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Analysis of the links between climate change,
protected areas and communities in West Africa



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Acronyms and Abbreviations

ACMAD	Centre Africain pour les Applications de la Météorologie au Développement
AfGF	Fonds vert pour l'Afrique
AP	Aire Protégée
BAD	Banque africaine de développement
CCAP	Plan d'action sur le changement climatique
CC	Changement Climatique
CCNUCC	Convention-cadre des Nations Unies sur les changements climatiques
CDB	Convention sur la diversité biologique
CEA	Commission Économique pour l'Afrique
CEDEAO	Communauté Économique des États d'Afrique de l'Ouest
CILSS	Comité permanent Inter-États de Lutte contre la Sécheresse dans le Sahel
ECOWAP	Politique Agricole de la CEDEAO
ECOWEP	Politique environnementale de la CEDEAO
FEM	Fonds pour l'environnement mondial
GES	Gaz à effet de serre
GIEC/IPCC	Groupe d'experts intergouvernemental sur l'évolution du Climat/Intergovernmental Panel on Climate Change
IFAD/FIDA	International Fund for Agricultural Development/Fonds africain pour le développement agricole
ONG	Organisation non gouvernementale
PANA/NAPA	Programme d'action national pour l'adaptation / National Adaptation Programme of Action
PARCC	Aires Protégées Résilientes au Changement Climatique (projet)
PASR-AO/CCD	Programme d'action sous-régional de lutte contre la desertification en Afrique de l'Ouest et au Tchad
PAU-UEMOA	Politique Agricole de l'Union Economique et Monétaire Ouest africaine
PIB	Produit intérieur brut
PFNL	Produits forestiers non ligneux
SAWAP	Sahel and West Africa Programme
MERF	Ministère de l'Environnement et des Ressources Forestières (Togo)
METT	Management Effectiveness Tracking Tool
NEA	National Environment Agency (Gambie)
UICN	Union Internationale pour la Conservation de la nature
WAP	Complexe W-Arly-Pendjari
WDPA	Base de données mondiales sur les aires protégées

Executive Summary

This study seeks to analyse the links that exist between climate change, protected areas and communities in West Africa, in particular the following countries: The Gambia, Mali, Sierra Leone, Chad and Togo. It was carried out as part of the Protected Areas Resilient to Climate Change (PARCC) project, funded by the Global Environment Fund (GEF). The project aims to improve protected area networks' resilience to the impact of climate change in the region. The study was mainly based on the results from initial national studies on this issue, but also drew on a literature review. It aims to analyse the complex relationship between protected areas, local communities and climate change, thus contributing to improving knowledge on how these are linked. Very little work has been carried out on these issues so the national studies were based on both a literature review and the perceptions of the local communities consulted.

Protected areas in West Africa and the five aforementioned countries in particular, are subject to considerable pressure, principally caused by human activity (poaching, over-use, fires etc.). Their habitat is deteriorating and changing and the wildlife populations are gradually diminishing. Protected areas are becoming increasingly vulnerable, particularly to the effects of climate change, as are the surrounding ecosystems.

This study shows that these ecosystems are used by the people living in the vicinity of protected areas. Indeed, in all five countries the most important activities identified around protected areas are agriculture, livestock farming, fishing and logging (timber and non-timber forest products). These activities depend highly on the climate for optimal development. The main climate hazards identified by the local communities and in the literature review (drought, flooding, strong winds, and irregular rainfall) have an impact both on their livelihoods and on their well-being. A loss of the animal and plant biodiversity used by the communities, a reduction in grazing land, a drop in crop yields and animal production, a drop in household income, food insecurity, deterioration of community health and in general an increase in poverty have all been noted.

The study shows that as a result, resources located within conservation zones are becoming more attractive as those outside protected areas no longer suffice to meet the communities' needs. The communities could thus, in turn, have a negative impact on protected areas due to the effects of climate change. Indeed, incursions into protected areas for poaching, to find grazing land, new fields and non-timber forest projects have been noted (IUCN/PACO, 2011).

The relationship between climate change, protected areas and the people living around them is nonetheless not yet very well understood by researchers, protected area managers, local populations and political decision makers. Much effort in terms of research, awareness-raising and information is still needed. Action plans and programmes have already been implemented in the countries and at a regional level to help communities to adapt. However these plans do not take into account how these three elements are related; the same can be said of existing national climate change policies. Efforts need to be made to reduce the negative effects of the relationships between protected areas, local communities and climate change.

To do this, five recommendations concerning the different stakeholders in protected area management have been made in order to better understand these relationships and implement appropriate actions:

1. Researchers should develop the appropriate tools for collecting and analysing data to highlight the relationships between protected areas, local communities and climate change,

2. Protected area managers should set up inclusive, climate change-related systems to monitor protected area biodiversity,
3. Protected area managers should step up actions to raise awareness regarding the direct and indirect effects of climate change among local communities,
4. Donors should improve the capacity of protected area managers and representatives of affected communities to use climate change adaptation planning and monitoring and evaluation tools,
5. Public authorities should develop integrated climate change adaptation and protected area management policies

1. Introduction

Africa is considered to be the region that is most vulnerable to the effects of climate change in the world due to the fragility of its economies (IPCC, 2005). However, it is very difficult to assess what the scope and nature of these changes will be in the future. Global climate models are relatively poorly suited to predicting changes in temperature and rainfall in Africa because on the one hand there is still a lack of knowledge: indeed many models do not represent the complexity of the African monsoon, particularly as regards West Africa (Cook and Vizi, 2006; Rutti et al., 2011); and on the other hand, global models do not take into account regional particularities. In its latest report, the Intergovernmental Panel on Climate Change (IPCC, 2005) confirmed that global warming will be more intense in Africa than in the rest of the world. The average rise in temperature between 1980/99 and 2080/99 is predicted to be between 3°C and 4°C for the continent as a whole; 1.5 times higher than on a global level. The rise would be less marked in coastal and equatorial regions (+3°C) and the greatest increase would be in the region west of the Sahara (+4°C). Furthermore, there was a substantial reduction in rainfall in West Africa in the second half of the 20th Century, with a clear break between 1968 and 1972 (OECD, 2009). Whatever the level of current knowledge regarding the scope and nature of climate change impacts in West Africa, it is clear that the region will not only have to deal with these changes but also with the uncertainty associated with climate models.

The uncertainty is linked to the fact that we still do not know exactly how climate parameters will evolve, because models may highlight insignificant changes. Climate uncertainty poses serious problems for the conservation of nature and natural resources as well as for development. In terms of development, the economies of West African countries remain dominated by the exploitation of natural resources. Indeed, farming still represents almost 25% to 30% of the gross domestic product of West African countries and employs between 50 and 90% of the population depending on the country (Jalloh et al., 2010). However, IPCC scenarios (Boko et al., 2007) indicate that the growing season in the Sahel and Sudano-sahelian zones could shrink by 20% by 2050. In terms of conserving nature and natural resources, the influence of climate change on people's livelihoods will have repercussions on how these resources are used. Whether these resources are located within biodiversity conservation areas or not, an increase of anthropic pressure on natural resources is to be feared.

In particular, most protected areas in West Africa are still overflowing with abundant, high-quality natural resources and may be the subject of considerable interest when resources outside protected areas are no longer sufficient to meet the population's needs. There are many protected areas in West Africa set up before climate change was identified as a challenge for sustainable development and the conservation of biodiversity. This raises several questions as to the survival of protected areas and their biological diversity, but also that of the local communities in the context of climate change. This report attempts to begin to answer the following questions:

- What are the effects of climate change on protected areas?
- What are the effects of climate change on the community in general and those located around protected areas in particular?
- What are the current relationships that exist between communities and protected areas and how will these change in light of predicted climate change?

The answers to these questions will help to improve how protected areas are managed while fostering the well-being of the local communities over time. However, very little research has been carried out on these issues. It is becoming critical to document the relationship between climate change, protected areas and local communities.

