Deforestation Impacts on Biodiversity Conservation in the Dja Biosphere Reserve, Cameroon

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Abstract
The tropical rainforest of the world are very important for the global ecosystems. Most of the remaining rainforest in Africa is concentrated within the Congo Basin forest area. The Congo basin rainforest is second that of the Amazon basin and with the Indonesian forest are the most important rainforest in the world. The Dja Biosphere reserve which is located in the South Eastern part of Cameroon forms the uppersparts of the Congo Basin Forest. Despite the fact that this area is a natural reserve implying that certain human activities like cutting down of forests around the buffer zones and hunting without permission are outlawed, we notice that there is increasing damage being done to this reserve especially around its periphery. The study aimed at examining the impact of deforestation activities on the Dja biosphere reserve to see if the exploitation is in a sustainable way or not. It also aimed at looking at the importance of the reserve to local communities who live around the area, the reasons for exploitation and the impacts, which stakeholders and what roles they play, and finally to find a better management strategy for the future. To be able to meet the objectives, the study was mostly analytical using carefully selected data to illustrate the problem and showed loopholes in policies. Suggestions for better management were made after looking at certain theories (Triple bottom line concept, Adaptive environmental planning, and Market instruments of Charge and Permit systems) and their possible applications. The study showed that the reserve was still 90% untouched but that some species were endangered even though none was critically under threat. It also showed that some species were conservation dependent and the reports of threats were increasing. Also, it was noticed that the reserve was very important to local populations not just as a means of subsistence but also as a way of increasing their household incomes. Recommendations are made with regards to the consideration for autonomous management, increase public participation in decision making and enforcement, and the creation of a special fund for collected charges from logging companies so that the funds can be used to increase conservation efforts. It is very necessary to increase conservation efforts as a precautionary step than to wait for the level of degradation to increase before taking action.

Key Words: Deforestation, Biodiversity Conservation, Sustainable Development
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1.0 Introduction

Ehrlich and Ehrlich (1992) looked at biodiversity as a variety of genetically distinct populations of species of plants, animals and micro-organisms with which man shares the earth, but also a variety of functional ecosystems of which biodiversity is a functioning part. They saw biodiversity as a “genetic library of species” which offered mankind with an array of ecosystem services, without which civilization could not persist. And in their attempt to value biodiversity, they came out with four main categories through which we could effectively see the importance or value attached with biodiversity, these included; ethical value, aesthetic value, direct economic value and indirect economic value. Conservation of biodiversity which implies protection of these species and, a fair and equitable use of these resources, and ensuring the sustainability of its diverse genetic components were the main issues behind the Biodiversity Conventions (CBD) signed at the Rio Earth Summit (1992). Other very important fall outs of this UN Conference on Environment and Development were the Agenda 21, the Statement of Forest Principles and the Framework Convention on Climate Change. Increase materialistic pursuit of economic growth by developing nations and major emerging economies have not been of any help to policies and actions geared towards an increase in biodiversity conservation despite the numerous engagement and efforts being made.

Most of the remaining rainforest in Africa is concentrated within the Congo basin forest area which is the second most important forest ecosystem in the world after the Amazon basin. The Dja biosphere reserve of Cameroon is a very important part of this forest given its enormous richness and potential in fauna and flora species (Lucienne W. & Jean-Pierre V., 2002). The importance of conservation in preserving the variety of forest and biodiversity in the Dja as world heritage sites for future generations cannot be overstressed. However, local communities and central governments dependence on forest resources has led to unsustainable rates of deforestation as people cut down forest for agriculture, fuel wood, constructions, timber for commercial purposes and also cutting down forest to enable extraction of mineral resources. The impacts from these activities can be multi-dimensional and if we intend to achieve sustainability in managing and using this forest now and also making sure that we in no way compromise its integrity so that future generations can also use it, something needs to be done to reverse the trends.

The Cameroon government has not officially handed out any permits or licenses authorizing logging activities within the Dja Biosphere Reserve but then there is a reported increase in the level of timber extraction and processing and also the exploitation of fauna for commercial purposes around the reserve periphery. Logging companies which are mostly owned by foreigners are the ones chiefly involved in these deforestation activities, another issue is the
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fact that they have opened up more forest areas and therefore made it easier for the local people to access the forest. This has increased the rate at which animals are being poached and also the amount of forest area on which unsustainable agricultural practices such as slash and burn are carried out. Some of the company Lories are even used in the illegal transportation of poached game and some of these drivers act as an intermediary between the poachers and those who buy their products. This has increased the level of poaching for commercial purposes rather than for subsistence reasons as it was before. Mining activities which are recently being introduced by GEOVIC are a cause for concern. Given the importance of this reserve in relation to the role it plays in the survival of the local populations, in providing some economic benefits, as a source of livelihood, and a home to the species who live in it, the indirect services which it provides the ecosystem, there is need to raise awareness of its importance to increase the consciousness of all actors stakeholders and also help in efficient policy formation that will lead to proper management of the Dja Biosphere Reserve.

