Scientific Research Publishing

Open Journal of Ecology, 2020, 10, 141-159
https://www.scirp.org/journal/oje
ISSN Online: 2162-1993
ISSN Print: 2162-1985

Assessment of the Protected Areas Strategy in Togo under Sustainable Management: The Case Study of Oti-Keran, Togodo, and Abdoulaye Faunal Reserve

Kossi Fandjinou[1,2], Kebin Zhang[1*], Fousseni Folega[2], Beckline Mukete[3], Xiaohui Yang[4*], Kperkouma Wala[2], Koffi Akpagana[2], Eve Bohnett[5]

[1]School of Soil and Water Conservation, Beijing Forestry University, Beijing, China
[2]Laboratoire de Botanique et d'Ecologie Végétale, Université de Lome, Lome, Togo
[3]Department of Forest Management, Beijing Forestry University, Beijing, China
[4]Institute of Desertification Studies, Chinese Academy of Forestry, Beijing, China
[5]Departement of Landscape Architecture, University of Florida, Gainesville, FL, USA
Email: fandnew@yahoo.fr, *ctccd@126.com, ffolegamez@live.fr, kpwala@yahoo.fr, koffi2100@gmail.com, munasawa@gmail.com, *yangxhcaf@126.com, *fandnew@yahoo.fr

How to cite this paper: Fandjinou, K., Zhang, K.B., Folega, F., Mukete, B., Yang, X.H., Wala, K., Akpagana, K. and Bohnett, E. (2020) Assessment of the Protected Areas Strategy in Togo under Sustainable Management: The Case Study of Oti-Keran, Togodo, and Abdoulaye Faunal Reserve. *Open Journal of Ecology*, **10**, 141-159.
https://doi.org/10.4236/oje.2020.104010

Received: February 28, 2020
Accepted: March 31, 2020
Published: April 3, 2020

Abstract

This study aims to identify the drivers of environmental degradation due to the dependency of surrounding residents on three protected areas in Togo, Africa (Oti-Keran, Togodo, and Abdoulaye national parks (abbr. OTA national parks)). Surveys of villagers conducted in and around the OTA national parks added to data downloaded from Indexmundi data portal. National-level trend analysis results indicated: 1) the number of terrestrial protected areas showed an upward trend, while savannah and forest cover showed alarming decrease trends. 2) At the local level, supplying socio-economic needs in the three selected protected areas directly resulted in biodiversity degradation through animal grazing, hunting and farming. 3) Over 70% of the respondent's livelihoods consisted of farming and related dependencies on the protected areas for timber and non-timber forest products and income despite the protected status hold by these classified areas. 4) The OTA national parks have been experiencing an increase of anthropogenic pressure such as uncontrolled tree logging and hunting, which seriously impacts animal and vegetation biodiversity. 5) Policymakers should invest more resources in implementing an integrated management system based not only on a holistic vision of the PA that includes participatory management but also accounts for multi-dimensional principles to enable anthropogenic activities in and around the protected areas to satisfy sustainable development requirements.

Keywords

Classified Area, Multi-Dimensional Principle, Viable Strategy Approach

1. Introduction

Anthropogenic disturbances from local communities securing their livelihoods and basic subsistence needs have continuously fragmented natural ecosystems [1]. Due to their legitimacy, the dependency of local farming communities on natural resources will likely increase in the coming years without any suitable alternatives [2] [3]. The burden and the pressure of the surrounding populations on the forest resources arise from poverty and lack of appropriate management systems, such as those that use participatory methods. The efficiency of participatory management in other areas has been demonstrated for monitoring bush fires, agricultural production, green plant growth and combating forest degradation [4] [5]. Therefore, PA systems based on reductionist principles often become degraded through normal anthropogenic pressure, which could be remediated by providing appropriate solutions based on sustainable development models.

The foundational principles of sustainable management encourage economic development without interrupting the capacity for future generations to enjoy the natural resources. African forests are mostly natural forest which supports the needs of the surrounding households, particularly the rural population [6]. Protected areas benefit greatly from sustainable management programs for many activities like controlled burning and other restoration efforts that can improve the conditions of natural forests [7]. However, there is a lack of systematic vegetation monitoring in African forests and protected areas directed towards understanding the social dynamics of the surrounding populations. Studies that examine which social factors are associated with disproportionate utilization of natural forest products would be useful, for example, to address the potential natural resource ramifications of low education and household income. There is a pressing need to manage forests and green spaces through the implementation of specific management programs and programs structuring alternative livelihoods from the results of such social research.

Protected areas are a globally recognized structure for natural resources conservation, and make effective contributions towards natural resource management and restoration [8]. The total expanse of the protected area was estimated by UN Environment World Conservation Monitoring Centre [9] at 21 million square kilometers, an area similar to that of the sum of the surfaces of three major countries, including India, Russia, and Afghanistan. The total area accounts for 12.9% of all continental land and 6.3% of the marine area.

Initially, the purpose of protected areas (PA) was purely subjective, without taking into account securing basic survival needs that populations extracted

from natural resources. Then, socio-economic factors and ecosystem service provisions appeared as instruments of sustainable development. The overarching goal of the concept of the protected area is the protection of biodiversity. However, natural resources objectives encounter enormous difficulties in the local and national sphere for ensuring practical efficacy in simultaneously serving the population's needs. Conflicts about protection mandates often arise between the local population and the policymakers [10]-[15]. Due to the regulations and application of management in the field, conflicts ensue where there is a lack of support for the interests of the local population who live at the expense of protected areas. Protected area establishment often drafts management objectives, without prior consultation with local populations [16] that prevent the use of the resources for the area on which they depend.

Among several global PA, especially in Africa, conflicts arise from the imbalance between resource use and preservation of nature [17]. The solution to this challenge is often to administer levels or zones of restriction to the access to the protected area (PA) to balance the need for resource use and preservation of nature [18]. Other research has also shown that this challenge links to land ownership issues [19] [20]. The local communities do not always have the rights of landowners in certain countries. Furthermore, the state holds the land ownership and can apply PA management policies according to the needs of the government and their perceptions of the local population. In countries where local communities hold land ownership, the application of protected area management techniques inevitably depends on the collaboration between the PA agents and the social party [21]. Zimbabwe and Kenya are among the countries that have successfully implemented community-based protected area management [22]. Applications have been proven effective through sharing revenues earned among the communities. [23] showed that by enacting similar management techniques in Namibia then increased wild animal biodiversity and improved the tourism sector.

In West Africa, especially in Sahelian countries such as Togo, there is a paucity of research attention on the topic of protected areas. Originally, traditional protected areas consisted of community-based management by sacred forest designations with no formal boundaries [24], which changed from periods during the colonization period and after the independence. Three-time periods can be historically distinguished related to protected areas in Togo [25] [26]. The first period includes the colonial and postcolonial periods characterized by the use of military force to protect natural resources. The second period extended from 1990 to the 21st century with less natural resource management and uncontrolled resource extraction due to socio-economic and political troubles during the democratization era. The third period, from 2000 to the present, sought the need to protect natural resources through strategies including establishing artificial visible or invisible boundaries. According to a survey conducted by the Ministry of Environment and Forest Resources of Togo, more than 80 protected areas estab-

lished between 1938 and 1958 had the purpose of biodiversity preservation. However, they originated without collaboration with the residents. In the 1990s, after the democratization, different forms of human occupation (*i.e.*, agriculture, livestock, and buildings) became the main cause of protected area degradation. Thus, due to conflicts and dismissal by residents of previous designations of protected areas in Togo, additional research is needed to address challenges hindering the successful implementation of natural resources protections going forward.