2. Methodology

This regional summary was carried out as part of the PARCC West Africa project based on five national (The Gambia, Mali, Chad, Togo and Sierra Leone) studies of the relationship between protected areas, climate change and local communities. The methodology used for the five national studies included a literature review and structured interviews with local inhabitants around a sample number of protected areas in each country to assess their understanding of climate change as well as their perceptions of it and how it relates to protected areas and their livelihoods. Interviews were also conducted with experts from the government and non-governmental organisations.

The results presented in the five national reports vary from one country to the next due to differences in the techniques and methodological approaches used to collect the data. Therefore the national reports were analysed using the analysis framework presented in Appendix I. This framework helped to highlight where key information on relationships between climate change, protected areas and local communities could be found in the national reports. It also facilitated the identification of gaps in these reports. These gaps were filled by the literature review also carried out for this report. This review aimed to obtain data on the countries covered by the national reports as well as on the West African region in terms of protected areas and how they are managed, the socio-economic situation, climate hazards and their impacts as described in national climate change adaptation action plans.

Therefore an additional bibliographical review of policies was carried out to see on the one hand if climate change adaptation policies take into account protected areas and on the other if protected area policies include climate change adaptation. The propositional analysis technique (Bardin, 1988) was used in order to ascertain the attitudes of political decision makers with regard to taking climate change into account in protected area management as presented in policy documents. An analysis of the priority actions identified in national adaptation action plans highlighted the weaknesses as regards the consideration of protected areas.

Recommendations have been made to fill these gaps and render protected areas and local communities more resilient to climate change.

3. Analysis of the trinomial climate change-protected area-socio-economic relationship

3.1. Overview of climate change in West Africa

West Africa has been known for its droughts since the 1970s (African Studies Center, 1999). According to the African Studies Center (1999), climate variability is the most significant problem for West African populations, whether at local, national or regional level. In particular, in marginal areas such as the Sahara desert, the Sahel and Africa's sub-tropical zone, difficulties linked to rainfall forecasts pose a significant threat to food security, leading each year to localised and sometimes more widespread food crises. Rainfall variability, defined as the deviation from the mean, is considerable and often reaches 40-80% (African Studies Center, 1999). Associated with other factors, recurrent droughts in West African countries also have repercussions on people's livelihoods. Generally speaking, climate change is both a threat and a challenge facing West African countries in years to come (Jalloh et al. 2010), however there are slight nuances between countries depending on the climate hazards they face and their agro-ecological location. For example, rising sea levels only affect coastal countries.

In **The Gambia**, the national climate change adaptation action plan (The Gambia, 2007) reports a drastic drop in rainfall since the 1940s. The proportion of the country which receives less than 800mm of rain per year has risen from 36% to 93% since 1965. Temperatures have increased by an average of 0.4°C over the same period. The main climate hazards identified at national level, including in areas where there are protected areas include: torrential rains, storms, droughts, cold snaps, intra-seasonal droughts, heatwaves, unseasonal rainfall and rising sea levels. The risks associated with these climate hazards include the limited capacity to predict when they will occur and their potential impact.

Mali has a Sahelian climate, characterised by great inter-annual rainfall variability, leading to recurrent dry years which have become increasingly frequent since 1968 (Ministry of Infrastructure and Transport, 2007). Rainfall is very irregular both over time and space, varying from less than 100mm per year in the North to more than 1,200mm per year in the South. Four types of climate can be identified: a Saharan climate (dry) in the North (annual rainfall <200mm), Sahelian in the centre (annual rainfall of between 200 and 600mm), Sudanian (annual rainfall of between 600 and 1000mm) and Sudano-Guinean in the south (rainfall >1000mm). The main climate hazards identified are: drought, flooding, strong winds and great temperature variations (Dramé, 2013).

In **Togo**, climate change models predict an increase in average monthly temperatures along a south-north gradient of 1.00°C to 1.25°C (Ministry of the Environment and Forestry Resources, 2009). As regards rainfall, forecasts indicate a drop of between 0% and 0.80% according to the isohyets extending from the north-west to the south-east. The most affected areas will be the southern half of the country (Maritime region and Plateaux) while the north-eastern horn of the country (around 15% of the land area) will experience a slight increase in rainfall from 0% to 0.60% with an inverse gradient: the north-east will have more rainfall than the north west. The warming of Togo's climate will go hand in hand with a dryer climate. The major climate hazards identified are drought, flooding, uneven rainfall distribution, late rainy seasons, violent winds and coastal erosion for the ecosystem of the coastal zone (Ministry of the Environment and Forestry Resources, 2009). At a local level, communities living around the protected areas studied identified the following climate hazards: insufficient and irregular rainfall, heat waves, violent winds and droughts (Guelly and Segniabeto, 2013).

In **Chad**, according to studies carried out in the context of the national adaptation action programme (Ministry of the Environment, Water and Fisheries, 2010), rainfall distribution overall is undergoing an increase in inter- and intra-annual climate variability. This is shown in a drop of around 200mm per year in average maximum rainfall between 1960 and 1990 (Bekayo, 1999) and a shifting of isohyets from north to south. To this can be added spatio-temporal irregularities. An analysis of the changes in temperature indexes shows a small increase in maximum temperatures whereas minimum temperatures have changed considerably. Several climate hazards have been identified: heavy rainfall, drought, flooding, heatwaves, violent winds and cold snaps (Boulanodji, 2014).

In **Sierra Leone**, studies on climate change (Ministry of transport and aviation, 2007) have shown that rainfall and temperature are both changing. According to simulations using global models, the average temperature for the period from 1961 to 1990 should increase by around 7% to 9% by 2100. These models also predict a reduction in rainfall of around 3% and 10% for monthly and annual averages respectively. The upward trend in temperatures, combined with the downward trend in rainfall, suggests that Sierra Leone will experience recurring periods of drought in coming years. Thus Sierra Leone faces a variety of climate hazards which include drought, strong winds, landslides, heatwaves, flooding, heavy rainfall and a reduction in rainfall (Conteh, 2014).

The five countries studied are representative of West Africa in terms of climate change. The same climate hazards are recorded in all West African countries with varying degrees of severity depending on the individual countries' agro-ecological conditions. For example, the continental countries of West Africa, which include Mali and Chad are more severely affected by drought than the coastal countries (Togo, Sierra Leone and The Gambia). Major climatic changes are predicted for the future climate of West Africa, with warming ranging from an average of +2°C to +6°C in 2100, and changes in rainfall that could cause the a temporal shift in the monsoon season (IPCC, 2007).

3.2. Overview of Protected Areas in West Africa

The IUCN defines a protected area as *a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values* (Dudley, 2008). This definition is recognised and used as a reference in many countries, including the countries covered by this study.

According to the world database on protected areas (IUCN, UNEP WCMC, 2014), there are more than 2,000 protected areas in West Africa (including Chad). However these data need to be continually updated. Terrestrial protected areas in West Africa represent around 8% of all protected land world-wide, and marine protected areas only 2.5%. this situation is far from Aichi Biodiversity Target 11 which aims to ensure at least 17% of terrestrial and inland water areas and 10% of marine and coastal areas are the subject of effective conservation measures.

Certain sites in the sub-region are recognised internationally (Ramsar, UNESCO-MAB, world heritage). However, not all the Ramsar recognised sites are necessarily protected areas according to the IUCN definition. Furthermore, some of these protected areas are on the UNESCO natural world heritage list: Taï National Park, Comoé National Park and Nimba Hills Natural Reserve (Ivory Coast), Nimba Hills Natural Reserve (Guinea), W National Park, Air and Ténéré Natural Reserves (Niger), Banc d'Arguin National Park (Mauritania) and Oiseaux du Djoudj National Park and Niokolo Koba National Park (Senegal).

West Africa is home to a great diversity of landscapes, including savannah, forest, mangroves, flood plains, deserts, lakes and oceans. The very varied ecosystems that are found across the region host a great diversity of flora and fauna. Thus the forests of upper Guinea constitute a very rich area with endemic species (Conservation International, 2013). The tropical forest of Gola in Sierra Leone, which is part of this area, was declared to be a national park by the Government of Sierra Leone in 2011, because it represents one of the last vestiges of the forests of upper Guinea in the country and is home to a large number of rare and endangered species both locally and world-wide. In Mali, the inland delta of the Niger River (Ramsar site) extends across more than 40,000 km² and constitutes one of the most remarkable ecological particularities of the country (Maiga, 2014). The populations of large mammals living in West Africa such as elephants have become vulnerable due to the destruction of their habitat and poaching. Now, the largest populations of elephants (around 4,500 individuals) are found within the WAP complex (European Commission, 2010). As for lions, a recent study shows that their number in West Africa is constantly decreasing and is now estimated at a mere 406 individuals (Henschel et al., 2014). Other species, such as rhinoceros have already disappeared from the sub-region¹.