1.2 Background of Study Area
Cameroon is a country located on the Gulf of Guinea and shares its boundaries with Nigeria, Equatorial Guinea, Gabon, The Republic of Congo, Central African Republic and Chad. It is a very peaceful country, one of the richest in diversity on the African continent and with a glittering specter of different languages and cultures. Often referred to as ‘Africa in Miniature’, its geographical features vary from the Saharan northern section, through the Adamawa plateau and Western highlands, the grass field areas right down to the very dense humid equatorial rainforest of the south west, centre, south and east provinces. The humid forest zones of Cameroon which covers an area of 270, 162 sq. km and given its enormous diversity in plant, animal and human resources is considered to be the richest in the whole of Central Africa (Cyprian Jum et al., 2007). According to Gartlan (1992), it is possible to find more than 200 different species of wood in one-tenth of a hectare.

![Figure 1 Map showing Cameroons location on in Africa and the World](image)

Figure 1 Map showing Cameroons location on in Africa and the World
The humid tropical rainforest of the South and Eastern provinces make up what is called the Congo basin. The Congo basin area is located within Cameroon, Gabon, Central African Republic, Republic of Congo and the Democratic Republic of the Congo. The forest area of the Congo basin runs over 1,813,000 sq. km, it is the second largest tropical forest ecosystem in the world after the Amazon basin and it holds a capacity of about one fifth of the tropical forest of the world. It houses over 10,000 plant species, over 1,000 bird species and over 400 mammal species. This area is equally a home to over 30 million people according to the Congo Basin Forest Partnership (CBFP) which is sponsored by the USAID for Sub-Saharan Africa. The Dja biosphere reserve in Cameroon is equally located within this area.

Figure 2 Maps of the Congo Basin Countries (Source; www.rainforests.mongabay.com/congo)

The Dja biosphere reserve is an important area for the conservation of biodiversity in Cameroon. The area is reported to have been subject to protection since 1932 under Decree No. 2254 of November 18th 1947 which regulated hunting activities in the former French African territories, certain species were to be protected. Over time, the history of this area evolved and much importance was attached to its protection. Under Law No. 319 of April 1950, the area was given the status of ‘reserve de faune et de chasse’ (Hunting and Fauna Reserve) and later on 22nd May 1973 it according to the National Forestry Act Ordinance No. 73/18 was declared a ‘reserve de faune’ (Fauna Reserve). UNESCO’s Man and Biosphere Program in 1981 classed it as a Biosphere reserve and declared it a World Heritage Site on December 5th 1987. The Dja Biosphere reserve represents the uppermost north section of the Congo basin. It is located within the South-Eastern part of Cameroon. The Reserve covers 5,260 sq. km of land area making it the largest protected forest reserve within this rainforest (Gartlan & Leakay, 1988). Most of the reserve area is bounded by the Dja river which forms a natural delimiting boundary for the area flowing westward from the northern part and through the southern
border into the Congo River as a tributary. The Dja Biosphere Reserve has a privileged geographic position between a bio-ecological and a hydrographic transition zone, (ECOFAC, 2007). According to Bedel et al., 1987, it naturally has a humid equatorial climate. Average annual temperatures are around 23 degree centigrade’s mean while annual rainfall is 1600mm. Peak periods of rainfall are in May and September with April being the driest month. The vegetation of the Dja Biosphere reserve is mostly that of the dense evergreen forest type. The main canopy of trees rises from 30-40m to about 60m, (ECOFAC, 2007). There is a modest level of research carried out within the biosphere reserve but World Protected Area Fact Sheet and publications by ECOFAC show that the area is home to over 1,500 documented plant species, over 107 mammals including the lowland gorillas and over 320 different species of birds. There are different ethnic indigenous populations who live around the Dja reserve periphery which include; the Badjoue in the North, Nzime in the East, Boulou in the West, Fang-Nzaman in the South and recently Kaka of the Bantou, and Baka pygmies. These people are scarcely dispersed in the forest with a population density of about 1.5 inhabitants/sq.km(Gartlan, 1989).