There is no previous research focusing on assessment of the management plans, socio-economic dependence and anthropogenic activities of the surrounding population, or the preservation of the natural resources in the Protected Areas of Oti-Keran, Togodo, and Abdoulaye fauna reserve (OTA) in Togo. The current study aims to fill this gap by assessing the protected areas strategy in Togo under sustainable management models through the case study of Oti-Keran, Togodo, and Abdoulaye faunal reserve.

2. Materials and Methods

2.1. Study Area

Togo (6˚06'N and 11˚08N and 0˚09W and 1˚49W), a West Africa country (**Figure 1**), covers a total area of 56,600 km^2 and is bordered by the Atlantic Ocean, Benin, Ghana, and Burkina-Faso to the South, East, West, and North respectively. With 61% urban population and 229 persons/km^2 of density, its total population was 7,965,055 persons in 2017 by the United Nations Food and Agriculture Organization (FAO) reports, which was also estimated to have grown to four times from 1960 (independence) to 2010 with 60% very young in age. Four eco-floristic areas divide Togo according to the vegetation type of each area. Two main regimes characterize the tropical climate type from the south to the north. Two types characterize the rainfall rhythm. In the northern areas, there is one rainy and one dry period. In the southern area, there are two rainy and two dry periods. There is an annual average temperature of around 27.8 degrees Celcius. The vegetation of Togo reported more than four thousand plant species and high species richness mainly from the forest species, as discovered by [27] [28]. Human activities threaten this rich flora by supplying basic needs for those who depend directly on forest resources for firewood energy and charcoal [29] and also for animal grazing and hunting.

The selected research areas are among the ten top protected areas of Togo: Abdoulaye faunal reserve managed by an international NGO (Society Togo-faune) and covers 30,000 hectares; Oti-Keran National Park decreased from 163,643 hectares to 69 hectares after being subjected to ongoing revision projects. Since 2002, Togodo National park revision projects resulted in a total decreased from 310,000 to 25,500 hectares, although dedicated to natural resources management. In Togo, the Ministry of Environment and Forestry Resources (MERF) is in charge of the environment and natural resources management, including

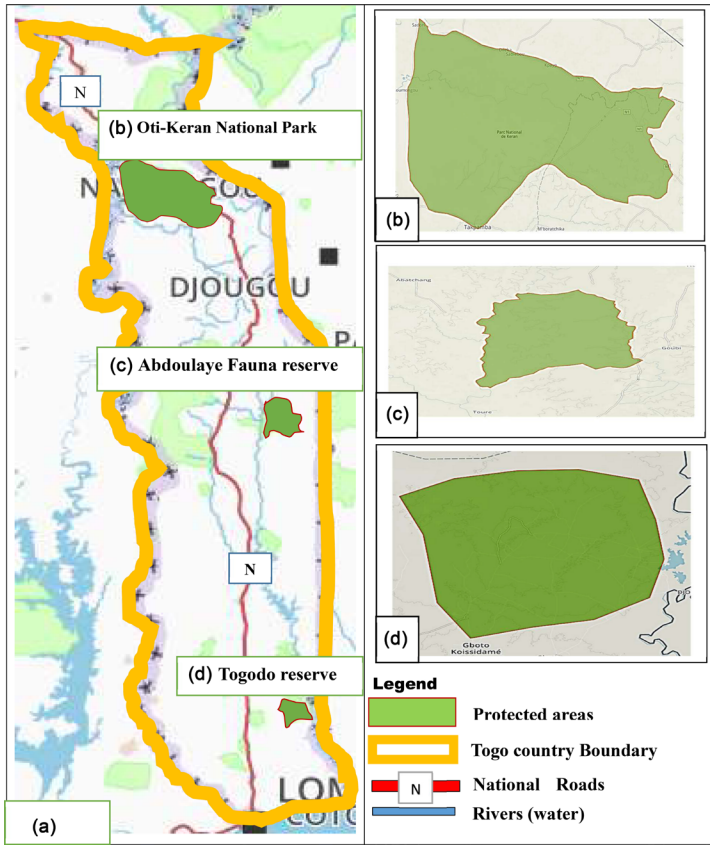


Figure 1. Research area map including the (a) Location of three protected areas within the country of Togo: (b) Oti-Keran National Park, (c) Abdoulaye fauna reserve, (d) Togodo Northern reserve (derived from World Database of Protected Areas)

protected areas through the Department of Fauna and Hunting (DFC).

2.2. Data Collection

At the national level, the socio-economic data was available from Indexmundi and UNEPWCMC (United Nations Environmental Program and the World Conservation Monitoring Center) database (https://www.indexmundi.com/). The national data included time-series GDP, rural area population, terrestrial protected areas, and agriculture area surfaces. Local-level data was obtained from secondary data from the field trips to assess the state of protected areas in Togo by interviewing local populations and doing surveys on the degree of degradation, vulnerability, and management of these protected areas. As part of this analysis, we randomly sampled the protected areas of Oti-Kéran, Togodo, and Abdoulaye national parks (abbr. OTA national parks) for comparative analysis at the local level (Figure 1) during August 2019. We surveyed villagers living near the protected areas using questionnaires designed to obtain information related to the villager's implications in the management systems of these protected areas and to determine needs supplied by the protected areas. These questions included the presence and the absence of certain particular plants and animals, the presence or absence of management agents, and the importance of the

protected areas for the villagers. The villager's national identity and phone numbers were notified and verified before engaging the questions. The interview captured at least 70% of the villagers of at least 18 years old per village across the adjacent villages around OTA national parks with a yes or no access to the protected areas questions giving a total of 210 interviews of villagers across the 9 adjacent villages.

2.3. System-Based Concept of Protected Areas

The model or concept of progressive openness respects sustainable principles because it allows effective activities in the transition area and the buffer area without disturbing the core area. It also promotes accurate monitoring and researching of long-run biological diversity conservation and sustainable use of natural resources around the protected area [30] [31].