There are also cross-border protected areas that have been or are soon to be officially established. These protected areas enable wildlife to move between two or more countries within a protected area, thus enabling a certain flow of genes to be maintained between the populations of a given species and thus ensure their survival. The cross-border protected area of Niimi-Saloum for instance between The Gambia and Senegal was formally established in 2008 in order to promote the conservation and participative management of the resources shared by these two countries. It is an area with Ramsar-classified estuaries containing a great diversity of fish. Between Chad and Cameroon the cross-border protected area of Sena Oura-Boubda Ndjidda was officially created in 2011 following a cooperation agreement between the two countries to manage the complex. The Sena Oura area constitutes one of the last little-disturbed Sudano-savannah ecological areas (Boulanodji, 2014). Its vegetation is that of wooded savannah with a great variety of flora. In Sierra Leone the *Greater Gola Transboundary Peace Park* which is currently being created, constitutes a good example of cross-border conservation with neighbouring Liberia, as it constitutes a biodiversity hot spot.

In terms of socio-economic importance, protected areas constitute a source of employment for local communities as they may find jobs as tour guides for instance or trackers. The resources in protected areas, particularly non-timber forest products (NTFP), are also a source of income for families (honey, shea butter etc.). Culturally, certain species of animal are used during ancestral rites in villages or during ceremonies (weddings, funerals etc.). The ecosystems of protected areas also provide other services such as regulating rainfall, protecting against strong winds, and providing raw materials such as timber for construction and firewood, fruit, seeds, animal fodder and medicinal substances.

This biodiversity, which holds major ecological and socio-economic significance for the people living in the countries of the region, is unfortunately subject to considerable pressure including for instance:

¹ <http://tempsreel.nouvelobs.com/monde/20111110.FAP7797/le-rhinoceros-noir-d-afrique-de-l-ouest-declare-eteint.html>

- Poaching: this exists in almost all protected areas; elephants when they are present are particularly sought-after for their tusks which supply the international ivory trade; the consumption of bush meat also causes poaching
- Illegal fishing
- Uncontrolled bush fires: these affect the whole of West Africa, including the countries studied; in The Gambia for instance, 12% of forests are ravaged by bush fires every two years (Camara, 2012)
- Illegal grazing of livestock by nomadic herds: very much the case in Mali and Chad
- Over-use of timber: to make charcoal and non-timber forest products (NTFP)
- Mining, particularly in Sierra Leone

The increase in demographic pressure, poor knowledge of and failure to obey the law, poverty and the settling of communities in protected areas, as is the case in protected areas in northern Togo, as well as climate change exacerbate these pressures.

3.3. Socio-economic activities of local communities around protected areas in West Africa

The socio-economic activities of communities living around protected areas are closely linked to the structure of the national economy. The economies in West African countries have been growing since 2005 at an average rate of 5% per year (UNECA, 2013). However, this situation masks several structural weaknesses, in particular a strong dependency on raw materials and climatic conditions. Despite these encouraging figures, the five project countries are characterised by wide-spread poverty which is omnipresent and predominant in rural areas (IFAD, 2010). Table 1 summarises the main economic indicators of the five countries studied.

Table 1: Some economic indicators from the five countries studied

Country	Population (x1000 inhbt)	Surface area (x 1000 km ²)	GDP (\$US/inhbt)	Annual GDP growth rate 2003-2011 (%)	Three largest export products
The Gambia	1,776	11	2,345	6.1	Cashew nut (20.3%), crude oil (14.9%), titanium ore and concentrate (11.2%).
Mali	15,840	1240	1,148	4.8	Cotton (35.7%), petroleum oils and bituminous liquids obtained (other than crude oils) and preparations (29.1%), sesame (7.8%)
Togo	6,155	57	966	3.1	Cocoa (26.7%), Gold (12.8%), cement clinker (10.1%)
Chad	11,525	1,284	2,155	10.1	Petroleum oils and crude bituminous liquids (80.6%), Petroleum oils and bituminous liquids obtained (other than crude oils) and preparations (8.6%)

Sierra Leone	5,997	72	896	6.4	Diamonds (26.9%), aluminium concentrates and ore (14.8%), cocoa (11.8%)
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Source: AfDB et al. (2012)

According to Jalloh et al. (2012), agriculture is the largest economic activity in West Africa, but farming conditions in the region are beset with challenges: farmers have to deal with irregular rainfall and soil degradation. West African farmers are generally speaking small-holders with limited access to inputs such as improved seeds and fertilisers. As farming in West Africa is reliant on the rains, this makes farmers particularly vulnerable to changes in rainfall.

In **The Gambia**, the factor underlying the high rate of poverty is the relative lack of economic diversity. According to the IFAD (2013), more than 60% of the population in The Gambia depends on agriculture for its livelihood. Around a third of the country is farmed (The Gambia, 2008). At least half the population considered to be poor² (or living under the poverty line) is made up of farmers and agricultural labourers (The Gambia, 2007). In comparison to men, women face a higher incidence and more severe levels of poverty because of unequal access to economic opportunities (The Gambia, 2007). And yet, women represent more than 50% of agricultural labour and 70% of unskilled labour, and they produce around 40% of total agricultural production. The agricultural and natural resource sectors provide jobs to around 75% of the active population, as well as providing the main source of food for most Gambians. According to Jaiteh and Sarr (2011), the forest ecosystems in The Gambia are the main source of pasture, crops, wood for construction, firewood, non-timber forest products (fruits and nuts etc.) and bush meat. The aquatic ecosystems provide fish and water.

The national economy of **Mali** depends mainly on the primary sector (agriculture, livestock farming, fisheries and forestry), which employs 80% of the active population (MEA, 2009). The incidence of poverty was at a national average of 44% in 2010, with a predominance in rural areas (51%) compared to urban areas (31%) (Ministry of the Economy and Finance, 2011). One of the main reasons for this poverty is the fact that Malian agriculture which is essentially rural, is characterised by low productivity due to a high dependency on various factors such as rainfall and hydrology, to poor and fragile soils, to poor systems to share agricultural knowledge and to the persistence of certain plant and animal diseases (Dramé, 2013). Around protected areas in Mali, agriculture consists mainly of family farming, and remains predominantly a subsistence activity, apart from in areas that generate a surplus to the west and south of the Gourma. According to Dramé (2013), sedentary and nomadic livestock farming is also practiced. Fishing also constitutes one of the pillars of both the rural and national economy. It provides work for around 7.2% of the active population (MEA, 2009). Hunting is an occasional ancestral activity that is firmly anchored in the local culture. Generally speaking, around protected areas in the south of Mali food gathering activities are practiced mainly by women who pick wild grapes, the fruit of the *néré*, the tamarind, the *goïne* vine (or “*zaban*”), the baobab, the palmyra palm and karite tree. These products are either consumed and/or processed and sold on the local market. Traditional medicine plays an important role in the communities’ lives.

² A person (or household) is considered to be poor if the person’s (or household) income is insufficient to acquire the reference set of goods and services. This concerns people (or households) living with less than 1 US dollar per day.

In **Togo** agriculture, which employs more than 75% of the active population, remains one of the main economic activities. The agricultural sector represented 38% of the Gross Domestic Product (GDP) between 1995 and 2003 (NCRAT, 2007). In 2006 agriculture provided more than 20% of export income (NCRAT, 2007). However, the incidence of poverty was estimated in 2006 at 62% of the Togolese population (Republic of Togo, 2009) and as being greater in rural areas (74%) than urban areas (37%). According to the report prepared by Guelly and Segniagbeto (2013), the rural world is characterized by agriculture, but also by the use of natural resources such as timber and non-timber forest products and wild animals. A little less than half (47.9%) of the Togolese population lives within households with farming as the main economic activity and 64% of the population living under the poverty line consists of farmers (Republic of Togo, 2009). Communities living around protected areas visited by the consultant as part of the national study are mainly farmers and hence amongst the country's poor. Furthermore, with livelihoods based on agriculture, these local populations no longer have enough arable land, as a significant proportion of their land heritage has become State property, thus worsening their situation and living conditions.

