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Opportunities and Challenges to Capturing the Multiple Potential Benefits of REDD+ in a Traditional Transnational Savanna-Woodland Region in West Africa

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Opportunities and challenges to capturing the multiple potential benefits of REDD+ in a traditional trans-boundary savanna-woodland region in West Africa

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Abstract The REDD+ scheme of United Nation intends to offer developing countries financial incentives to reduce the rates of deforestation and forest degradation for reducing global CO^2 emissions, while building carbon stocks in existing wooded ecosystems and fostering other soil, biodiversity and water conservation objectives. Successful application of REDD+ to the Xylophone Triangle of West Africa faces substantial challenges and risks to both meeting REDD+ objectives and to the local people's rights and livelihoods. The trans-nationality of the culturally coherent area requires collaboration of three national governments. The opportunities however are great to capitalize on the region's biodiversity, the well-developed traditional ecological knowledge, the use of local medicinal plants as an integral part of the agro-ecosystem, under the traditional tenure system and governance, to not only sequester carbon but also to increase the resilience of the ecosystem and of independent rural livelihoods in the face of climate change and globalization.

Keywords Traditional ecological knowledge Sustainable use of woodland biodiversity Medicinal plants Community based management Climate change REDD+

INTRODUCTION

Under the convention of United Nations Framework Convention on Climate Change (UNFCC) a decision was established in 2007 on incentives for Reducing Emissions from Deforestation and Forest Degradation (REDD) as an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (UN-REDD 2012). The REDD+ would give possibilities to include the rights of local peoples and include their involvement in the management of forest resources (Sikor et al. 2010). The current paper gives views on possibilities and challenges for applying REDD+ in a sub-tropical savanna-woodland in a transboudary region involving traditional knowledge for the use and management of woodland biodiversity.

The Sahel region[1] in West Africa is a focal point for a number of complex interactions between serious challenges towards resilient human livelihoods: a dry region affected by climate change with increasing unpredictability of weather events such as prolonged drought periods and floods, environmental degradation due to over utilization, increased human population growth, political unrest, migration of refugees, changed transhumance routes, all factors contributing to increased food insecurity and poverty and circular enforcing of the existing challenges. Further, in this region 80% of the population depends on natural resources for their livelihoods (UNEP 2011).

[1] The Sahel countries: Gambia, Guinée-Bissau, Mauritania, Sénégal, Burkina Faso, Mali, Niger, Chad, Cape Verde, www.cliss.bt retrieved 4 June 2012.

Although belonging to the Sahel but situated at its southern border, the Xylophone triangle in the countries Mali, Burkina Faso and Cote d'Ivoire (the region including the towns of Sikasso – Bobo Dioulasso – Korhogo; Fig. 1a), is a transboundary savanna-woodland region with less dry and less harsh climatic and environmental conditions than the main Sahel. The region is named after the occurrence here of the tree species *Pterocarpus erinaceus* that is used for the production of the music instrument *xylophone* (Fig.1b,c).

Living is gained from subsistence rain-fed agriculture of arable food crops combined with herds of livestock pastured in the savanna-woodland and cotton is cultivated as cash crop (Bassett 2001; Fig. 2). This region is the home of the *dozobele* community, practicing traditional medicine for treatment and prevention of diseases, in fact they provide most of the medical care to humans in the region (Hellweg 2001; Ouattara 2006, 2008). Most of these traditional medicines are based on different plant parts harvested from wild species in the savanna-woodland (Fig. 3) deriving from applied traditional ecological knowledge (Berkes 1999). Woodlands of Xylophone Triangle constitute part of the local agro-ecosystem, their resources are used and managed by local communities and the woodland can be labeled 'Domestic forest' sensu Michon et al. (2007). A number of threats towards the woodlands and their resources are emerging and outlined below.

The aim of this paper is to: 1) illustrate the link between traditional ecological knowledge and the use of woodland biological resources forming a vital part of the agro-ecosystem for rural communities with example from the transboundary region Xylophone Triangle in West Africa; 2) outline the climate dimension of woodlands in the semi-dry region of West Africa and give an overview of current threats to this ecosystem and its resources; 3) discuss how current resource tenure systems could be used for creation of community based management systems of the woodlands and their resources, and 4) discuss how application of REDD-plus can be used for the combined effect of reducing emissions from deforestation and forest degradation with maintenance of cultural and biological diversity critical for resilient livelihoods.

