

Full Length Research Paper

Environmental education and ecotourism using termitaria research findings: A case study of Pendjari reserve, Benin

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Findings are available on termitaria and their vegetation in the Pendjari Biosphere Reserve and other Sudanian regions in West Africa, but research without dissemination and impacts on communities seems not to be useful. This work aims at providing non-governmental organization (NGOs) and forestry advisers with useful data for environmental education projects and taking termitaria and their vegetation into account for ecotourism in Pendjari Reserve. This article on termitaria and termitaria-related vegetation summarizes data useful for two purposes. Traditional knowledge on termitaria is useful for education; termitaria plants are used as medicine. Mushrooms growing on termitaria and small mammals living in dead and abandoned mounds are consumed in the reserve. There is a need to train kids and students on termitaria and their vegetation conservation. The panoramic view of mounds and their vegetation is really attractive to tourists. Vegetation on termitaria differs between management types of an area and is dominated by woody species belonging mostly to Combretaceae botanical group. Cappareae species seem restricted to termitaria. The three major ethnic groups in the Reserve hold a diversity of ethnological knowledge on termitaria and their vegetation. These can serve for ecotourism development towards termitaria to lower poverty probability of small households in the Reserve.

Key words: Conservation, ecotourism, environmental education, reserve, termitaria.

INTRODUCTION

The United Nations Educational, Scientific and Cultural Organization (UNESCO) states that environmental education is vital in imparting an inherent aspect for

nature amongst society, which enhances public environmental awareness. UNESCO (2014) emphasizes the role of environmental education in safeguarding

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future global developments of societal quality of life (QOL), through protection of the environment, eradication of poverty, minimization of inequalities and insurance of sustainable development.

Education for Sustainable Development (ESD) is the most used term worldwide, by the United Nations. Agenda 21 was the first international document, which identified education as an essential tool for achieving sustainable development in highlighted areas of action for education (McKeown, 2002). Environmental education towards kids has positive impact on natural resources conservation, since in the present day children are disconnected from nature and they have to be trained to become environmental stewards.

All this shows that, environmental education is quite important for sustainable management of natural resources especially in protected areas. Like environmental education, ecotourism and its effects on rural people welfare received several attentions worldwide. For instance, a well-planned tourism provides economic and political incentives for management and conservation, which may bring additional benefits to local communities and regional economies (Tundi Agardy, 1993).

The sum of effects for ecotourism in city is bioclimatic comfort as well as particular matter and CO₂. Ecotourism is very important for plants which affect CO₂ in the environment (Cetin and Sevik, 2016b; Cetin, 2015b; Cetin, 2015c). Rural and urban areas have rich ecotourism potential for protection, used by rural people. GIS (Geographic Information System) is used to determine suitable ecotourism area. Management and planning of ecotourism is very important for the protection of ecotourism areas (Cetin, 2015d; Cetin, 2015e; Cetin, 2016b; Cetin, 2016c; Cetin and Sevik, 2016c; Cetin and Sevik, 2016d). Cavendish and Campbell (2008) emphasized that, environmental income lowers the poverty probability of small households and those with young heads. Many years ago, Goodwin (1996) found that ecotourism is expected by the tourism industry and academics to grow rapidly over the next 20 years. Later, Scheyvens (1999) stated that, ecotourism ventures should only be considered 'successful' if local communities have some measures of control over them and share equitably in the benefits emerging from ecotourism activities. In a review article on the social impacts of protected areas on people, West et al. (2006) focused on social, economic, scientific, and political changes in places where there are protected areas and in the urban centers that control these areas.