The main economic activities in **Chad** are associated with the primary sector, despite oil production which has contributed to increasing the Gross Domestic Product. The activities of more than 80% of the population are linked to agriculture (particularly cotton growing) and to subsistence livestock farming (CIA World Factbook, 2012). The rural sector, in particular cash crops and livestock farming contribute to 40% of GDP (Chad, 2010). While relatively recent, the oil industry is growing with exports representing 27% of GDP (CIA World factbook, 2012). Despite these resources, Chad remains a poor country with 55% of the population living below the poverty line (Chad, 2008). Poverty is mainly a rural phenomenon where its incidence has been estimated at 58.6% as against 25% in urban areas. The rural population represents 80% of the total population with 20% living in urban areas. The communities living around protected areas use natural resources, in particular for farming, fishing, non-timber forest products and hunting.

In **Sierra Leone** the economic sector is dominated by farming and associated activities which support around two thirds of the population. Agriculture, essentially subsistence farming with only small areas of commercial farming made the greatest contribution to GDP in 2010 at around 62% (AfDB et al., 2012). The mining sector is largely oriented towards export and in 2006 constituted the second largest productive resource of the economy and 20% of GDP (Ministry of Transport and Aviation, 2007). According to the World Bank (2013), the incidence of poverty was estimated at 53% in 2011, with a higher incidence in rural (66%) than in urban areas (31%). The main activities of communities living around protected areas include agriculture, small trade, livestock farming, fishing and firewood production.

Generally speaking, the socio-economic activities of local communities around protected areas are essentially based around agriculture, livestock and fishing. Fishing for instance plays an important role in the economies of coastal West African countries: West African fisheries exports totalled more than 489 million USD on the world market in 2011. Furthermore, fishing constitutes an important food source for the local communities and this sector generates jobs (Ndiaye, 2013). Inland fishing is also developed in countries such as Burkina Faso, Niger and Mali, thanks to the existence of large rivers such as the Niger and the Senegal Rivers.

4. Identification and analysis of the relationships between climate change, protected areas and local communities

4.1. *Analysis of the effects of climate change on protected areas*

Current analyses show that protected areas are directly and indirectly affected by climate change and variability. Very few studies have been carried out on West African protected areas but certain authors (Parmesan, 2006; Wilson and Gutiérrez, 2011) maintain that the distribution of species will most often be negatively and rarely positively affected by climate change. Furthermore, climate hazards could worsen in the future as climate scenarios predict a drop in rainfall and an average increase in temperatures of +2°C by 2020 (IPCC, 2007); hence the importance of identifying, planning and implementing adaptation actions.

In many countries of the sub-region, protected areas undergo climate variability in the form of alternating dry and wet seasons. Generally speaking, during the surveys carried out amongst the communities living around protected areas in the five countries studied, the people confirm that they have observed a reduction in rainfall and in the number of rainy days, prolonged droughts, and violent winds just before it rains.

All these forms of climate change also endanger the flora and fauna which may become more vulnerable. Faced with climate hazards, protected area ecosystems are slowly degrading and changing, which causes the loss of habitats and as a result the loss of wildlife. Water points in protected areas are drying up because of prolonged droughts and lack of rain, endangering wildlife. Climate hazards can also lead to a modification in animal migration periods, migration often being linked to the availability of food. In addition, rising sea levels will cause coastlines to recede and will thus affect coastal biodiversity, as is already the case in West Africa (IPCC, 2001).

The proximity of the Atlantic ocean exposes **The Gambia** to rising sea levels due to climate change; this rise could reach 2m by 2100. The town of Banjul (the country's capital and a major urban centre) is located 50cm above sea level. The nearby protected areas of Tanbi and Tanji are thus very exposed to flooding which could occur much more frequently as sea levels rise (Bakurin et al. 2010, Republic of The Gambia, 2007a).

In **Mali**, bush fires linked to sharp increases in temperatures and the lack of water constitute a danger for protected areas and the local species. For example, in the protected area of the Boucle du Baoulé, vegetation has changed and as a result so has the food available for herbivores. Species such as buffalo, hartebeest or the Defassa waterbuck have become very vulnerable (Dramé, 2013).

Concerning marine biodiversity, the rise in sea levels is causing salt water to seep into fresh water courses. The resulting flooding of estuaries and mangrove swamps is disturbing the reproduction areas for fish which now have to migrate to other fresh water sources (PANAP, 2010; Guelly and Segniagbeto, 2013). In **Togo** this phenomenon can be observed in Aného lagoon and in the mouth of the Mono River due to the high salinization of the river and lagoon areas (Guelly and Segniagbeto, 2013).

In **Sierra Leone**, extreme climatic events, in particular heatwaves associated with violent winds are increasing the spread of bush fires, including in protected areas (Conteh, 2014). Rainfall varies greatly from one region to another. Low rainfall and a potential increase in evapotranspiration due to the effects of climate change can have an impact on the distribution of species of flora and fauna (*Ministry of Transport and Aviation, 2007*).

In **Chad**, the effects of climate change on ecosystems vary in the different regions of the country. In the Sahelian zone, timber resources are very vulnerable to climate change and that is accentuated by anthropic pressure. Thus, if current trends (increasing temperatures, rainfall stability) are not reversed, a gradual recession of vegetation cover or even desertification in the long term are to be expected (Chad, 2001). Over recent years, Chad has in fact seen a decline in timber and the appearance of cracks in the soil in this area (Boulanodji, 2014). In this same zone, water resources are undergoing the effects of climate hazards (climate variability and extreme episodes), which are causing considerable water evaporation. The volume of Lake Chad for example has gone from 44 billion m³ in 1963 to 18 billion m³ in 1992 since the droughts of recent decades and its surface area has shrunk from 20,000km² to 7,000km². The continuous drop in the lake's volume can be explained by the drop in volume in the Logone and Chari Rivers which provide 95% of the lake's water (Boulanodji, 2014). Two great droughts also struck Chad in 1984/1985 and again in 1993/1994. In the Canton of Dari, in the area of Sena Oura national park, these successive droughts caused water points to dry up and wetlands to dry out as well as causing wide-spread bush fires including inside protected areas, destroying the habitat of certain wildlife species (Boulanodji, 2014).

Generally speaking, in West Africa, all protected areas are liable to be affected by climate change and this will be manifested by: a change in the composition of ecosystems, the extinction of certain species or changes in migration patterns (IPCC, 2007). In the Sahel, periods of drought are increasingly frequent, rendering this area, which is experiencing an increase in bush fires, more fragile. During the past ten years in West Africa several extreme climatic events have caused major damage which have affected infrastructure, people and biodiversity. In 2006, for example, low rainfall led to a critical drop in the level of Lake Volta (ECOWAS, 2009), which borders Digya national park in Ghana.

4.2. *Analysis of the effects of climate change on local communities*

The previous sections have shown that in West Africa rural communities in general and those living around protected areas depend mainly on natural resources for their livelihoods. However, analyses carried out as part of the development of national climate change adaptation programmes show that the most vulnerable sectors are agriculture and those associated with other natural resources (see Table 2). The impacts of climate change on these sectors differ from one country to the next and the NAPA process has adopted an approach which prioritises the sectors most sensitive to climate change.

Table 2: Comparison of the main socio-economic sectors retained as most sensitive to climate change in the five countries

Country	Farming (agriculture and livestock)	Fisheries	Energy	Water	Forestry	Health
The Gambia	X	X	X	X	X	X
Mali	X	X	X	X	X	X
Togo	X	-	-	X	X	X
Chad	X	-	X	X	X	X
Sierra Leone	X	X	-	X	X	X

Source: adapted from the National climate change Adaptation Programmes for Action.