Figure 3  Dja Biosphere Reserve
2.0 Purpose and Objectives

The Dja biosphere reserve has over the years been subject to forest exploitation by the local communities there. With the introduction of a commercial way of using the forest, its exploitation has increased over the years. The main objective of this study was to examine the impacts of deforestation on the reserve. The study was also aimed at trying to answer some pertinent research questions related to the reserve.

- What is the present state of the Dja biosphere reserve in terms of sustainable conservation?
- What is the importance of the reserve to the local communities around the reserve periphery?
- Who are the actors and stakeholders, and what roles do they play in the Dja biosphere reserve?
- What are the reasons for and impacts of deforestation on the Dja biosphere reserve?
- What possible instruments for sustainable development can lead to a sustainable management plan for the Dja biosphere reserve?

2.1 Scope of Study

The main boundary for this study falls within the examination of deforestation due to anthropogenic activities within the Dja biosphere reserve of Cameroon and the Impacts which those activities have on the ecosystems biodiversity conservation and also the survival of the local communities within the bounds of the reserve. Equally, an examination of ways through which effective policy formation and implementation can lead to better management of the Dja Biosphere Reserve is carried out in this study.
3.0 Methodology

The first part of this section explains how the study was carried out to be able to reach the objectives and answer the research questions which were raised in the previous chapter. The later section explains the instruments/tools for sustainable development which were used in the study.

3.1 Research Methodology

Firstly, for a better understanding of the problem and to get an in-depth knowledge of how the Dja biosphere reserve is managed, phone interviews were conducted with important players who are involved in the reserve.

- The Department at the Ministry of Environment and Forestry of Cameroon in charge of the Dja Biosphere Reserve.

- ECOFAC (eco-système foresti ère d’Afrique Centrale) which is a program sponsored by the European Union to carry out activities that lead to promotion of conservation activities but also helping local communities with projects that help in their development.

- Cameroon biodiversity conservation Society (Affiliate of Birdlife International) whom I discovered that unfortunately was not involved in the Dja Biosphere Reserve.

Also I was privileged to have a phone interview and email correspondences with Dr. J. L. Betti, former co-ordinator of ECOFAC and currently a lecturer in the University of Douala.

Secondly, data was gathered from secondary sources. Extensive review of literature within the scope of my study and other issues related to deforestation and biodiversity conservation. Books were consulted, scientific articles, journals (both published and unpublished), newspaper articles and many websites.

Thirdly, the study entailed carrying out qualitative analysis of the relevant data. Therefore the study was mainly analytical making use of relevant data which had been gathered from secondary sources. The study did not involve any quantitative methods or practical work. It was very important given data restrictions to not just look specifically at the way each of the activities is being carried out but to look at the impact of individual activities as a whole. Focus on the failure of government policy in appropriately managing the Dja faunal reserve is a very important aspect, methods of issuing logging permits and flaws in legal criteria for their issuance is another important issue. Sufficient demonstration of the non-compliance with forest regulations by reports and also the unsustainable nature of harvest practices were deemed enough to enable me carry out my analysis. Actual and present population data for the whole area was not available and therefore the research made use of the actual population
pressure estimates from reports for the whole area. Looking at the present state of the Dja biosphere reserve necessitated the examination of certain factors like the fauna and flora species which are harvested to see if some are endangered or not, looking at the environmental indicators such as temperature, rainfall, fires, water bodies, vegetation, and aspects such as; population pressure and land use impacts especially caused by agriculture for subsistence reasons and the trend of events in terms of biodiversity loss of the reserve.

To be able to find out what the importance of the reserve is to the local population, it was very necessary to look at what they use the forest and other resources in the area. Also, most importantly the proportion of the most commonly used resources which are harvested most often. Another important issue was to see how resources harvested from the reserve affect their local incomes and livelihood. Given the long history of the coexistence of the local people in the forest, it was also very important to see if there was any special connection between the local people and their habitat.

The relevance of the instruments for sustainable development which were proposed was based on findings from the data which was collected. Suggestions were made to how they can be applied. Discussions were made; recommendations were advanced as to the new way forward and finally conclusions were drawn.