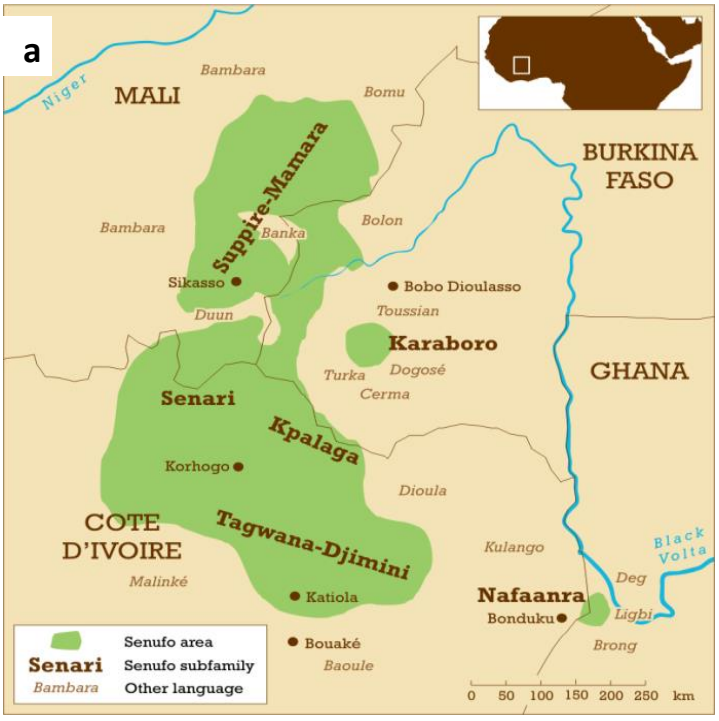

Fig. 1a –The Xylophone Triangle and the location of the in Senoufo in Burkina Faso, Côte-d'Ivoire, Mali and Ghana (by Mark Dingemanse, Language & Cognition Group Max Planck Institute for Psycholinguistics, The Netherlands).

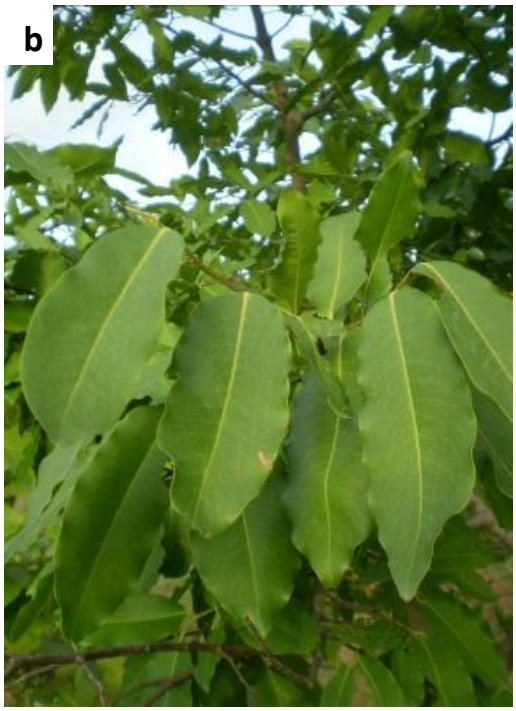

Fig. 1b *Pterocarpus erinaceus;* local name in Bamana: *Gbèn;* local name in Sénoufo: *Nafounyarcige*, Korhogo 2009. Photo: Syna Ouattara.

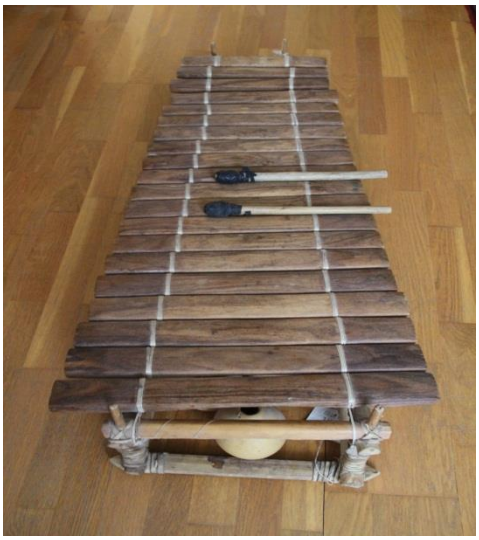

Fig. 1c The traditional music instrument *balaphone.* Xylophone, made from the Gbèn tree in Mali, 2010. Photo: Syna Ouattara.