Among the six most sensitive sectors to climate change, four are common to all five countries. These are farming, water, forestry and health. However, this configuration of most sensitive sectors must be analysed prudently due to inter-sectoral relationships. For example, although fisheries and

energy are not explicitly mentioned in Togo, there are close relationships between water and fisheries on the one hand and between the forest and energy on the other. The same can be said in Chad which did not identify fisheries as a sensitive sector but rather water.

Finally, certain countries identified other sectors that are not listed in Table 2. For example, Sierra Leone included food security and the erosion of soil, human habitats and coastlines. Togo added the coastal ecosystem to its list of most sensitive sectors. Analysing the sectors considered by the countries to be sensitive helps to better understand the effects of climate change on communities living around protected areas as these sectors are on the one hand associated with the communities' activities (logging, use of water, encroachment of agriculture), and on the other hand affected by climate change and variability.

In **The Gambia**, the climate hazards identified by the communities interviewed during the national study included flooding, heatwaves, violent winds drought and salinization. The effects of these hazards vary but generally speaking, the communities mentioned deterioration in health, food insecurity, loss of biodiversity, an increase in conflicts relating to natural resources, a drop in income and a lack of jobs. Most affected by flooding were houses, communications (roads and telephone lines) and crops. According to Sonko (2013), more than 18,000 people were affected by food insecurity due to flooding, violent winds and forest fires in 2009. The same author reports that in 2010, 34,990 people were affected by flooding, the most affected areas being those with the highest population densities (Tanji, Tanbi and the area of Banjul). The National Disaster Management Agency (NDMA, 2011) indicates that communities are vulnerable to forest fires because these fires reduce soil quality and crop productivity, increase land degradation, destroy timber for construction and fuel, as well as pasture, and reduce food security. The communities living around protected areas (Tanbi, Tanji, Pirang, Kiang West National Park and Niimi National Park) near the coastal zone are also affected by flooding and rising sea levels, while those living in the high lands (Sibac and Brinkanai) are sensitive to the effects of drought. This perception of vulnerability by the members of the communities interviewed confirms that observed by the government departments and NGOs.

In **Mali**, the national report prepared by Dramé (2013) indicates that the local communities around protected areas identified the following climate hazards: drought, flooding, violent winds and high variations in temperature. The extent of damage caused by these climate hazards depends on their impact on resources considered as important for the communities, that is to say agricultural and grazing land. In recent decades there has been an overall drop in yields on agricultural land which can lead to the loss of agricultural production. As regards grazing land, recurrent droughts lead to increasing scarcity of pastoral resources, conflicts between crop and livestock farmers and a drop in meat and milk production (Environmental and Sustainable Development Agency (2011). Climate hazards also affect the availability of other natural resources that the communities living around protected areas depend on, and this can be seen, among other things, in a drop in the production of non-timber forest products and a degradation of firewood. The effects of climate change on the communities around protected areas often lead to a drop in agricultural production and as a result an increase in food insecurity with the corresponding increase in poverty. This situation also affects the occupation of rural areas. In particular it leads to the clearing of farmland and increases intra- and inter-community conflicts over access to resources.

In **Togo**, the increase in temperature and the drop in rainfall have led to a drop in crop yields and hence in household incomes. According to Guelly and Segniagbeto (2013), this has led to an intensification of rural exodus. Furthermore, as a consequence of the drop in crop yields, the risk of famine has increased, eating habits have changed and biodiversity has been lost. In addition, floods are partly responsible for a resurgence of diseases such as malaria, diarrhoea and cholera. Droughts

and heatwaves increase the risk of meningitis, cardiovascular and cerebro-vascular diseases and certain respiratory diseases (Guelly and Segniabeto, 2013).

In **Chad**, the effects of climate change concern the main economic sectors upon which rural populations depend, including those living around protected areas (Ministry of the Environment, Water and Fisheries, 2010). These are agriculture, livestock farming, energy, water resources, fisheries and forestry. As regards agriculture and livestock farming, a drop in production has been noted following the degradation of the main natural resources used in these sectors (land, water, pasture etc.). As regards fisheries, resources are also diminishing. Furthermore, timber resources are regressing. This is also the case for water resources. With a variation in rainfall, its poor distribution over time and a rise in temperatures, a reduction in water courses, forest resources and agricultural production can be noted, with repercussions on the socio-economic conditions of rural communities in general and those living around protected areas in particular (Boulanodji, 2014).

In **Sierra Leone**, the national adaptation programme for action indicates that climate change is already affecting communities with the changes observed in rainfall and temperature (Ministry of Transport and Aviation, 2007). This report shows that the agricultural sector is highly vulnerable to climate change and variability. The domains linked to agricultural production that are negatively affected are: land management, livestock farming and crop production. Forests are also liable to be negatively affected by climate change due to inappropriate policies. Indeed, there is a lack of policies to regulate and encourage forest management, the sustainable use of forest resources and their conservation. In general, long years of socio-political crises have prevented Sierra Leone from acquiring reliable data and information on the relationships between people's livelihoods and the effects of climate change.

In conclusion, the people of West Africa have already observed several effects of climate change, the most dramatic consequences of which are the drop in agricultural production, soil erosion, a deterioration of human health, food insecurity and a loss of biodiversity (Jallow et al., 2013). This has led the majority of West African countries to develop national climate change and variability adaptation action plans (Jallow et al., 2013).

4.3. Analysis of the effects of communities on protected areas

Protected areas provide ecosystem goods and services, in the same way that ecosystems outside protected areas do. These goods and services (cultural, support, supply and regulation) include for instance the beauty of landscapes, eco-tourism, the supply of timber, food and water, pollination and the maintenance of soil biodiversity (serving as a filter and storage system for water and pollutants). Protected areas can also constitute a natural buffer zone during extreme events and reduce vulnerability to floods and droughts. Studies have revealed that climate change will have effects on ecosystems and on the access to services they provide (McCarty, 2001 ; McKenzie, 2004 ; Lemieux, 2011). If climate change continues to reduce the supply of ecosystem goods and services provided by protected areas to local communities, an increase in anthropic pressure on protected areas is to be feared. Indeed, communities could be forced to exploit them before these ecosystem goods and services are lost forever. Below we analyse the potential effects of communities on protected areas for each of the five countries studied.

In **The Gambia**, the negative effects of local communities on protected areas are due in particular to slash and burn agriculture, hunting, collecting of wild honey and charcoal production. Domestic waste dumped nearby protected areas also constitutes a serious threat. This is particularly the case in the wetlands of Tanbi, near the city of Banjul, which is polluted by the dumping of waste,

sometimes containing dangerous elements (such as medicines). This has contaminated the fish and oysters in this area, which are usually consumed by the local communities (Sonko, 2013).

In **Mali**, forest resources provide communities with around 93% of their energy needs; the villages located around protected areas use the wood as the main source of household energy (Dramé, 2013). Forest resources also provide timber for construction, food and pharmaceutical products. All the protected areas in the south of the country are subject to illegal logging. Large quantities of firewood and charcoal are produced and transported to the main cities of Bamako, Kayes, Kita and Bougouni. As for wildlife, it provides the communities with the bush meat that is their main source of animal protein. On a cultural level, hunting plays an important role in Malian society, particularly as regards hunting associations. In the Gourma area, the main elephant migration paths between Burkina Faso and Mali are used for nomadic and sedentary livestock farming. The use of migration corridors by domesticated livestock obliges the elephants to change corridors, often causing damage to crops and conflict between humans and wildlife. These conflicts also occur because of the presence of farming hamlets and the extended stay of livestock around water points during the dry season. Finally, the grazing of livestock by nomadic herders inside protected areas scares away the wildlife which moves towards the protected areas of Guinea and Senegal (Dramé, 2013).

In **Togo**, the encroachment of communities into protected areas is a major problem. For instance, whole villages have settled in the protected areas in the north of the country (Oti-Kéran and Oti-Mandouri). The villagers clear the land, settle to grow crops on these very fertile soils and graze their livestock. As a result, these two protected areas are highly degraded and today the environment has become so inappropriate and even hostile to the continued presence of animals that a very large proportion of the wildlife has been lost (Guelly et Segniagbeto, 2013).