2.4. Trend Analysis

Non-parametric Mann Kendall's method was chosen to evaluate the trend of the parameters. These methods detect intra-annual changes and inter-annual socio-economic trends. Consider a time series with n observation records each year for m years. Let $\{i, t\}$ $X = X$ be the observation value (for example, temperature, rainfall, protected areas number…) at the date t of the year i with $i \in M = \{1, 2, \cdots, m\}$ and $t \in T = \{1, 2, \cdots, n\}$, where n is the number of records in each year. The absolute difference $D = \{D_{i-1,it}\ i \in M, t \in T\}$ is calculated between the two years of each date t as

$$D_{i-t,it} = \left| X_{i-1,t} - X_{i,t} \right| \tag{1}$$

Switching from one type of land cover to another then results in a sharp

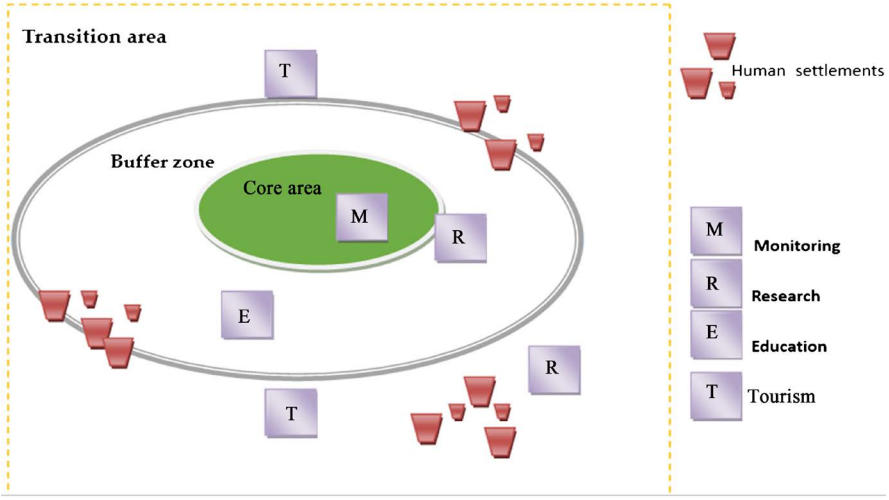


Figure 2. The system-based conception of a PA based on the Viable Strategy Approach (VSA). This model is based on the progressive openness of a protected area to a sustainable use by the surrounding people. The zonation of the protected area into three parts (core, buffer, and transition areas) relates to the three pillars of sustainable management (environmental, economic, and social).

increase to a larger value of D at the time of the change. This jump should not occur only on a single date but also on subsequent days with a greater similar deviation. A change in land cover is likely to be of low frequency within a certain the time period that is distinct from recurring intra-annual variations. Specifically, suppose that year i was marked in step 1, the date t^* year i will be determined as the date change if it meets two criteria at the same time:

$$D_{i-1,i,t^*-p} < K, \forall_p = 1,2,3,\cdots,t^*-1 \tag{2}$$

$$C_{i-1,i,t^*-p} > K, \forall_p = 1,2,3,\cdots,p^* \tag{3}$$

where κ is a threshold, and p^* is the smallest number of records showing a deviation after the date change. We determined that p^* was 3, based on some trial and error experiments. The threshold κ is calculated by multiplying a scale factor (β) and the maximum of the absolute difference

$$(\max D): \max \kappa = \beta \cdot D \tag{4}$$

where the value of the scale factor β is determined during the learning process. Once a change date t^* is detected in year i, the algorithm returns to the annual scale and implements step 1 for the next two consecutive years. In the case where a change date t^* is detected in year $i-1$ of two consecutive years, only records acquired on dates t^*+1 to n in years $i-1$ and i will be used to calculate D and tested against both criteria in Equation (2). To know and quantify how obvious each trend appears, the MK principle is often used. The MK method is suitable for non-parametric values of data. The observed data in the year Y_j and Y_i respectively differ and the sign $(Y_j - Y_i)$ equals 1, −1 or 0 with $j > i$. The test statistic, S, then calculated as follows:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} Sgn\left(y_i - y_j\right) \tag{5}$$

When $S > 0$, later-measured values tend to be higher than the earlier values indicating growth. When $S < 0$, the other values tend to be smaller than the earlier values indicating a downward trend. Therefore, when the value of S is smaller, no trend observed. The test is implemented in the following way:

$$\tau = \frac{S}{n(n-1)/2} \tag{6}$$

τ has a range from minus one to plus one and is similar to the quantification of the relationship between two factors. This case is used when there is evidence of a link between these components showed by a value of "τ" different from zero. In the case that an obvious trend is found, the variation can be calculated using the Sen slope factor for estimation [32]

$$\beta = \text{median}\left(\frac{y_j - y_i}{x_j - x_i}\right) \tag{7}$$

For all i lower than j, $\left(i = 1,2,\cdots, n-1 \text{ and } j = 2,3,\cdots,n\right)$; in other words, the slope is analyzed for all pairs of data that used to compute S. In 1945, Mann de-

veloped a method which was completed to statistically show the law that rules the relationship between two factors. When there is no link between the values of the data on:

$$E(s)=0$$
$$Var(s)=\frac{n(n-1)(2n+5)}{18}=\sigma \quad (8)$$

The standard test statistic Z is calculated by the following formula:

$$Z=\frac{S-1}{\sqrt{Var(s)}} \text{ For } s\geq 0$$
$$Z=0 \text{ For } s=0 \quad (9)$$
$$Z=\frac{s+1}{\sqrt{Var(s)}} \text{ For } S\leq 0$$

When the values are constant, Z evolves with mean zero. When $Z>0$, there is a growth, and when $Z<0$ there is no growth and it decreases. The trend is then displayed numerically or by graphics, as it will be the case in this analysis.

3. Results

3.1. Togo National Level Socio-Economic Drivers Including GDP, Population Density and Terrestrial Protected Areas Trend Analysis

The purchasing power of the Togolese population fluctuates with two major periods of growth from 2000 to 2005, then from 2007 to 2017, with a decrease between 2005 and 2007 (**Figure 3**). The rural population decreased since independence in 1960, probably due to the rural exodus. However, the density of the overall population has been increasing from year to year, showing very high rates of growth. Also, terrestrial protected areas have increased sharply since 2000 after experiencing a period of stagnation between 1990 and 2000.

To display these drivers accurately, they have been modelled through formulas showing that, Togo-rural population growth = 0.006% - 11.57% annually, R^2 = 0.02; Togo population density = 3.601 (±86.63) per year; R^2 = 0.95; Togo's terrestrial protected areas = 6.96 (±1.94) per year; R^2 = 0.77 predicting the protected areas to increase by the future. Togolese purchasing power was analysed, showing the following trends: GDP = 0.070 (± 7.20) per year; R^2 = 0.03. These trend equations showed that the protected areas increased considerably in Togo since the 2000s after a period of constancy between 1990 and 2000. At the national level, the protected areas have multiplied, which implies that there is a change in the way they addressed protected area designations before this period.