In addition, Lindberg (2001) mentioned two related and distinct economic concepts in ecotourism: economic impact and economic value. Similarly, Naughton-Treves et al. (2005) reported that many initiatives aim to link protected areas to local socioeconomic development. They added that, some of these initiatives have been successful, but general expectations are to be tampered

with, regarding the capacity of protected areas to alleviate poverty. Termitaria like many biodiversity hotspots in Sub-Saharan Africa and all over the world have received several research attentions in past years. In fact, research activities carried out on termitaria in West African savannahs mostly focused on the behavioral ecology of mounds, the ecology and patterns of termitaria-related vegetation, the medicinal uses of plant species associated with termitaria and other ethnological knowledge related to them. Exclusively, it has been stated on termitaria that, they maintain tree and herbaceous plant species diversity in West African Savannahs (Dossou-Yovo et al., 2016; Dossou-Yovo et al., 2009; Traoré et al., 2008; Mahamane and Mahamane, 2005, Konaté et al., 1999; Grouzis, 1988).

The termitaria vegetations around Pendjari National Park are dominated by woody species which mostly belong to Combretaceae botanical group. Plant species associated with termitaria in fields and fallows are mostly used as medicine by indigenous people surrounding the Pendjari National Park (Dossou-Yovo et al., 2014). These authors also mentioned various traditional beliefs towards termitaria such as, consideration of termitaria as places where ancestral spirits dwell, the medicinal efficiency of termitaria-associated plants recognized by healers in addition to the maintenance of mounds in agricultural lands for fertilization. Sileshi et al. (2009), in their review article, stated how far ethno-ecological and scientific knowledge on termites can serve for the sustainable termite management and human welfare in Africa. In the field of animal species conservation, termitaria in Sub-Saharan savannahs serve as nesting place for wild birds and reptiles habitats (Thompson and Thompson, 2015; Dossou-Yovo and Korb, 2010; Heermans, 2010; Knapp and Owens, 2008).

This study highlights data to be used by any stakeholder or forestry advisers in the Biosphere Reserve to train kids and students, on importance of termitaria or write good ESD programs on termitaria by using existing research outcomes. There is a vast review on available publications about termitaria in the Pendjari Reserve as well as other articles published elsewhere on environmental education and ecotourism; therefore, the aim of this study is to provide information about how termitaria preservation can be used, for environmental education and ecotourism.

MATERIALS AND METHODS

Articles published on termitaria in the Biosphere Reserve of Pendjari, have been reviewed in similar ecological zone of Burkina-Faso which summed up relevant information useful for environmental education and ecotourism purpose in the reserve.

Articles regarding key results or suggestions that serve either for environmental education or ecotourism or both were analyzed. Many other articles related to environmental education and ecotourism have been used. The database used for gathering the manuscripts was Google scholar and University of Laval (Canada),

covering a period of the last twenty years. The major key words used were: articles on termitaria in West Africa and articles on termitaria in Pendjari Reserve. Information gathered from each publication was related to biological, ecological and ethnological characteristics of termitaria. Duplicates of articles were eliminated considering their title and general goals; articles were filtered based on the research area and ecological region (sudanian) concerned in this paper. This has led to a total of 46 journal articles as well as articles published by international institutes, having been exploited to write this paper. Some means by which environmental education and ecotourism development on termitaria can be undertaken have been suggested in this article.

RESULTS AND DISCUSSION

Percentage of publications according to the fields on interest

This article diversely focused on ecotourism, environmental education and biodiversity conservation. Among all publications, 50% were related to ecotourism, 13.04% on environmental education while the remaining 36.96% were related to biological diversity. The majority of articles highlighted the positive environmental aspects of ecotourism as well as the contribution of environmental education to the sustainable management of protected areas and environment.

How research findings on termitaria can serve for environmental education in the Pendjari biosphere reserve?