In **Chad**, protected areas also suffer from the impact of local community activities (Boulanodji, 2014). Indeed, the presence of cattle in Sena Oura national park for example constitutes a threat to the ecosystems and species due to the disturbances that this causes to the flora and fauna, particularly the competition between wildlife and cattle for food resources, the risk of epizootic contagion, the risk of poisoning and the killing of large carnivores by herders. The availability of feed and the presence of permanent water points in the park attract domesticated animals. Outside protected areas many water sources dry up because of climate change, particularly in the dry season. Similarly, timber and non-timber forest products are better preserved in protected areas. The local communities covet these and harvest them illegally inside protected areas when they are no longer to be found outside. Wildlife is also affected by poaching and this concerns all species. This pressure has caused the extinction or rarity of certain key animal species such as giraffes, lycaon and black rhinoceros. Wild animals are also used in traditional medicine, such as elephant (skin, faeces and urine), hyena (faeces, intestines), lion (urine, bones, fat), bush duiker (hair and testicles) and porcupine (intestines, quills). As for fish, these are endangered by the use of toxic products, particularly certain pesticides used in cotton growing.

In **Sierra Leone**, bush meat constitutes an important source of protein and is an integral part of rural communities eating habits. The steady increase in demand exacerbates illegal hunting of wild animals, including endangered species within protected areas (Conteh, 2013). The other impacts caused by the communities (or their activities) living around parks in Sierra Leone are the use of water for domestic purposes and irrigation and the gathering of firewood and medicinal plants. The communities also use the resources of certain protected areas, such as Outamba-Kilimi park for honey production. The people interviewed during the surveys indicated that because of these activities (including agriculture, grazing and hunting), the communities have contributed to deforestation, leading to a degradation of the protected area and the loss of animal and plant

species. There are also isolated human settlements within and around the country's protected areas, which constitute a serious threat for forest the landscapes.

In conclusion, the harmful effects of communities on protected areas in West Africa are caused by incursions to exploit the flora and fauna, a phenomenon which will very probably be exacerbated by climate change. Poaching appears to have the most devastating effect on protected area wildlife biodiversity. To this can be added fishing and the illegal exploitation of timber and non-timber forest products within protected areas. Other dangers associated with industrial pollution, uncontrolled urbanisation, mining, uncontrolled development of tourism, natural disasters and armed conflict are also listed by Fournier et al. (2007). This situation often poses a problem of coexistence between development and biodiversity conservation in protected areas.

5. Current policy and practice to manage the effects of climate change on protected areas and local communities

5.1. *National adaptation and mitigation policies and programmes*

The five countries studied have a national climate change adaptation action plan. These action plans analyse the vulnerability to climate change of certain sectors such as agriculture, fisheries, energy, forestry and water resources, food security and health, sometimes paying particular attention to coastal areas. All the action plans were developed making the distinction between the socio-economic sector and the environmental sector (natural ecosystems). In certain documents biodiversity is analysed without making a distinction between that within protected areas and that in intensive farming areas (agro-ecosystems for instance), but none of the countries specifically deals with the relationships between protected areas and climate change in the climate change adaptation policy documents, particularly the National Adaptation Plans of Action (NAPA).

As a result, two observations have emerged from the current adaptation policies and plans developed by the five countries to manage the effects of climate change. Firstly, given that the priority actions identified in the national climate change adaptation plans of action do not specifically concern protected areas, the latter cannot be specifically taken into account when the plans are implemented. Indeed, an analysis of priority climate change adaptation actions identified in the five adaptation plans shows that only The Gambia and Sierra Leone specifically consider the adaptation of protected areas and local communities. Other countries have simply integrated aspects of natural resource conservation and/or sustainable development into the priority actions selected (MERF, 2009 ; The Gambia, 2007 ; Chad, 2010 ; Ministry of Transport and Aviation, 2007).

Secondly, the budget allocated to adaptation actions focussing on protected areas in The Gambia and Sierra Leone is relatively large compared to the three other countries involved in the project. In The Gambia for example, the provisional budget for the protected area adaptation action plan represents 9.36% of the total climate change adaptation action plan budget. In Sierra Leone, the provisional budget for adaptation actions³ targeting protected areas corresponds to 23.72% of the provisional national climate change adaptation action plan budget (The Gambia, 2007 ; Ministry of Transport and Aviation, 2007).

The situation in the other countries of West Africa, judging from their NAPAs is similar, with action plans that do not specifically integrate biodiversity and protected areas. It therefore clearly appears that national programmes dedicated to climate change have not often paid sufficient attention to protected areas. Despite not having been given sufficient consideration, all the priority actions identified are potentially applicable to communities living around protected areas. Indeed, these communities are involved in all the sectors and/or ecosystems in which priority actions have been identified. The question is to know how these priority actions have been or could be geographically implemented.

³ Project 9- *Establishment of Forest Reserves, Protected Areas and National Parks/Sanctuaries in Sierra Leone* and Project 10- *Management and Protection of Forest Reserves and Catchment areas including Wetlands in Sierra Leone*.

5.2. *National protected area policies*

Given the dawning awareness of the degraded state of natural resources in the countries studied, the latter have developed laws and policies to reverse these trends. Laws have generally been in place since the protected areas were created but few have been reviewed or adapted to often changing contexts and situations.

Regarding **The Gambia**, the Department of Parks and Wildlife Management (DPWM) is the governmental institution responsible for managing wildlife and setting up and managing protected areas. There are eight protected areas managed by the DPWM; it also manages the community wildlife reserve of Bolon Fenyo, the largest community reserve in the country. The forestry department manages forests and forestry reserves. Aware of the need for communities to participate in natural resource management, the Gambian Government has set up an initiative which integrates community participation into forest management. A new forestry policy (1995-2005) and new forestry legislation (1998) were thus approved by the Government. In 2013, around 111 communities managed around 14,416.83ha of forest (Sonko, 2013). There is also a national fund for forests and a fund for local communities which were created to fund forest management activities (Forest Act, 1998). Similarly, *The Gambia's Biodiversity Act* of 2002 provides additional financial resources, managed by the DPWM, to manage protected areas.

Protected areas in **Mali** are only managed by the state through the National Directorate for the Conservation of Nature (DNCN). This works at a regional level through its Regional Directorates for the Conservation of Nature (DRCN) and at local level through its nature conservation departments (SCN) which then disseminate information to the district level (*communes*). The Boucle du Baoulé Biosphere reserve is managed by a department that reports to the DNCN: the Boucle du Baoulé national park development operation (French acronym OPNBB).

Law No. 95-031 dated 20 March 1995 stipulates the conditions for managing wildlife and its habitat classified as protected areas, including strict nature reserves, national parks, wildlife reserves, special reserves or sanctuaries, biosphere reserves, game areas and all areas dedicated to wildlife protection or promotion.

Furthermore, a national protected area strategy has existed since 2011 and aims to improve their conservation. The involvement of local communities in environmental management has emerged through the administrative and institutional reforms undertaken in the country, particularly decentralisation, which are gradually entrusting the local authorities with greater responsibility for natural resource management.

In **Togo**, the parks and reserves are managed by the Ministry for the Environment and Forestry Resources (MERF), in particular by the Wildlife and Hunting Directorate (DFC). The MERF was created in 1987, then reorganised by Decree No.2005-095/PR of 4 October 2005. It is responsible for overall environmental policy. Its policy regarding forest resources also concerns the marine and coastal environment. Today, the Wildlife and Hunting Directorate and the Water and Forestry Directorate are to merge to become the Natural Resources Directorate. In July 2001, an overall planning framework called the National Action Plan for the Environment (PNAE) was adopted. It constitutes the tool for putting the environmental policy into action, particularly by the taking into account of the environmental dimension in a cross-cutting and inter-sectoral manner. Added to this is the National Programme for Environmental Management (PNGE) which includes the National Programme for Decentralised Environmental Management Actions (PNADE).