3.2. Trend Analysis for Land-Use Surfaces: Agriculture, Savannah, and Forest Areas

While terrestrial areas are showing an upward trend (**Figure 3(d)**), forest areas are decreasing alarmingly (**Figure 4**). Anthropogenic disturbances related to

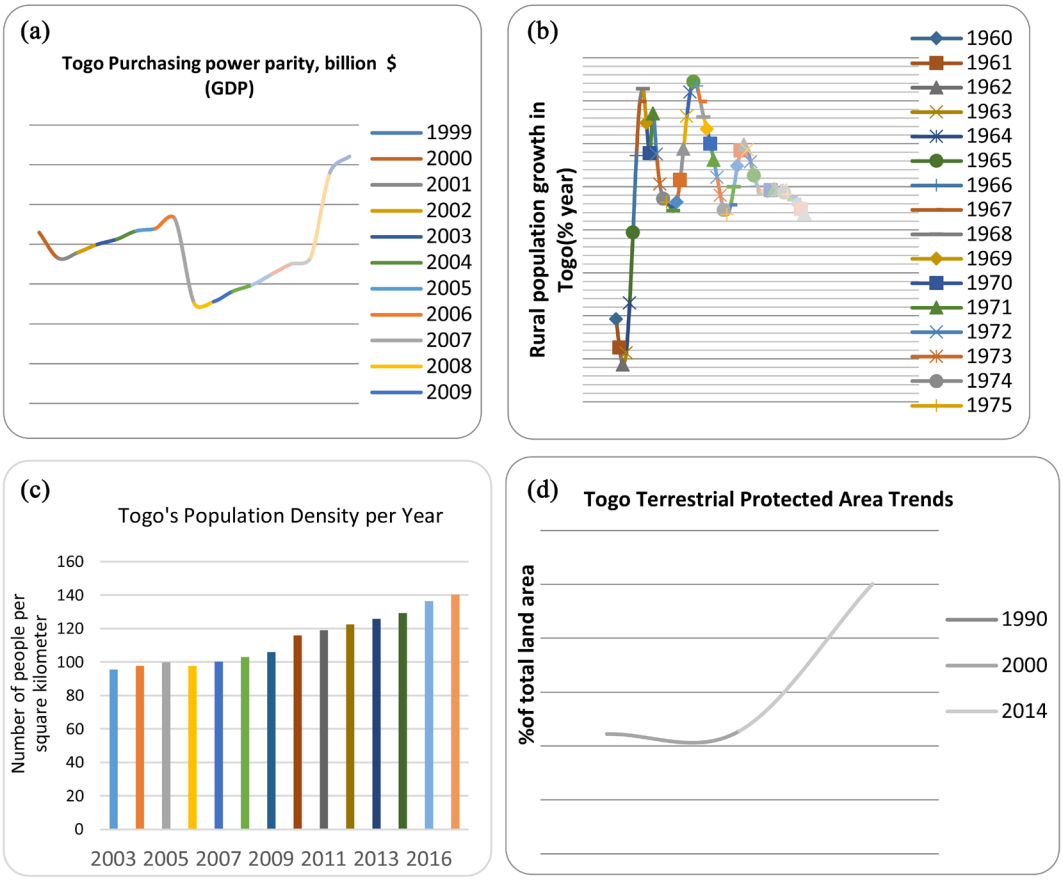


Figure 3. Togo's population GDP (a); Rural population growth per year (b); Population density per year (c); and Terrestrial Protected Areas (TPA) per year (d).

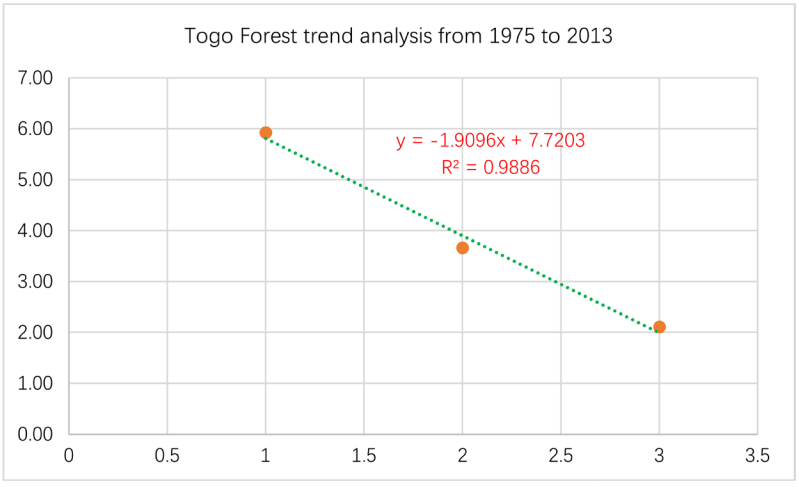
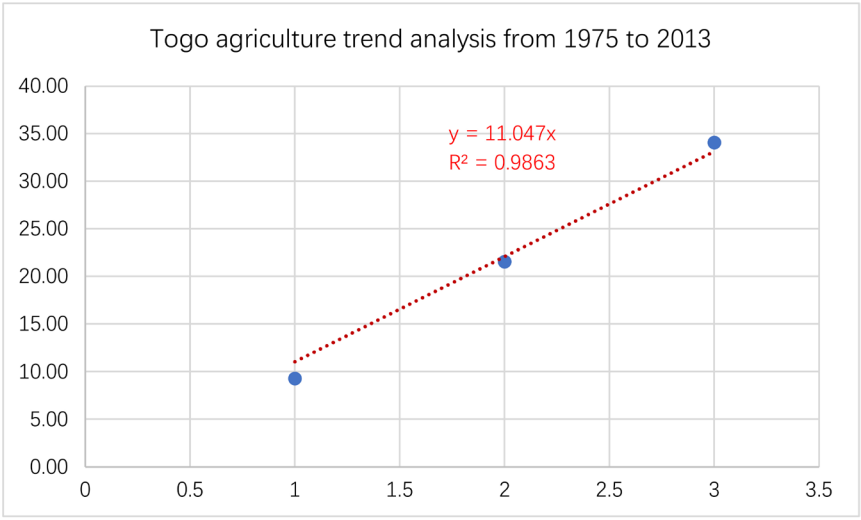
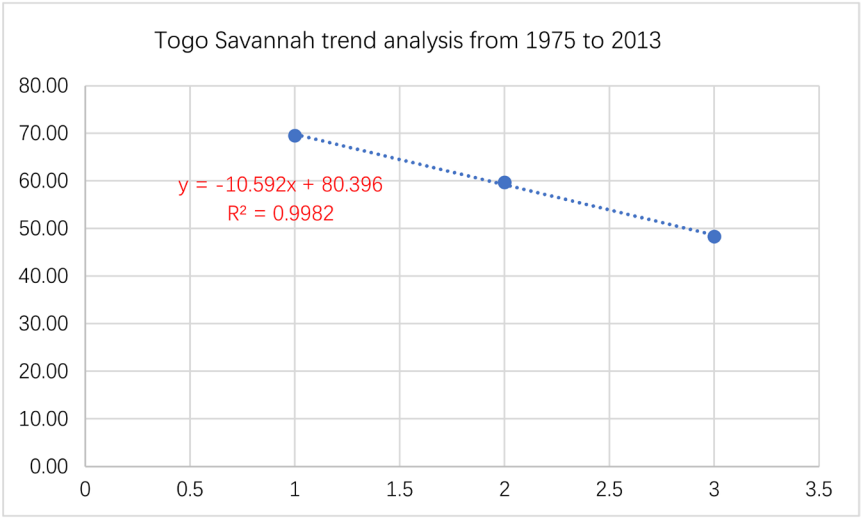


Figure 4. Togo forest trends.