Fig. 2 Harvesting cotton in the rural municipality of Doumanaba, located north-west of the Sikasso city, Niaradougou 2010. Photo: Syna Ouattara

TRADITIONAL MEDICINE BUILT ON TRADITIONAL ECOLOGICAL KNOWLEDGE PRACTISED BY THE *DOZOBELE* COMMUNITY

The *dozobele* represents a form of medical practitioners in Western Africa, unbound of ethnicity or religion and found in several West African countries such as Côte d'Ivoire, Mali, Burkina Faso, Guinea and Sierra Leone (Leach 2004; Ouattara 2006). The Sikasso district in southern Mali is regarded as an original home place of *dozobele* (Ouattara 2008). In this region as well as in adjacent regions in the neighboring countries (Fig. 1a) the Sénoufo is the main ethnic group. As medicinal practitioners, they provide most of the medical care to both the rural and urban population (Cissé 1994; Ouattara 2006; 2008).

Dozobele and their organizations have long been equally central to practices and representations of socio-ecological and moral relations: to the governance of proper conduct among people and between people and animals, plants, and other forces of 'the bush'. These broader capacities are reflected in the local terms for what has been translated into English, too narrowly, as 'hunter' (Leach 2004). After initiation the *dozo* can socialize freely with his colleagues and acquire and exchange further knowledge of fauna, flora, spirits, treatment of diseases and prevention of misfortune with them (Hellweg 2001; Ouattara 2006). Ownership of traditional knowledge, its transmission, use and benefits within the *dozo-ton* are subject to customary laws. Women become members of the *dozo-ton* by marriage to an initiated *dozo*. Female power is necessary in order to gain access to knowledge, something emphasized in the structural parallels between male hunter societies and female fishing societies. In fact, most myths portray women as the true owners of knowledge, men being merely the implementers of this expertise (Traore 2004). Women are also significantly involved in the trading of medicinal plants since medicinal plant sellers in rural and urban markets and herbalists for self-medication in West Africa are mainly women (Cunningham 1993).

Traditional ecological knowledge (TEK) includes a system of classification, empirical observations of the environment and a system of resource management and plays a crucial role in the maintenance and conservation of biodiversity through the management of species and their habitats based on their use values in the traditional community (Berkes 1999). Cultural understanding of the environment can not only give rise to sustainable management practices, but also to knowledge of natural species, ecological interactions and dynamics of the ecosystem (Berkes 1999; Folke et al. 2003). The knowledge and skills practiced by the

dozobele in the Xylophone Triangle woodland is a perfect example on TEK in use with detailed knowledge of biodiversity. This use is central for the viability of the local livelihoods by complementing the farming activities and contributing to the subsistence economy in the villages (Fig. 3).