There are several laws, by-laws and decrees that govern protected areas, wildlife and hunting in Togo. These include:

- Law No. 2008-005 on the Environmental framework: it concerns the protection of flora, fauna and natural areas
- Law No. 2008-09 on forests: it defines and harmonises forest resource management rules
- By-law No. 4 dated 16 January 1968 regulating the protection of wildlife and hunting practices in Togo: it defines what constitutes wildlife, protects it, organises hunting and capture and prosecutes infringements.
- Decree No. 2003-237/PR dated 26 September 2003: it establishes a standardised framework for protected area management and by-law No. 005/MERF/CAB/SG/DFC dated 21 May 2004 which specifies the protocols for reorganising protected areas.

It should be noted that in Togo protected areas were extended in an authoritarian manner with no compensation paid to local residents, leading to often extensive displacement of communities (Northern extension of Kéran for example). These extensions have never been accepted by the local people. This conservation and protection policy ended up rousing the hostility of the general population, particularly among the local communities. Socio-political troubles occurred between 1990 and 1993, and some communities settled within certain protected areas, mainly for agriculture and grazing, sometimes constituting entire villages. The resulting destruction of habitats is the main cause of the current degradation of protected areas in Togo. The government is currently attempting to mitigate these problems and regain the trust of the communities concerned through awareness-raising meetings and regular consultations.

In **Chad**, the Ministry of the Environment, Water and Fisheries is responsible for monitoring forestry and wildlife policies by developing, classifying, conserving and managing national parks as well as developing and managing national forests. National policies are beginning to promote the sustainable management of the land and certain land conservation tools such as management plans. Inspired by the regional strategy to combat desertification created by the international standing committee on combating drought in the Sahel (CILSS) or the Nouakchott strategy (1984), Chad, like the other Sahel countries, has drawn up a master plan to combat desertification (PDLCD) which was adopted by the Government in 1989.

Regarding legislation, Chad has by-law 14/63 dated 28 March 1963 governing protected areas. This by-law was supplemented by a certain number of decrees including No. 088/99 on the closure dates for hunting in Chad. On 2 June 2008, the National Assembly passed a law on forests, wildlife and fisheries, the first of its kind in Chad since independence in 1960. This law, passed on 10 June 2008, reference No.14/PR/2008, introduces many community-led natural resource management concepts and in particular allows for the reclassification of certain categories of protected area into “consultative wildlife management zones”, managed by the local communities in partnership with the government departments and the private sector. This new participative approach to protected area management represents a significant step forward.

In **Sierra Leone**, the 1972 wildlife law and the 1998 forestry law constitute the current legislative basis for the conservation of biological biodiversity. Certain provisions of these laws are insufficient or obsolete and the institutions responsible for their application often lack the capacities to do so. However, the National Environmental Policy of Sierra Leone (1995) and the Environmental Protection Law (2000) offer a model for sustainable development based on true environmental management with a particular emphasis on forests supported by the Forestry Law of 1998.

As well as national policies, the five countries have signed or ratified all international conventions on protected areas and climate change in particular the Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD) and the UN Framework Convention on Climate Change (UNFCCC), but there are no synergies between these three

conventions which could foster the integration of climate change into national nature conservation strategies or policies. The lack of reliable climate data in West Africa and of in-depth knowledge of this issue and its connection to biodiversity also hinder coordinated action among the different entities involved in climate change on the one hand and the environment on the other.

5.3. *Regional policy on climate change*

Although certain countries have a national strategy on climate change, at a regional level such a policy/strategy does not yet exist, even if the issue of climate change adaptation remains one of the key concerns of the region. Climate change-related action plans and programmes in particular do exist.

For example, a sub-regional action programme to reduce West Africa and Chad's vulnerability to climate change was developed following a recommendation of the *International Conference on reducing natural, economic and social systems' vulnerability to climate change in West Africa*, held in 2007 by the Economic Community of West African States (ECOWAS), the international standing committee on combating drought in the Sahel (CILSS), the Economic Commission for Africa (ECA) and the African Centre of Meteorological Application for Development (ACMAD). Thus, these institutions were entrusted with developing this action programme. The overall objective of the programme is to develop and build resilience and adaptation capacities in the sub-region to manage climate change and extreme climatic phenomena. It is based on the strategies and programme frameworks developed by sub-regional organisations in the environment, water, agriculture and forestry sectors (such as ECOWAP, ECOWEP, PAU-UEMOA, PASR-AO/CCD, etc.) and will be implemented over a ten-year period.

The African Development Bank (AfDB) also developed a climate change action plan (CCAP) for 2011-2015. This plan should help countries in the Africa region to adapt to climate change and mitigate its effects. The plan aims to help African countries to build their capacity to manage climate change and mobilise resources. Like the other action plans, it is based on the different existing strategies.

The Sahel and West Africa Programme (SAWAP) is jointly funded by the Global Environment Fund (GEF), the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). This programme encompasses 12 national projects in the following countries: Benin, Burkina, Chad, Ethiopia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Soudan and Togo. The projects aim, among other things, to reduce vulnerability and increase the capacity for adapting to current or potential effects of climate variability.

Thus, no regional policy on climate change yet exists, even if much progress has been made towards trying to understand the impacts of climate hazards on people and natural resources and to develop possible adaptation or risk reduction strategies at national and regional levels. However, these strategies must now be integrated into regional frameworks, plans and policies, whose implementation should be rigorously monitored and evaluated.

5.4. *Adaptation Strategies in and around Protected Areas*

Several adaptation strategies have been promoted by the communities living within and around protected areas, with or without the support of external partners and governments.

In **The Gambia**, Sonko (2013) reported that communities should be more involved in protected area conservation and protection by promoting ecotourism. The Government should also harmonise policies relating to climate change with other sectoral policies and build the capacities of local communities around protected areas.

According to Dramé (2013), in **Mali**, possible climate change adaptation strategies around protected areas include:

- The promotion of water and soil conservation techniques
- The introduction of improved seeds
- The intensification of floodplain recession crops, the development of market gardening and income generating activities for women and youth
- The creation of grain banks to ensure food security
- The linking of agricultural and livestock farming activities
- The development of water points
- Information and awareness-raising among local communities to get them involved in protecting protected areas

In **Togo**, Guelly and Segniagbeto (2013) propose adaptation strategies that aim to reinforce agro-forestry practices, promote income generating activities that respect both the environment and natural resources (fish farming, bee keeping etc.), combat bush fires and water pollution and promote the use of early maturing and drought-resistant varieties.

According to Boulanodji (2014), the climate change adaptation strategies of communities around protected areas in **Chad** are mainly based on:

- Access to agro-climatic information: the communities need such information to prepare for extreme climatic events and adapt to climate change
- The development of appropriate and diversified intensive crops: climate hazards would have less of an effect on these appropriate crops, thus increasing household incomes
- The construction of infrastructure to protect and restore land for agricultural activities: the fertility of soil depleted by recurring droughts should be restored.

For the communities in **Sierra Leone**, Conteh (2014) identified the following strategies:

- The organisation of tree planting campaigns to restore virgin forest
- Improvement of agricultural irrigation systems
- Awareness-raising among communities on natural resource protection
- Development of early-warning systems such as weather stations to predict climate risks
- Implementation of the National Adaptation plan for Action (NAPA) on forestry management taking climate change issues into account
- Improvement of communities' living conditions by implementing income generating activities
- Building human capacities for better management of natural resources and protected areas

It can be noted that the adaptation strategies identified above differ very little from the emergency actions recommended in the national climate change adaptation action plans. The approaches currently used to analyse vulnerability do not specifically focus on the relationships between protected areas, communities and climate change. Therefore they need to be adapted before being implemented to identify clearly the protected area goods and services used by the communities and their interaction with climate hazards. If this is not done the resulting strategies could even increase the pressure placed by communities on protected area natural resources.