agricultural demands (**Figure 5(a)** and **Figure 5(b)**) have risen to meet the food needs and extractive wood demands of the population (**Figure 4**). Agricultural area expansion has been occurring along with the rapid growth of the Togolese population. These populations are not only growing but also dominated by the younger generation. A large part of this country's income comes from the



(a)



(b)

Figure 5. Togo (a) agriculture and (b) savannah land cover trends after independence from 1975 to 2013.

agricultural sector, where the need to grow more food to feed this population effectively has been proportional to the increase of croplands and fallows. The degradation of forest lands and savannahs relates to the economic and financial survival of each household. There are no suitable alternatives to replace livelihood and income bound to extractive forest behaviour for timber and firewood charcoal supply. The only source for securing livelihoods in the country is subsistence farming and extraction from the forest reserves, not only because of poverty but also because of the lack of sustainability regulations adapted to the reality of this population. Moreover, the increase of areas allocated to the settlements revealed basic subsistence needs as the main drivers of the natural resources utilization, but also the need to build houses for this growing population. The built infrastructure and private settlements are consuming space for many other causes.

3.3. Local-Level Analysis

The selected protected areas reported the presence/absence of plants/animals and the survey of the management agent's (Appendix Table A1):

In the Oti-Keran reserve, 80% of these local respondents agreed to the protected area regulatory structure, while many farmers continue to grow crops and graze domestic animals inside the PA. Some villagers recognized that several animal populations disappeared from protected areas because of human pressure through uncontrolled hunting. Animals like buffaloes, antelopes, lions, and elephants are no longer extant in the area, as historical populations have diminished. Forest species such as *Vitelleria paradoxa*, Anogeissus*, Terminalia lactiflora* are present while Khaya, Pterocarpus, *Accacia albiob*, *Deterium microcarpum*, G*ardenia termifolium* disappeared from the area. Farmers have argued that some factors, such as bush fires and tree logging, have been contributing to climate change, and seasons come late or earlier between years. At the time the survey was conducted, no effective structure or proactive management system existed. The past reductionist view management approach of PA from the policymakers has resulted in conflicts and distrust arising from the local population.

In the protected area of Togodo North, there is a high richness of plant and animal diversity. Tree species such as *Ciba pentandra*, *Milicia excelsa*, *Pterocarpus*, *Afzelia africana*, *Diospyros mespiloformis* are present in the PA. Many young people feel disenfranchised from the management of this diverse and species-rich area.

In the Abdoulaye faunal reserve, villagers reported various issues with local wildlife. Many animals destroy crops, such as foxes, baboons. African elephants, which were very abundant in the past, are no longer extant. Farms continue to expand at the expense of the reserve area, causing a lack of appropriate wildlife habitat and subsequent movement over the boundaries to the Benin Republic. The forest resources found are mainly Pterocarpus and Anogeissus. Resource use comprises firewood, charcoal, and timber. Many honey producers recognized a decrease in the honey harvest, which is an important activity that benefits the local populations of the reserve. Effective implementation of sustainable management plans of this rich and useful area for animal biodiversity conservation and the surrounding populations' needs would be of great importance.

The contradiction between terrestrial protected areas increasing and the savannahs and forests decreasing demonstrates the challenge of strategizing the protected areas. The conception of management regulations for protected areas is very important, but not sufficient without PA models suitable for each area. Indeed, results Oti-Keran National Park in the north showed that there were anthropogenic settlements in the PA coupled to farming activities and hunting, and these observations also exist in the south part of the country in Abdoulaye fauna reserve and Togodo national reserve.

3.4. System-Based Concept/Model of Protected Area

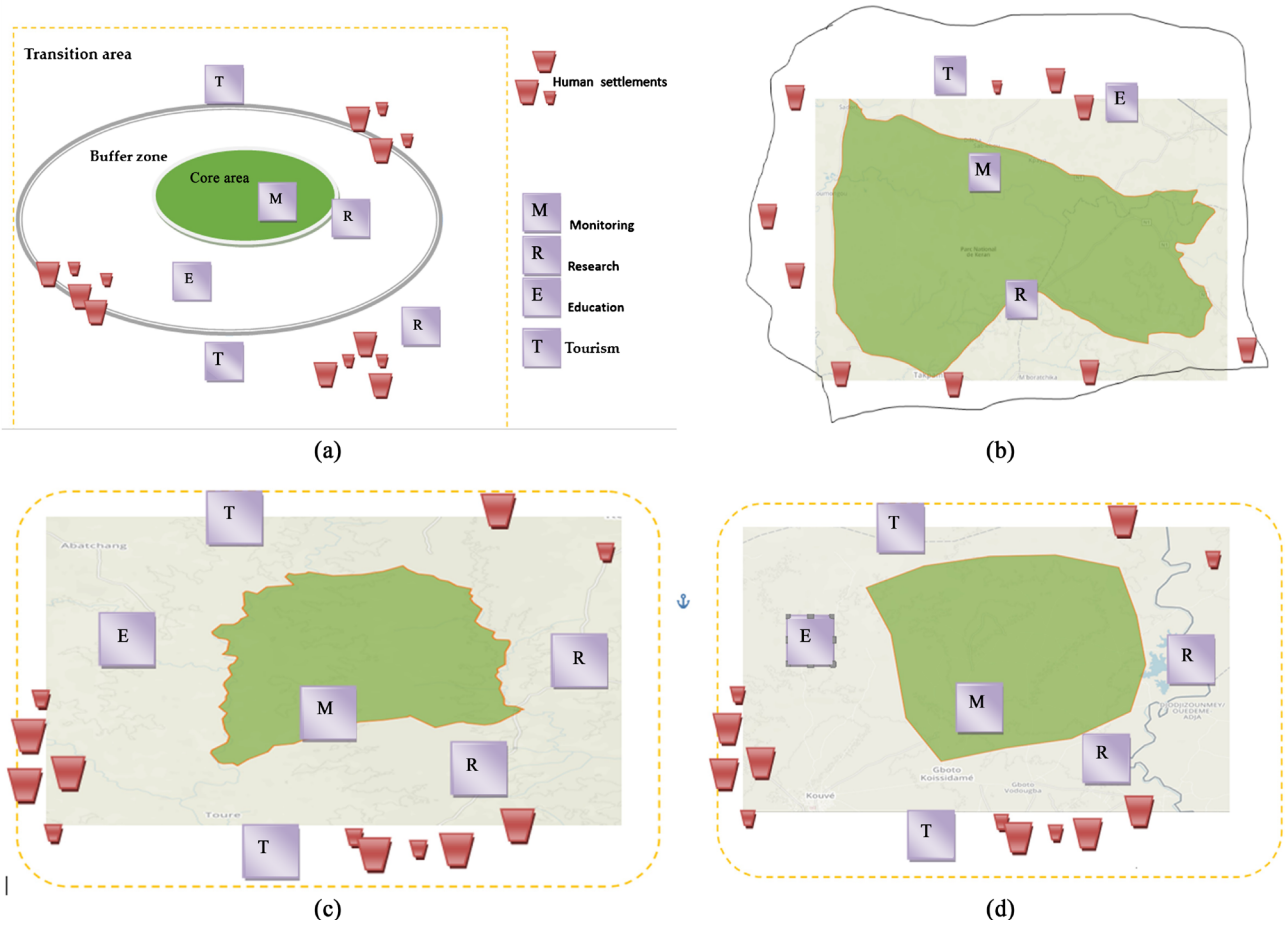


Figure 6. The system based conception of protected areas in Togo reconciles the protection of nature with human settlements. The traditional concepts of "protected areas" have been unable to accommodate human settlements without interruption of biological diversity conservation. The PA was not divided before into three-parts managed under this model. In these three protected areas, only the core area was previously designated a protected area for long-run biodiversity conservation and lacked any structured zonation to accommodate the wider needs of the population. (a) Conceptual Model; (b) Applied to Oti-Keran National Park; (c) Applied to Abdoulaye faunal reserve; (d) Applied to Togodo reserve.