There is much traditional for their welfare. For instance, several plants associated with termitaria can be used as medication. Against dysentery, the reserve dwellers used *Anogeissus leiocarpa*, *Diospyros mespiliformis* medicinal and ethnological knowledge on termitaria that present and future generations should inherit and *Flueggea virosa*. The latter as well as *Crossopteryx febrifuga* and *Grewia lasiodiscus* were used against headaches. Stomach aches and diarrhea were treated using two species *A. leiocarpa* and *Grewia venusta*, *F. virosa* and *Vitellaria paradoxa* (Dossou-Yovo et al., 2014). Termitaria mushrooms *Termitomyces* sp. Are consumed as protein by people living in the Biosphere Reserve (Dossou-Yovo and Korb, 2010; Dossou-Yovo, 2007). Traditional hunters frequently use termitaria to hide from wild animals (Dossou-Yovo et al., 2014) in fallows. Dead and abandoned mounds are habitat for small mammals; when hunted they can be used as food (Dossou-Yovo and Korb, 2010). However, this hunting negatively impacts the conservation of the biological diversity of small mammals. People, by looking for these animals, totally break dead mounds. As a result, hunting in these habitats is not to be promoted.

Since 1982, Batisse highlighted that the primary function of Reserves remains the *in situ* long-term

conservation of plant and animal genetic resources, together with research on ecosystem management and conservation, monitoring of changes in the biosphere, training of specialists, and environmental education. This proves that many decades ago, environmental education was seen as priority function of biosphere reserve. Bonajuto et al. (2002), investigating local residents' attitudes towards two Italian National Parks, found that people are more involved in ecological and pro-environmental activities, which had more positive attitudes towards natural protected areas as compared to local residents involved in other local economic activities. Vodouhê et al. (2010) stated that Pendjari's local populations' perceptions of biodiversity conservation were strongly related to locally perceived benefits. Therefore, train kids and students on termitaria importance for their life and conservation in the reserve will contribute to stimulate their positive attitudes towards termitaria, now and in the future in order to realize the profits obtained from termitaria.

As a result, training kids and students environmentally on termite mounds helps to reduce pressure on the mounds and the mounds-related vegetation. Research without dissemination appears to have no impact on people's behavior, as indigenous people most times do not have access to published data. Moreover, non-governmental organization (NGOs) which are expected to use research outcomes focus of the majority of their activities, on their own annual work plan. However, we do hope that this summary article will be used by different NGOs and forestry advisers, involved in environment conservation within the reserve. Posters, oral presentations and leaflets in primary and secondary schools, training of community groups, and local environmental educators will serve to disseminate all existing knowledge and information on termitaria, to ensure an ESD.

Similarly to these suggested methods, educational outputs (including posters, stickers, videos, lesson plans, and workshops), primarily linking human needs to the ecosystem services provided by bats, were delivered to schools and community groups while, local environmental educators were trained to further develop the environmental education programs (EEPs), for the conservation of Critically Endangered Fruit Bats in the Western Indian Ocean (Trehwella et al., 2005).

How research findings on termitaria can serve for ecotourism purpose in the Pendjari biosphere reserve?

NGOs and any other agency in charge of tourism development in Benin and elsewhere can use some relevant data on termitaria, in order to write ecotourism projects or take termitaria into account in their touristic activities. With regard to the behavioral ecology of

termitaria in Savannah, Korb and Linsenmair (2000) had noticed that during the day, sun heats the air in the peripheral air channels inside the ridges of the mounds above the central nest temperature, which produces a temperature gradient in the peripheral air channels with decreased temperatures at the top of the mound.

In contrast, during the night in Savannah and generally in the forest, the authors recorded air channels lower than those of the central nest with CO₂ in mounds. Termitaria and their vegetation have received several attentions in the Pendjari Reserve. In fact, they offer panoramic view in the savannah ecosystem, which can really attract tourists. Traoré et al. (2008) as well as Dossou-Yovo et al. (2016) recorded the genera *Capparis* and *Maerua* both *Capparaceae*, solitary on termitaria and absent in the adjacent vegetation. Twenty-four *Capparaceae* species (*Capparis* and *Maerua* genera included) were reported on red list of threatened species, by International Union for Conservation of Nature (IUCN) (2016).