Cross-border conservation is one of the conservation strategies that deserves to be considered as it involves the consultative management of adjacent protected areas located in different countries and also enables communities to be involved in their management, particularly in the face of climate change. To do this, climate change adaptation policies in and around protected areas should be designed and implemented using a cooperative approach, that is to say by implementing a strategy in which all stakeholders have clearly determined the preferable elements from a social point of view (Nielsen, 1988). In other words, to be deemed collaborative strategies, synergies must be found between the adaptation strategies of communities living in and around protected areas and the effective and sustainable management of protected areas. Such adaptation strategies will help the communities, protected area managers and other donors to build a culture of collaboration, innovation and shared responsibility in order to be fully equipped to then implement these strategies. It is thus indispensable to properly analyse the relationships between the climate change adaptation strategies identified by the communities and the conservation objectives of the protected areas concerned. Hence the need to have appropriate tools and approaches to analyse vulnerability and identify strategies which involve, in this case, interdependent decisions (Frank and Sarkar, 2010) between protected area managers, communities and other departments responsible for development around protected areas.

6. Conclusions and recommendations

6.1. Conclusions

Climate forecasts for West Africa are generally speaking too unreliable due to the scarcity of climatic data and the unsuitability of global models used in the regional context (OECD, 2009). In the context of the PARCC Project, regional climatic projections were made for West Africa (Met Office Hadley Centre, 2012). However, these estimates still carry a large degree of uncertainty regarding the future impact of the climate in the region and the results must be interpreted prudently. However, this situation should not prevent certain questions from being raised, particularly regarding current and future relationships between protected areas and the communities living around and/or within these protected areas and the implications for the conservation of biological diversity.

This study of the links between communities, protected areas and climate change shows that climate change and variability are already affecting the local communities around protected areas as they can already observe their manifestations (floods, recurring and prolonged drought, poor rainfall distribution, violent winds etc.) and impacts, particularly on agriculture. Indeed, the livelihoods of communities living around protected areas often depend on activities associated with the exploitation of natural resources, in particular agriculture, livestock farming, fisheries and the exploitation of timber and non-timber forest products. All these activities are dependent on climatic conditions and a deterioration of these conditions can affect crop yields, the development of certain diseases and the availability of non-timber forest products and hence have a significant impact on household incomes and poverty. Regarding protected areas, climate hazards can cause degradation of habitats for wildlife which in certain cases may become increasingly scarce if nothing is done to reverse current trends (Baker et al. 2014). These results are all the more worrying in that Africa is considered by the IPCC as the region that stands to suffer the most from climate change and variability in the world.

To date, little has been published on the links between climate change, protected areas and local communities. However, this study has highlighted the fact that the impact of climate change on one (protected area or local community) can affect the other. Therefore if resources outside protected areas become insufficient due to climate change, the communities living around a protected area may be forced to encroach on this area to obtain the resources they need to survive. There is therefore a clear, if not necessarily direct, relationship between climate change, protected areas and communities, but this is not yet always properly integrated into the plans and programmes intended to better take into account the needs of communities living around protected areas.

This study suggests that knowledge and understanding of the relationship between climate change, protected areas and local communities be improved by gathering and analysing data in order to provide a sound basis for developing climate change plans and programmes that integrate socio-economic sectors and natural ecosystems. In developing climate change plans and programmes particular attention should be paid to the necessary collaborative nature of adaptation options for local communities, which could involve several countries sharing the same protected ecosystem, such as for example by creating cross-border management plans.

6.2. Recommendations

The recommendations provided below aim on the one hand to better take into account the relationship that exists between climate change, protected areas and local communities and on the other to integrate these three elements into national and regional climate change adaptation plans and protected area management plans.

Recommendation 1: develop appropriate data gathering and analysis tools to highlight the relationships between protected areas, local communities and climate change

Gathering reliable data remains an important preliminary step in understanding and analysing the relationships that can exist between climate change, protected areas and communities in West Africa. Data gathering tools exist (such as the tools for assessing protected area management effectiveness), but they do not always enable these relationships to be identified. There are also other tools for analysing communities' vulnerability and capacity for adaptation (TOP-SECAC)⁴ which can be used to analyse the relationships between climate change, protected areas and local communities. The data gathering tools and protocols need to be developed in such a way as to integrate these relationships, ensuring that they are adaptable to the local context and take local community needs into account.

Recommendation 2: set up an inclusive biodiversity monitoring system in protected areas

This involves promoting the regular gathering of data on protected area biodiversity, the activities of local communities and the climate in order to improve knowledge around protected area resources and the way in which they are affected (by the climate and/or by the local communities). The utility of such integrated monitoring of biodiversity is to facilitate the rapid identification of adaptation or awareness-raising actions to be implemented. Monitoring could be carried out using existing tools, such as the management effectiveness monitoring tool (METT). In the context of the PARCC West Africa Project, a new module with questions relating to climate change has been developed (Belle et al. 2012) and this tool could also integrate socio-economic parameters relating to community activities. This type of monitoring of biodiversity and protected area management actions must however involve the local community at all stages: from design to implementation. Protected area managers hold primary responsibility for implementing this recommendation.

Recommendation 3: step up protected area stakeholder awareness-raising

The communities living around protected areas should better understand the stakes and importance of conserving natural resources, but also the effects (negative and positive) that climate change can have on these resources and hence on their livelihoods. In this way, the communities will be better able to visualise the relationships that exist between climate change, protected areas and their well-being. Protected area managers must also extend their awareness-raising activities among local communities to other stakeholders in conservation such as stakeholders in energy, agriculture and health. This study showed that all these sectors directly and/or indirectly influence

⁴ Toolbox for planning, monitoring and evaluating climate change adaptation capacities. http://cmsdata.iucn.org/downloads/top_secac_agrhymet_edition_francaise_combine_1.pdf

the complex relationships between protected areas, communities and climate change. The aim of stepping up stakeholder awareness-raising will be to develop inter-sector synergies to benefit both protected areas and the local communities.

Recommendation 4: strengthen capacities of protected area managers and representatives of the communities concerned to implement planning and monitoring-evaluation tools

This recommendation aims to improve the understanding and consideration of the complex relationships between climate change, protected areas and communities and to identify adaptation actions as well as monitoring and evaluation indicators. The implementation of this recommendation principally concerns the application of climate change as well as biodiversity and socio-economic data gathering and analysis tools. The lack of managers' capacities to apply these tools is the main cause of the lack of reliable data for better analysing the links between climate change, protected areas and communities. These analyses include for instance the evaluation of the impact of protected areas on communities (and vice-versa), the evaluation of communities' vulnerability to climate change and the evaluation of the impact of climate change on protected areas. The capacity to use these tools needs to be strengthened in order to improve the quality of both the data collected and hence of the analyses.

Recommendation 5: improve the formulation of climate change adaptation and protected area management policies

Current national and regional policies do not always take into account the relationships between the climate and other sectors of activity. The objective of this recommendation is to create national frameworks for improving protected area management that take climate change issues into account. Three aspects for improving national policy should be envisaged. The first concerns the taking into account of the complex relationships between protected areas, local communities and climate change. This means the public authorities must ensure that (i) climate change is integrated into policy on protected areas and that (ii) the particularities of protected areas and local communities are integrated into policy on climate change. The second aspect for improving policy formulation concerns the taking into account of the cross-border aspect of certain protected areas. Public authorities should collaborate to identify the most effective way to manage cross-border protected areas that take into account both local communities and climate change. The third aspect to be improved is associated with the monitoring and evaluation of climate change adaptation and protected area management policies. Although this recommendation targets the public authorities, the PARCC Project could also guide institutions in developing policies that take into account the effects of climate change in the management of protected areas.

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Appendix 1. Analysis framework for the national reports

Analysis framework for the national reports	Mali	Togo	The Gambia	Sierra Leone	Chad
1. What climate hazards are identified in the report?					
2. Is there a clear description of the livelihoods in the country?					
3. Is there a clear description of the climatic situation in the country?					
4. Is there a clear description of the situation of protected areas in the country?					
5. What impacts of climate hazards on protected areas are identified in the report?					
6. What impacts of climate hazards on protected area local communities are identified in the report?					
7. What impacts of local communities on protected areas are identified in the report?					
8. What impacts of protected areas on local communities are identified in the report?					
9. Is there a clear description of the country's adaptation and mitigation policies?					
10. Is there a clear description of the country's protected area policies?					
11. Is there a clear description of the links between the protected area policies and those associated with climate change?					