4. Discussion

At the national level, trends in driving factors showed that while terrestrial protected areas are increasing, forest and savannah land covers are decreasing alarmingly. This contrast showed that the implementation of a protected area strategy encounters some difficulties especially in the management process and system. The Togolese government's efforts to protect biodiversity showed remarkable growth and multiplication of protected areas in Togo since 2000 (Figure 1) with positive trends in the equation reflecting this parameter increase. However, these efforts have not prevented certain protected areas from being subjected to strong socio-economic pressure. Indeed, it has been insufficient to focus solely on avoiding biodiversity losses as the protected area strategy, where proactive measures are necessary to confront the needs of the local population and their vulnerability.

Therefore, faced with the degradation of plant and animal biodiversity and

compounding environmental problems, protected areas appear as an all-terrain solution adopted by several countries. Their effectiveness is not the same everywhere as previously implemented. This analysis has shown that despite the status of classified areas, the protected areas suffer the same degradation as all other forests due to uncontrolled tree logging for timber production by the surrounding local population. If the status of the PA cannot preserve the environment from degradation, then effective interventions can confront any local population misunderstandings about the purpose of the protected area and also address improvements to the management plan that reduce the protected area into the core area only. A reductionist view of protected areas should be replaced by a model which will reduce conflicts between man and nature. Protected areas can aim to provide all the needs of the human population while maintaining diverse species richness if the Viable Strategy Approach is implemented [33]. A protected area would be effectively benefiting both the officials and the local population if the PA satisfies the triple basic needs of sustainable management, including social, economic and environmental, in such a way that the resources remain available from generation to generation through sustainable use. For example, since the local economy bases sales and income from agriculture and the wood products, then if these were extracted primarily from protected areas, this situation would be normal and non-antagonist. If protected areas divided into areas able to satisfy agricultural and other anthropogenic needs and managed on a system-based approach, then it would bring integrated activities such as education, monitoring, research and any human settlements in a useful circle (**Figure 2** and **Figure 6**). These findings were not consistent with the work of [34] on the OTA which found that agricultural activities were the main drivers of forest ecosystem degradation around a protected area. This research shows that agriculture was not planned to take place in the buffer zone, and was absent from the management plan that had conceptually opposed agriculture encroaching the protected area. In previous research, in the OTA national parks, many think that tree logging and hunting are illegal activities without proving the legitimacy of these activities, which helped those populations to survive from generation to generation. Thus, the zonation of the PA attempt to mitigate the challenge of local populations' opinion of a PA as restricted or otherwise hostile to man's freedom to benefit nature's services freely.

In these villages surrounding a protected area, the population depends on farming and forest resource use. No other professional activities nor governmental financial support or subsidies in the form of economic incentives are available to the local population to mitigate these problems. These findings are also consistent with the results found by previously in the Rumpi Hill in Cameroon. Social factors and lack of structured government programs seriously impact the natural resources despite the effective implementation of a protected areas strategy. These examples testify for the need to redefine the "notion" of a protected area (PA), which should not be perceived as a "forbidden area" ruled

strongly as a gold mine. The PA should be able to be divided and managed synergistically to benefit both local populations and as non-local people, such as academic workers, tourists and officials, based on the principle of sustainable use and renewal of the zoned PA. Indeed, sustainable development stands in the background of the present generation to meet basic needs without forgetting the future generation. The present generation's basic needs should be satisfied before planning for the future. As long as the present generation's basic needs are in jeopardy, then it is impossible to think of future sustainability. Moreover, for [35] in 1998, the "triple bottom line principle" of sustainability requires three pillars; economic (profit), social (people) and environmental (planet) to sustain any PA's aim to be a model of sustainability.

Many researchers think that local government policies are inefficient in classified forest management for African regions, especially West Africa. Policies lack economic facilities to put regulations into action that would alternatively stimulate the economy in the region, and consequently, these protected areas management policies lack cooperation with the local population. Unaddressed social needs become the drivers that negatively impact vegetation coverage and the biodiversity in and around a protected area. The biggest challenge of PA resource management is not only the absence of concrete regulations to account for the basic needs of the surrounding population but their understanding and total participation in the protected area management process [36]. Henceforth, the community management strategy can be developed in these protected areas to find a suitable period to enjoy the resources wisely and to renew them for the achievement of sustainable management principles.

In many protected areas, researchers have shown that the management rules and enforcement are nearly absent, thus inadvertently permitting the uncontrolled access of the surrounding populations to natural resources, especially forests or faunas. In Togo, for example, Law No. 2008-009 of June 2008 provides for provisions concerning the forest regime, testifying to the desire of the Togolese government to involve, at all stages, local governments in the process of setting up and managing sustainable-use forest and animal resources [37]. Thus, despite the insufficiency of the efforts of the Togolese local authorities to preserve the ecosystems for the well-being of the current and future generations, these efforts are promoted and encouraged by the national government. It is therefore imperative to be part of the logic of multi-scale sustainable development principles, the most basic of which involve participatory or community management to take into account the different socio-economic and environmental needs of the local area and the mutual sharing of the services provided by the PA.

The principles established within a protected area are derived from the specific goals and reasons for implementation. Setting limits to avoid using any resources has been a popular strategy in many countries and areas, and serves as a method to perpetuate the existence of natural resources. Natural resources

should be available not only for the present generation but also for the future ones; therefore, this is the foundation of sustainable management. The reason why an area establishes boundaries was originally only for plants, animals, or biodiversity purposes. As this goal is facing real challenges related to the supply of ecosystem services to supply basic human needs, then policymakers realized that this paradigm of focusing only on biodiversity preservation was not effective. Thus, the concept of protecting nature and profiting wisely from it becomes unavoidable for a balanced supply of ecosystem services and also for biodiversity preservation. This equilibrium becomes the solution for the survival of the protected area and is based on the background of sustainable principles. PA should reconcile man with nature through new viable management approaches based on the zonation of these protected areas, as suggested by UNESCO. These models are consistent with those used by [38] [39] in tropical forests.