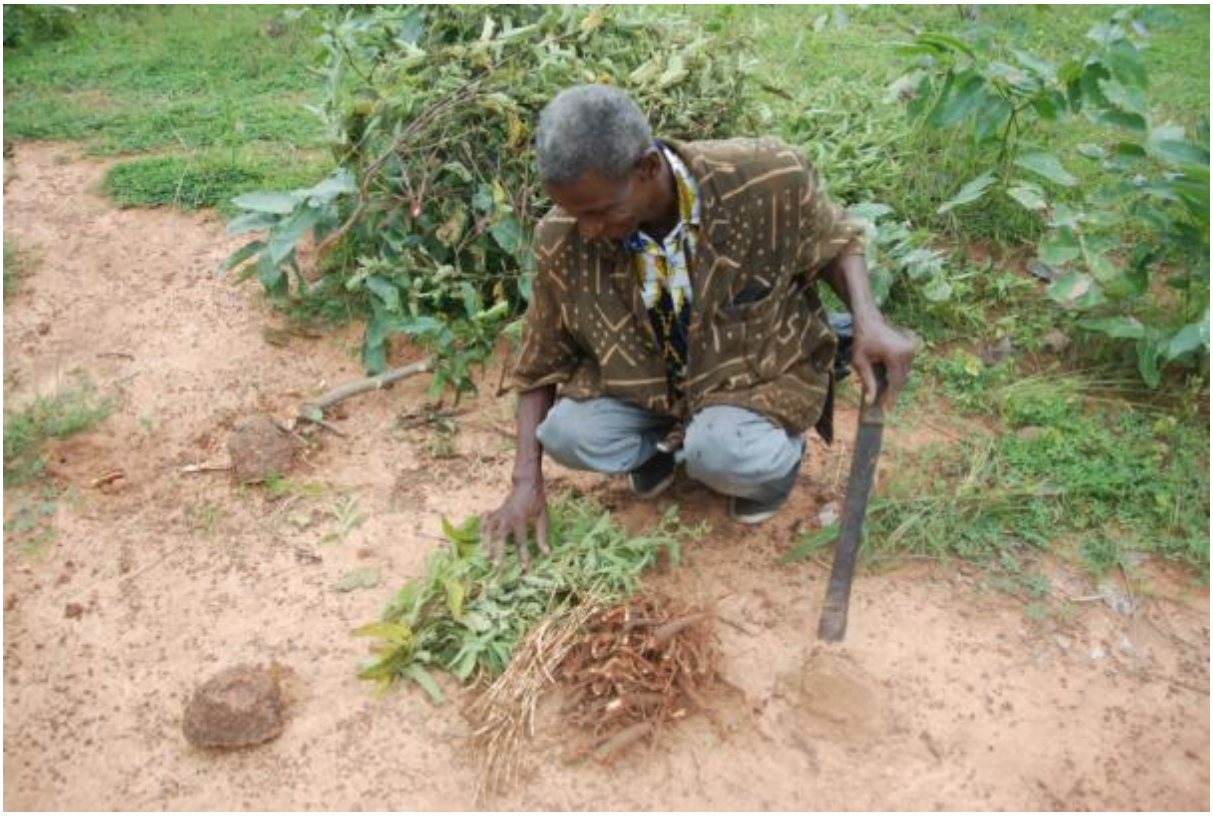

Fig. 3 Harvesting wild medicinal plants, Korhogo 2009. Photo: Syna Ouattara.

However, much remains to do in terms of integrating the TEK with academic science in the spirit of obtaining continued sustainable management under the contemporary and future pressures of global climate change and multiple influences of globalization (cf. Bohensky and Maru 2011).

The ministerial Departments of Public Health in Mali, Burkina Faso and Côte d'Ivoire have established national programs for the promotion of traditional medicine (WHO 2005; Yangni-Angaté 2004; Berge et al. 2005). In these three countries studies have focused primarily on ethno-botanical and phytochemical aspects (see Diallo and Paulsen 2000; Togola et al. 2008). In Côte d'Ivoire a law about traditional medicine was also established in 1999 by the Council of Ministers and expert committee on traditional medicine was established in 2002 (WHO 2005). Yet, no regulatory requirements exist for safety assessment or manufacturing of traditional medicine. Traditional medicines are sold freely in Côte d'Ivoire (WHO 2005). Mali has official legislative texts governing the practice of traditional medicine. A registry of traditional health practitioners and a Department of Traditional Medicine have been established in Bamako, Mali. This institute is mandated to perform inventory of medicinal plants and verify the therapeutic and toxic effects of the recorded plants; undertake studies to improve and standardize the presentation of traditional medicines; train researchers in the fields of traditional medicine and traditional pharmacopoeia; involve traditional medicine practitioners in the politics of primary health care and write technical notices related to traditional medicine (WHO 2001).

THE CLIMATE DIMENSION OF SAVANNA-WOODLANDS – AND WOODLAND IS PART OF THE AGRO-ECOSYSTEM

The Sikasso region in southern Mali belongs to the Sudanian zone and has the highest precipitation and the best conditions for rain-fed cultivation in the country. With a yearly rainfall (>1100 mm) and with fertile soils, the Sikasso region accounts for a considerable share of the total agricultural production in Mali (Colin 2004; USAID 2008).The savanna here is more dense than in the Sahelian zone with occasional patches of dry scrub and there are scattered forests and woodlands (Sanogo 1989; Vitale et al. 2011; FAO 2011). In this paper we use the collective term *savanna-woodland* for this ecosystem in the Xylophone Triangle. Tropical and boreal forests are estimated to have the largest carbon stock (vegetation + soils) of all biomes (UNEP 2011). However, tropical savannas on average are estimated to have a carbon store of 77% compared to the tropical forests (ibid.). The value of the savanna-woodland of the Xylophone Triangle as a carbon store would thus be significant. The dry parkland ecosystem of neighboring Burkina Faso with several similarities to the savanna-woodland, was recently studied for potential REDD+ scheme using average estimates of carbon stock in Burkina forests of 35 ton carbon per hectare (Westholm and Kokko 2011).

