

11.2011.35 **N.S.A. Derkyi** – *Traditional forest knowledge on conservation of seed oil, medicinals, dye and tannin plants*

11.40- 11.55 **Carolle Avocevou & Brice Sinsin** - *Quantitative ethnobotany of Pentadesma butyracea in Benin*

12.00- 12.15 **Tefera Belay Endalamaw** - *Traditional access and forest management arrangements for beekeeping: the case of southwest Ethiopia forest region*

12.20-12.35 **Belem Bassirou *et al*** - *Identification des arbres hors forêt préférés par les populations locales dans la Province du Sanmatenga au Burkina Faso*

12.40- 12.55 **Fidèle Bognounou *et al.*** - *Ethnobotany of five Combretaceae species among four ethnic groups of four villages of West Burkina Faso*

13.00 -13.15 **Dominic Byarugaba** - *The plight of indigenous and traditional knowledge in health seeking behaviour using herbal medicine in remote areas of south western Uganda*

Technical Section VI: *Forest Biodiversity Conservation and Management*

Chair: **Prof. Dominic Byarugaba**

14.15-14.30 **Sylvestre Chabi Adéyèmi Marc Djagoun *et al.*** - *Diversity and ethnozoological study of small mammals in village surrounding the Pendjari biosphere reserve in northern Benin*

14.30-14.45 **Ekeoba Matthew Isikheumen & O.F. Iduozee -** *Degraded forests in protected landscapes: Prospects of biodiversity rehabilitation in Urhonigbe Forest Reserve, Edo State, Nigeria*

14.45-15.55 **General Discussion**

16.30-17.15 **Closing**

Appendix II

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