The Biosphere and Man concept includes the principle of integrated protected areas that are managed sustainably without contradiction or exclusion of human settlements and accompanying activities such as education, monitoring, research, and tourism in the limits of the PA. Those who reject ideology for the inclusion of protected areas towards progressive openness to the public will continue to face challenges and conflicts between natural resources conservation and fundamental anthropogenic land cover change and disturbances. The protected area does not belong only to the local people living locally, as it is a model of sustainable development that seeks to harmonize biodiversity conservation and anthropogenic needs. Alignment with sustainable development is a long process with many uncertainties, although, when managed with the wisdom of sustainability clearly defined, then it becomes understandable and accepted by all the actors involved in the management from the beginning to the end. Moreover, many previous studies on the topic of PA in Togo pointed out that anthropogenic pressure due to socio-economic and political troubles consequences as serious drivers of PA resources degradation [40] [41]. Therefore, monitoring unavoidable activities such as agriculture to be predicted and previewed for integration into the management process by dividing the PA into different areas that supply several services for a peaceful and symbiotic relationship between PAs and residents. It also remains important that sustainability is understood and accepted by all the actors involved in the PA management process to reverse the reductionist concept of PA through educational awareness and promotion.

5. Conclusion

The observation of national socio-economic and environmental factors in Togo highlighted the contradiction of an uptrend in the area of designated terrestrial protected areas along with a downward trend indicating forest and savannahs area loss. These findings displayed the fact that, at the local level, protected areas are suffering the pressure of anthropogenic activities at the expense of the natural resources. The key to address this challenge efficiently dwells in management

choices should not embrace the traditional reductionist view of a protected area that creates restricted or forbidden areas, and instead implement a Viable Strategy Approach based on the integration of education, research, human settlements, agriculture, and monitoring activities in the three parts of the PA for practical achievement of sustainable development.

Acknowledgements

This research was funded by the International Science & Technology cooperation Programme of China (2015DFR31130) and the National Natural Science Foundation of China (31670715; 41471029; 41371500). We are also grateful to the Chinese and Togolese Government for the cooperation scholarship and to my Supervisors for their generous help in the field investigation and English improvement during this research.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Gardner, T.A., Barlow, J., Chazdon, R., Ewers, R.M., Harvey, C.A., Peres, C.A. and Sodhi, N.S. (2009) Prospects for Tropical Forest Biodiversity in a Human-Modified World. *Ecology Letters*, **12**, 561-582. https://doi.org/10.1111/j.1461-0248.2009.01294.x

[2] Kimengsi, J. and Lambi, C. (2015) Pamol Plantations Plc: Prelude to a Looming Population Problem in Ekondo-Titi Sub-Division, the Southwest Region of Cameroon. *Journal of Sustainable Development in Africa*, **17**, 79-95.

[3] Kokou, K., Natta, A., Adjonou, K. and Kokutse, A.D. (2012) Ecological and Socioeconomic Stakes for Conserving and Protecting Riparian Forests in the Dahomey Gap (West Africa). In: Karem, A. and Har-Even, H., Eds., *Riparian Zones: Protection, Restoration and Ecological Benefits. Environment Remediation Technologies, Regulations and Safety*, Nova Science Publishers, New York, 63-98.

[4] Achard, F., Eva, H.D., Stibig, H.J., Mayaux, P., Gallego, J., Richards, T. and Malingreau, J.P. (2002) Determination of Deforestation Rates of the World's Human Tropical Forests. *Science*, **297**, 999-1002. https://doi.org/10.1126/science.1070656

[5] Eva, H.D. and Lambin, E.F. (1998) Remote Sensing of Biomass Burning in Tropical Regions: Sampling Issues and Multisensor Approach. *Remote Sensing of Environment*, **64**, 292-315. https://doi.org/10.1016/S0034-4257(98)00006-6

[6] Beckline, M., Yujun, S., Etongo, D., Saeed, S. and Mannan, A. (2018) Assessing the Drivers of Land-Use Change in the Rumpi Hills Forest Protected Area, Cameroon. *Journal of Sustainable Forestry*, **37**, 592-618. https://doi.org/10.1080/10549811.2018.1449121

[7] Palumbo, I., Grégoire, J.-M., Boschetti, L. and Eva, H. (2003) Fire Regimes in Protected Areas of Sub-Saharan.

[8] Fandjinou, K., Folega, F., Wala, K., Batawila, K., Akpagana, K. and Zhang, K. (2016) Efficiency of an Artificial Fencing Method for Combating Desertification in the Northwest of China, the Case of Yanchi County of Ningxia Hui Autonomous Re-

gion. *Nature Environment and Pollution Technology*: *An International Quarterly Scientific Journal*, **15**, 355-363.

[9] WCMC World Conservation Monitoring Centre (2011) World Database on Protected Areas. WCMC, Cambridge.

[10] Adams, W.M. and Hulme, D. (2001) If Community Conservation Is the Answer in Africa, What Is the Question? *Oryx*, **35**, 193-200. https://doi.org/10.1046/j.1365-3008.2001.00183.x

[11] Badameli, A. and Dubreuil, V. (2015) Diagnostic du changement Climatique au TOGO à travers l'évolution de la température entre 1961 et 2010-XXVIIIe Colloque de l'Association Internationale de Climatologie, Liège 2015. https://www.researchgate.net/publication/280646780

[12] Cuthbert, R. (2010) Sustainability of Hunting, Population Densities, and Intrinsic Rates of Increase and Conservation of Papua New Guinean Mammals: A Quantitative Review. *Biological Conservation*, **143**, 1850-1859. https://doi.org/10.1016/j.biocon.2010.04.005

[13] Holmern, T. (2003) Human-Wildlife Conflicts and Hunting in the Western Serengeti, Tanzania. Norwegian Institute for Nature Research, Trondheim.

[14] Oli, K.P., Chaudhary, S. and Sharma, U.R. (2013) Are Governance and Management Effective within Protected Areas of the Kanchenjunga Landscape (Bhutan, India, and Nepal). *Parks*, **19**, 25-36. https://doi.org/10.2305/IUCN.CH.2013.PARKS-19-1.KPO.en

[15] Shahabuddin, G. and Rao, M. (2010) Do Community-Conserved Areas Effectively Conserve Biological Diversity, Global Insights, and the Indian Context. *Biological Conservation*, **143**, 2926-2936. https://doi.org/10.1016/j.biocon.2010.04.040

[16] Ogra, M.V. (2012) Gender and Community-Oriented Wildlife Conservation: Views from Project Supervisors in India. *Environment*, *Development and Sustainability*, **14**, 407-424. https://doi.org/10.1007/s10668-011-9332-6

[17] De Boer, W.F. and Baquete, D.S. (1998) Natural Resource Use, Crop Damage, and Attitudes of Rural People in the Vicinity of the Maputo Elephant Reserve, Mozambique. *Environmental Conservation*, **25**, 208-218. https://doi.org/10.1017/S0376892998000265

[18] Dudley, N. (2009) Why Is Biodiversity Conservation Important in Protected Landscapes? *George Wright Forum*, **26**, 31-38.