The *dozobele* are also farmers. The arable cultivation of food crops is using manure from the livestock which are pastured both in the savanna-woodland and on fallowed arable. A number of resources for the households are collected in the woodlands i.e. fuel wood, spices, medicinal plants and bush meat. The woodlands thus constitute an inevitable part of the agro-ecosystem and its use and management are prerequisite for viable livelihoods for the local communities in this region. Similar situations are described from a number of tropical and sub-tropical forested ecosystems, 'domestic forest' (Michon et al. 2007). The important message here is that the local users must be involved in the management of the woodland and "there is no choice to be made between people and nature"… (ibid.).

CURRENT THREATS TO THE SAVANNA-WOODLAND AND ITS RESOURCES

The woodlands and forest resources of the Xylophone triangle are endangered by several pressures. The expansion of the intensive cotton cultivation into woodland and pasture areas is a major threat towards existing savanna-woodland, its biological diversity as well as to the medicinal plants and to the carbon stock of the woodland. In 2011 The Xylophone Triangle produced more than 61 percent of total cotton in in West Africa and there is an effort to increase the cotton production in the region (USDA 2011; Vitale et al. 2011). The state cotton company, CMDT in Mali, has improved provision of subsidized inputs and reinforced its extension service towards this goal.

Another threat to the woodlands is the increasing interest in African medicinal plants domestically, as well as from other continents, e.g. China, India and Europe, leading to overexploitation and unsustainable harvest methods (IUCN 2012). From 2001-2009, Africa exported wild medicinal plants to China worth nearly 23 million USD - which certainly is a great challenge for wild biological diversity (IUCN 2012). There is yet no data for West Africa or for the Xylophone Triangle on the extent and ecological effects of this resource extraction in terms of species, habitats and monetary values of the medicinal species. We also lack detailed knowledge on the plant species, quantities harvested and ecological distribution enabling vulnerability assessments of the medicinal plants and their habitats (Fig. 4). Here is a potential beneficial market for local communities if the knowledge-base and documentation were built to put such business on an ecologically sustainable basis.

A threat towards the maintenance of the traditional ecological knowledge is cultural erosion (Cunningham 1993). As youth move to urban areas there is a loss of heirs of traditional knowledge which is mostly transmitted by oral tradition. From this follows a decreased interest of maintaining the habitats for the medicinal plants in the savanna-woodland.

Additional threats to this ecosystem and its biological resources are the effects from a changing climate, e. g. increased rainfall variability and droughts (Simonsson 2005; IMF 2010). In the Xylophone Triangle, as in other semi-dry regions (XT belongs to West Sudanian savanna region) the resources and sectors that are sensitive to climate variability and hence highly at risk are the water resources, biodiversity, agriculture and food security, and health (vector-borne diseases; FAO 2007).

Fig. 4. Nauclea latifolia*;* local name in Sénoufo: *Gotjortjigue*, *tinyerikasanhagacige*; illnesses treated malaria and jaundice Korhogo, 2008. Photo: Syna Ouattara.

Rainfall has indeed increased in the Xylophone Triangle during the period 1970-2006 while other regions in Mali, Burkina Faso and Cote d'Ivoire have experienced less rainfall compared to long-term means from the early 1900s (UNEP 2011). This changes water availability for livestock and for fodder production in the dry and semi-dry areas of Mali and other regions of the Sahel which in turn leads to changed migration routes for pastoralists. Further, increasing migration from environmental refugees, escaping environmental degradation and disasters such as prolonged drought periods in the north of Mali and neighboring regions in the Sahel, as well as refugees from regions of armed conflict and political unrest, are recognized in the south of Mali[2] (UNEP 2011). This creates increased pressure on the savanna-woodland and its biological resources in the Xylophone Triangle. Livelihood vulnerability in the Xylophone Triangle is directly and indirectly linked to changes in climatic conditions but several factors are confounded in circular ways and might enforce resource scarcity and food insecurity (UNEP 2011).