Therefore, termitaria can be seen as important conservation habitats for these threatened species. Plant communities on termitaria were different from agricultural lands (field and fallows) to the National Park (Dossou-Yovo et al., 2016). Fandohan et al. (2012) suggested termitaria as a factor used in controlling the establishment of *Tamarindus indica* and most of the plant species they host, although the termitaria-tamarind associations may be profitable to both termites and tamarind trees. They added that, termitaria may help to mitigate drought on tamarind trees while the trees in turn may offer food to termites. When conducting touristic visits, all data highlighted above will no doubt be very useful and interesting.

Furthermore, much ethnological knowledge on termitaria and their vegetation is available and there is a diversity of medicinal utilizations of termitaria plant species held by the three (03) major ethnic groups of the Pendjari's populations (Gourmanche, Berba and Wama). In fact, twenty-two (22) medicinal plant species from which twenty-one (21) woody species and one herbaceous species were recorded, as collected on termitaria in fields and fallows in the Reserve (Dossou-Yovo et al., 2014). These plants were used by the three ethnic groups to treat thirty (30) diseases and illnesses. Having the full list of the concerned species as well diseases treated and being able to recognize them during field visits will really interest tourists. All these data are interesting and important for ecotourism. Termitaria in Pendjari Biosphere Reserve serve as nesting place for bird species; they are also habitats for small mammals and reptiles (Dossou-Yovo et al., 2010). These findings increase the probability that tourists observe likely animal species on or inside termitaria.

One benefit of ecotourism is the maintenance of biodiversity as in some areas species and ecosystems are protected primarily to attract tourist (Barnard, 1995).

Ecotourism was reported as a potential for sustainable development in three ecotourism lodges in the Southeastern Peruvian Amazon (Torres-Sovero et al., 2012). A common ecotourism goal is the generation of economic benefits, whether there are profits for companies, jobs for communities, or revenues for parks (Okech, 2008). Termitaria and their vegetation have until now been investigated biologically, ecologically and chemically and our article is the first one stating their importance for ecotourism. So its implementation will not only provide sustainable jobs for youths but also revenue for the Pendjari National Park and many companies.

Environmental income to be generated by ecotourism will lower the poverty probability of small households and those with young heads in the Biosphere Reserve (Cavendish and Campbell, 2008), so it will improve the QOL of the reserve dwellers. Wearing and Neil (1999) reported that, the tourists and host population benefit experientially from ecotourism through interactive processes. So visitors will also benefit from this ecotourism development. As suggested for environmental education, posters, oral presentations and leaflets suggested in this article, television and radio panels can also serve to inform and sensitize local populations and tourists on the importance of termitaria.

Technical guides on termitaria for ecotourism development are also necessary for that purpose. This guide can be easily and well developed by using existing data. For a better development of ecotourism in the three ecotourism lodges in the Southeastern Peruvian Amazon, Torres-Sovero et al. (2012) first identified and characterized tourist types, and then they found out variables influencing the level of satisfaction in each tourist type. Finally, these authors highlighted factors influencing the tourists' overall satisfaction. For future projects on ecotourism towards termitaria a similar approach can be adopted.

Conclusion

Termitaria and their vegetation, in addition to the biological and ecological role they play, can also serve for environmental education as well as ecotourism services. The ethnological and medicinal knowledge available on termitaria and their vegetation is quite important to be known by kids and students from primary and secondary school and tourists for a better conservation of termitaria and termitaria-associated vegetation.

The panoramic view of termitaria in savannah, their vegetation as well as the variation of plant communities on mounds according to the management type area is very attractive to tourists. Ethnological and medicinal knowledge on termitaria will serve for ecotourism in the reserve. Posters, oral presentations, TV and radio panels, leaflets and technical guide on termitaria are necessary for environmental education and ecotourism

development.

This article by stating the way research findings on termitaria can serve both for environmental education and ecotourism is a way to contribute to biodiversity conservation and poverty alleviation in the biosphere reserve. For its dissemination, we will also make it available to the ecological team in charge of the reserve management as well as any forestry advisers and stakeholders.

CONFLICT OF INTEREST

The authors have not declared any conflict of interest

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