[19] Wilshusen, P., Brechin, S., Fortwangler, C. and West, P. (2002) Réinventer une roue carrée: Critique d'un "paradigm" de protection renaissant dans la conservation internationale de la biodiversité. *Société et Ressources Naturelles*, **15**, 17-40. https://doi.org/10.1080/089419202317174002

[20] Falkanger, T. (2009) Allmenningsrett. Universitetsforlaget.

[21] Fauchald, O.K. and Gulbrandsen, L.H. (2012) The Norwegian Reform of Protected Area Management a Grand Experiment with Delegation of Authority? *Local Environment*, **17**, 203-222. https://doi.org/10.1080/13549839.2012.660910

[22] Nelson, F. and Agrawal, A. (2008) Patronage or Participation? Community-Based Natural Resource Management Reform in Sub-Saharan Africa. *Development and Change*, **39**, 557-585. https://doi.org/10.1111/j.1467-7660.2008.00496.x

[23] Suich, H. (2008) Tourism in Transfrontier Conservation Areas: The Kavango-Zambezi TFCA. In: Spenceley, A., Ed., *Responsible Tourism*: *Critical Issues for Conservation and Development*, Earthscan, London, 187-205.

[24] Kokou, K., Nuto, Y. and Atsri, H. (2009) Impact of Charcoal Production on Woody

Plant Species in West Africa: A Case Study in Togo. *Scientific Research and Essay*, **4**, 881-893.

[25] Diwediga, B., Wala, K., Folega, F., Dourma, M., Woegan, Y.A., Akpagana, K. and Le, Q.B. (2015) Biophysical and Anthropogenous Determinants of Landscape Patterns and Degradation of Plant Communities in Mo Hilly Basin (Togo). *Ecological Engineering*, **85**, 132-143.

[26] UICN/PACO (2008) Evaluation of Effectiveness Management of Protected Areas: Protected Areas in Togo.

[27] Akpagana, K. and Guelly, A.K. (1994) Nouvelles espèces d'Angiospermes pour la flore du Togo. *Acta Botanica Gallica*, **141**, 781-787. https://doi.org/10.1080/12538078.1994.10515237

[28] Brunel, J.F., Hiekpo, P. and Scholz, H. (1984) La flore analytique du Togo: Phanérogames. https://doi.org/10.2307/3776742

[29] Folega, F., Zhang, C.Y., Wala, K., Zhao, X.H. and Akpagana, K. (2011) Wooded Vegetation of Protected Areas in Northern Togo. Case of Barkoissi, Galangashi, and Oti-Keran: Ecological and Structure Analysis of Plant Communities. *Forestry Studies in China*, **13**, 23-35. https://doi.org/10.1007/s11632-011-0105-y

[30] Prins, C. (1996) Comparaison d'algorithmes de plus courts chemins sur des graphes routiers de grande taille. *RAIRO Operational Research*, **30**, 333-357. https://www.numdam.org/item?Id=RO_1996__30_4_333_0 https://doi.org/10.1051/ro/1996300403331

[31] United Nations Educational, Scientific, and Cultural Organization (UNESCO) (2018) Man & the Biosphere (MaB). An Integrated Zonation Systems. http://webarchive.unesco.org/20161030223131/http://portal.unesco.org/geography/en/ev.php-URL_ID=8763&URL_DO=DO_TOPIC&URL_SECTION=201.html

[32] Helsel, D.R. and Hirsch, R.M. (1992) Statistical Methods in Water Resources. Studies in Environmental Science Vol. 49, Elsevier, New York.

[33] Agbessi, K.G.E., Ouedraogo, M., Camara, M., Ségniagbéto, H., Houngbédji, M.B. and Kabré, A.T. (2017) Distribution spatiale du singe à ventre rouge, Cercopithecuserythrogastererythrogaster Gray et lesmenaces pesant sur sa conservation. *International Journal of Biological and Chemical Sciences*, **11**, 157-173. https://doi.org/10.4314/ijbcs.v11i1.13

[34] Tietenberg, T. and Lewis, L. (2009) Environmental Economics & Policy. 6th Edition, Pearson Education, Upper Saddle River.

[35] Elkington, J. (1998) Cannibals with Forks: The Triple Bottom Line of 21st-Century Business. New Society, Philadelphia. https://doi.org/10.1002/tqem.3310080106

[36] Ashley, R. and Mbile, P. (2005) The Policy Terrain in Protected Area Landscapes: How Laws and Institutions Affect Conservation, Livelihoods, and Agroforestry in the Landscapes Surrounding Campo Ma'an National Park and the Dja Biosphere Reserve, Cameroon. World Agroforestry Centre, Tropical Resources Institute of Yale University, and the University of Georgia.

[37] Atakpama, W., Asseki, E., Kpemessi, E.A., Koudegna, C., Batawila, K. and Akpagana, K. (2018) Importance socio-économique de la forêt communautaire d'Edouwossi-copé dans la préfecture d'Amou au Togo-Rev. *Revue Marocaine des Sciences Agronomiques et Vétérinaires*, **6**, 55-63.

[38] Newnham, R.M. (1964) The Development of a Stand Model for Douglas-Fir. PhD Thesis, Faculty of Forestry, University of British Columbia, Vancouver.

[39] Usher, M.B. (1966) A Matrix Approach to the Management of Renewable Re-

sources, with Special Reference to the Selection Forests. *Journal of Applied Ecology*, **3**, 355-367. https://doi.org/10.2307/2401258

[40] Folega, F., Dourma, M., Wala, K., Batawila, K., Zhang, C.Y., Zhao, X.H. and Koffi, A. (2012) Assessment and Impact of Anthropogenic Disturbances in Protected Areas of Northern Togo. *Forestry Studies in China*, **14**, 216-223. https://doi.org/10.1007/s11632-012-0308-x

[41] Smallwood, K.S. (2015) Habitat Fragmentation and Corridors. In: Morrison, M.L. and Mathewson, H.A., Eds., *Wildlife Habitat Conservation*: *Concepts*, *Challenges*, *and Solutions*, Johns Hopkins University Press, Baltimore, 84-101.

Appendix

Table A1. The villager's factors that explained the dependencies on forest resources. Because of no alternative energy source, the Protected area resources represent the main impacting factors that influence the natural resources by 76.9% of the interviewed villagers in the OTA national parks.

Socio-economic factors		Number of responses per administrative sub-division (%)									Total response (%)
		Oti-Keran			Abdoulaye Fauna Reserve			Togodo Reserve			
		Sadori	Sagbiegou	Pesside	Goubi	Djamdi Mono	Agbalawiliga	Agbawiliga	Tomety Kondji	Aketekui	
Settlements	Yes	79.5	77.5	89.7	80	73	77	79	81.5	55	76.9
	No	20.5	22.5	10.3	20	27	23	21	18.5	45	23.1
No hunting	Yes	87	73.4	79.5	50	40	39.9	41.1	27.6	21	52.8
	No	13	26.6	20.5	50	60	60.1	58.9	62.4	79	47.8
No fences	Yes	88.3	19.3	75.8	19.8	40	23	67	21	75	47.7
	No	11.7	80.7	24.2	80.2	60	77	33	79	25	52.3