LAND USE RIGHTS AND COMMUNITY BASED RESOURCE USE AMONG THE SÉNOUFO IN THE XYLOPHONE TRIANGLE

Among the Sénoufo[3], land is traditionally conceived as a collective good that cannot be owned privately; the individual, family or even village who inhabits or cultivates the land has a right of extended use, but village land remains the property of the first Sénoufo ancestors. Generally, land in a Sénoufo village may be divided between independent, interrelated farmers and artisanal residents, public meeting spaces, and collective agricultural lands maintained and harvested by the villagers. Customarily, among Sénoufo the real owners of the land are the *tugubele* ('creatures of the wilderness'; Förster 1998; Ouattara 2008).

[2] Mali received almost 1 million refugees from Cote d'Ivore and Burkina Faso in the period 2000-2002 (UNEP 2011).

[3] The main ethnic group in the *dozobele* and in the Xylophone triangle.

Traditionally, access to farmland is possible for immigrants regardless of ethnicity or religion and requires no fees. Customarily, to borrow a farmland the applicant has to give a symbolic gift (e.g. cola nuts or firewood) to the *tarfolo,* 'land owner'. The regeneration of the contract of loan land is often implied, the borrower may continue to exploit the plot until the *tarfolo* claims it. To prevent any event that can lead the borrowers to claim of ownership, it is forbidden to plant trees on a borrowed farmland. In general, only crops that do not last more than six months are allowed.

Most Sénoufo villages has one *katjire*, a sacred grove which is the seat of *tugubele* (protective spirits) of the village (Fig. 5) and at least one *sinzanga (*sacred forests) used for initiations rites (Ouattara 2006). The existence and protection of those sacred groves are of utmost importance for biological diversity since they also function as conservation refuges for a number of biological species (Ntiamoa-Baidu 2008). This cultural relation to the land and to the biological resources used collectively by the community (cf. *`resource tenure´,* Lyster 2011) provides a foundation for further development of the system of community based management of the woodland resources and its biological diversity (cf. Ostrom et al. 1999; Ostrom 2009). Such systems can be very successful in maintaining both high biodiversity and sustainability in resource use (Berkes 1999; Persha et al. 2010).

A village In the Xylophone Triangle is composed of several neighborhoods and inhabited by one or several *félé* (clans) including members bound by marital relations of the founding clans of the area. The neighborhood recognizes two categories of leaders. The first which might be called "traditional leader" is the *ningefolo* or *tarfolo* (land owner), also called *koulofolo* (local chief). It is his/her ancestors who created the *katjire* (sacred grove of the village) and the first to have occupied the land and signed a pact with the *tugubele* (geniuses) of this place for permission to settle on this soil. The second leader, called *kanhfolo* (village chief), was introduced after national independence (1960 in Mali, Cote d'Ivoire and Burkina Faso). The *ningefolo* is responsible for ritual activities, while the *kanhfolo* represents the administrative authorities. The traditional council does not lead the village, but meets to resolve everyone's problems such as disputes about land, marital disputes, relations between neighborhoods and ethnic subgroups, initiation rituals (including funerals), relations with other villages or with the national administration. The *kanhfolo* (village chief) and his counselors are nominated by the villagers and recognized by the central administrative authorities (Ouattara 2006, 2008). Further, there is another level of organisation in all the villages in this region, the Village Association (AV) created under the auspice of the governmental cotton enterprises in Mali, Burkina and Cote d'Ivoire. The main aim is to stimulate the cotton production and the organisation of production groups by providing resources such as financial credits, introducing new agricultural practises etc. But the AV is also involved in a number of development activities such as literacy training, assistance to help the most vulnerable and organises human and financial resources for festivity activities etc. (Sanogo 1989).

There are thus three levels of functional organisation of the resource use in the villages, of which the first two are related to the use of woodland resources. This use is linked to management and can be used as a basis for further development of management systems.

Fig. 5 Cotton fields and *katjire* (*katjire* refers to a sacred grove which is the seat of *tugubele* (protective spirits) in the rural municipality of Doumanaba, located north-west of the Sikasso city, 2010. Photo: Syna Ouattara.

TRANS-NATIONAL AGREEMENTS ON THE XYLOPHONE TRIANGLE

The transboundary ecosystem of the savanna-woodland of the Xylophone Triangle (Fig. 1) has a cultural equivalent. The *dozobele* in the Xylophone Triangle of these three countries are sharing cultural and economic practices and are linked to each other through sociocultural bounds (Hagberg and Ouattara 2010). Mali, Burkina Faso and Côte d'Ivoire have recently joined the trans-national development program of the *Club du Sahel et de l'Afrique de l'Ouest* with the ambition to institutionalize and develop the cultural identity of this transboundary region. By initiative of Ministers of Culture in the three countries in 2004, there is an annual festival with artistic and cultural character in the Xylophone Triangle. Its main objective is to contribute to the consolidation of the sub-regional integration and peace between peoples of the participating countries. It is a prized competition sponsored and administered by the above-mentioned nation-states, albeit funded jointly by the *Organization de la Francophonie.* During the ceremony, the prize "Lamissa Bengaly", named after the famous xylophone, is presented. For the Sénoufo people, the xylophone is more than a musical instrument for entertainment. They use the term *Jegele* to refer to both the instrument and its performance traditions and social organization (Berte 2007).

A regional network strategy for bio-cultural collaboration is crucial for three basic reasons: a) the distribution of species and ecological boundaries do not match the political and administrative boundaries; b) the exchange of raw products involves transactions relating to the historical trade networks that are pulling together communities of friends and relatives and that subsumes multiethnic relationships and social networks and; c) trans-regional

collaboration is essential for any cost effective implementation of international conventions on biodiversity, trade and sustainable use of medicinal plants and climate change.

Cultural-ecological understanding of the environment which includes knowledge of species, ecological interactions and dynamics of the ecosystem underpins sustainable management practices (Berkes 1999; Folke et al. 2003). In West Africa, no other group than the *dozobele* associations meet so diverse criteria encompassing issues related to fauna, flora, and indigenous medical knowledge (Traoré 2004). The European Union has identified *dozobele* as the new force for conservation across West Africa, and regional conservation programmes in which these groups might operate are developing. PACIPE (*Programme d'assistance technique à la communication pour la protection de l'environnement*) alone covers six West African countries, while many other donors are working directly through the *dozobele* associations (Leach 2000). *Dozobele* have thereby become sociopolitical actors of relevance to contemporary environmental and development projects.

Mali is involved in a number of development projects related to environment with international donors, including the Global Environment Fund and the Carbon Fund. Both Mali and Cote d'Ivoire are partners to REDD+ (UN-REDD+ 2012), although Mali is not yet actively engaged in any initiatives (Hardcastle 2011). Here opens a perspective of managing REDD+ with transboundary frames highly motivated by the bio-cultural links in this region.

REDD PLUS AND SYNERGIES FOR CLIMATE, CULTURAL AND BIOLOGICAL DIVERSITY AND HUMAN LIVELIHOODS IN THE XYLOPHONE TRIANGLE

The woodlands of the Xylophone Triangle harbor both climate change mitigation dimensions as well as biodiversity qualities. The value of the biodiversity of the savanna-woodland for the *dozobele* in their practice of traditional knowledge is not yet evaluated in monetary terms. However, it is an evident ecosystem service of large importance for local communities, complementing the agricultural activities in the agro-ecosystem there. Simultaneously the value of the ecosystem service of potential net carbon sequestration of this woodland has importance for the region's contribution for climate change mitigation. The maintenance and use of sacred forest groves for ritual purposes in the *dozobele* communities contributes to biodiversity conservation (cf. Ntiamoa-Baidu 2008; Kala 2011). Emergent threats towards this ecosystem have been outlined above. There is thus a prospect for applying REDD+ incentives to the region to achieve multiple benefits, a situation that is elaborated in a number of recent studies (Christopherson & Stahl 2011; Phelps et al. 2012).

An important aspect and potential for innovative REDD+ application in this region is the transboundary dimension of the Xylophone Triangle. The savanna-woodland ecosystem of this region is clearly transboundary and conservation of its ecological qualities would benefit from targeting the whole area by a joint effort from the three nations Mali, Burkina Faso and Cote d'Ivoire. This transboundary dimension of the ecosystem is emphasized by the existing strong cultural links within this region manifested in the annual music festival here (Festival du Balafon) with a focal point in Sikasso in Mali (Maliweb 2012). Since the climate challenges are also of regional and transboundary character this region would offer a number of additional co-benefits for a transboundary approach of REDD+ incentives.

Governance systems of REDD+ that transcend national boundaries and involve traditional and non-traditional policy actors are increasingly asked for (Corbera and Schroeder 2011). However, a number of unsettled challenges exist for a potential REDD+ application in the Xylophone Triangle. A major issue is how to maintain the rights of local peoples. A basis for their application of traditional ecological knowledge (TEK) along several dimensions of which the traditional medicine based on wild medicinal plants is very important. The biological resources are used collectively by the villagers with customary regulations, a form

of ‘resource tenure’ (Lyster 2011), even if the land is not individually owned - see above. The process of making countries ‘ready for REDD+’ involves central national governance and institutions with the risk of over-looking the participation of local communities. In such cases the REDD+ incentives might be hazardous towards livelihood sustainability (Beymer-Farris and Bassett 2012). Whether the countries of Mali, Cote d’Ivoire and Burkina Faso are ready for receiving REDD+ support is not clear, even if the two first mentioned are members of the REDD+ partnership (UN-REDD+ 2012). There is a substantial gap between governance at national level and a governance system involving indigenous communities with their property rights and common pool resources such as the *dozobele.*

An additional challenge is to make this work at a transboundary level. However, on condition of the development of an appropriate governance system for handling a REDD+ scheme where the rights and involvement of local peoples are granted, the REDD+ payments opens several possibilities for development and investment in the rural villages, e.g. could be combined and positively enforce a number of communal resource uses in the savanna-woodland such as medicinal plants, collection of mushrooms and fruits, beekeeping etc. (Mwape and Gumbo 2010; Naughton-Treves & Day 2012). Maintaining woodland ecosystems can contribute to increased resilience to climate change and thus to livelihood resilience. To achieve these multiple benefits, REDD+ will require the full engagement and respect for the rights of woodland-dependent communities (CBD Secretariat 2011). The long-term success of REDD+ will stand or fall with local ownership and support (Agrawal and Anglesen 2009).

A number of issues regarding the present agro-ecosystem in the savanna-woodland still remain unresolved and deserve further study. Such issues are: How can the traditional ecological knowledge in this region be maintained and used as a basis for sustainable development of local communities and livelihoods? What is the current economic role of the medicinal practices in the local social-ecological system? Could the role of medicinal plants be increased and include sustainable cultivation at the expense of the environmentally challenging cultivation of cotton? Could the cultivation of medicinal plants be organized within a silvi-pastoral system to optimize biodiversity, carbon sequestration and medicinal plants values? What would be the optimal arrangement of a such system to secure the benefits and rights of local peoples? What are the socio-ecological implications of gendered resource use of the medicinal plants?

CONCLUSIONS

The savanna-woodlands of the Xylophone triangle in subtropical West Africa constitute valuable wooded ecosystem with significant carbon storage capacity. Those woodlands are part of local agro-ecosystems and their resources are intensively used by humans along several resource dimensions. The socio-cultural association *dozobele* inhabits this ecosystem and their use of non-timber-forest-products (NTFP) is important for viable livelihoods and the use shapes local biodiversity. There are very strong eco-cultural bonds between humans and nature here by the application of traditional ecological knowledge especially by the traditional medicine on the foundation of use of wild medicinal plants from the woodlands. The conservation dimensions of the local and regional biological diversity is further enforced by the transboundary dimension for the regional ecosystem and by the cultural identity for the same region. Thus there are several arguments for multiple benefits of potential REDD+ payments to this transboundary region.

However, several unresolved issues remain for the handling and governance of such payments of which the involvement of local peoples and their ‘resource tenure’ based on use of common access and customary regulation, is at forefront. Nonetheless the existing resource

use and management systems in the *dozobele* villages could be a basis for elaboration of local governance systems for handling the REDD+ schemes where the maintenance of the savanna-woodland ecosystem is a prerequisite. The culture and traditional knowledge related to the use of medicinal plants is a core issue in the region and thus highly qualified for development of economic activities that could increase the resilience of local livelihoods and lessen the dependence on the cotton cultivation. A number of promising possibilities could be realized such as development of sustainable cultivation and harvest methods for medicinal plants within the agro-ecosystem of the savanna-woodland; providing incentives for restoration of some of the degraded agricultural land currently used for cotton cultivation. This would be a new and innovative illustration of multiple benefits of REDD-plus combining global carbon, regional and local biodiversity challenges with local rural development and strengthening livelihood resilience – and recognition of forest peoples' cultural identity in sub-Saharan Africa[4].

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