3.2 Theories, Instruments/Tools for Sustainable Development

Under this section the instruments which can be used to achieve biodiversity conservation of the reserve and sustainable development within the Dja area are proposed. The present situation of the reserve offers us certain indicators which show that the reserve area has abundant biodiversity. At the same time poverty is a major problem for this area which needs development like is the case in most developing nations. There is weak control from the authorities which is leading to increase forests being cut down and animals hunted. The three instruments or tools which will be examined here include: the triple bottom line, adaptive environmental planning and market instruments (charge and permit systems).

3.2.1 The Triple Bottom Line Concept (3BL, TBL)

The companies which are involved in forests and mineral exploitation in the area are not bound by any ethical limits. They are driven by the desire to make economic gains and therefore they show very little engagements with regards to development of local communities and the environment. This creates the need for accountability and transparency in the activities of these companies. The need for corporate social responsibility requires companies in this area can embark on the triple bottom line assessments of their activities. What does the triple bottom line stand mean?
Triple bottom line (TBL, 3BL) concept was ratified by the United Nations and The Local Governments for Sustainability (2007). The concept was first defined in the Bruntland Commission Report of the United Nations (1987). TBL can be used by governments, communities, companies as a framework for corporate reporting, an approach or strategy to achieve sustainability, tool for corporate accounting, as a tool for measuring corporate or societal development. TBL stands for People (social), Planet (environment) and Profit (economy). The concept originated in the 20th Century as a result of health issues from economic activities and it marked the beginning of environmental consciousness of the negative impacts of economic activities. TBL uses a systems approach which considers corporate responsibility and the need to carry out economic activities for profitability but also sustainably and ethically. Social responsibility of all actors (internal and external) and the management of environmental impacts of company activities rather than just focusing only on profit making is the basis for TBL. It expands social and economic performance with ecological performance in the society and by organizations. The TBL concept is a widely accepted concept which can be incorporated into law to help design and expand the decision making scope. It puts forward the concept of environmental sustainability from the point of view whereby companies should act taking into consideration most importantly the interests of stakeholders before the interests of the shareholders. The ambiguity in actually defining the TBL or describing its methodology cannot be denied.

This study will focus on the TBL as an approach to community development that incorporates the three pillars of sustainable development and as a reporting strategy to measure the performance of companies within the social, the environmental and economic domains. The indicators under the TBL include; Social/ People/Equity (health and safety of workers, community and social impacts, fair compensation, equal opportunity, education and recognition). Social justice and equity were the main factors that led to the TBL. Socially, companies need to take care of their workers but also making sure that communities where they are established reap some gains from their activities. This will mean a shift of attention from shareholders to stakeholders. Economic/Profit/Financial (revenue growth, productivity, profit margin, return on investments, capital costs, risk management, valuation of enterprise, appeal to investors. Economically, companies need to make profits but in the most honest way possible and in collaboration with the social and ecological indicators. Environment/Planet/Ecology (energy and water consumption, material and resource use, emissions and wastes, operation and design efficiencies, life system impact and new products or service opportunities. Environmentally Companies will have to do their utmost best to reduce the impact of their activities on the environment considering life cycle thinking and taking into consideration long term effects.
Input-Output Analysis and Life Cycle Assessment can be used to audit the costs and profits of company impacts to come out with reports so that planning can be carried out if needed to increase social responsibility, ecological sustainability and at the same time make profits. TBL reports enable decision makers to put in place a functioning mechanism for planning, monitoring and reporting of sustainable development, it encompasses the values, issues and processes which companies need to control to enable them minimize the harmful impacts of their activities to enable them create economic, social and environmental values (Elkington, 1998).

Stages for implementing the TBL to achieve sustainable development will include;

- Commitment to Change Process
- Awareness and Assessment
- Clarifying Vision, Mission and Goals
- Strategy, Planning and Policy Development
- Implementation of Work Plan
- Evaluation and Review
- Reporting to Stakeholders
- Continuous Improvement and Education

Figure 4 The Triple Bottom Line Concept and The three pillars of sustainable development
Through the TBL concept we can pay more attention and review performance of companies from the environmental, economic and social points of view. Concerns about ecological sustainability can be addressed; the impacts of processes, products, services on air, water, biodiversity and human health can also be reviewed. This concept shows the three pillars of sustainable development and how they are all related, intertwined but also conflicting in interest. However there is a need to achieve sustainable balance between them.

The Prism of Sustainability which was developed by the German Wuppertal Institute (1999) as an extension to the concept of sustainable development and the triple bottom line concept calls for the reduction of the impacts of activities on the environment taking into consideration the notion that environmental resources are limited. The use of institutions to strengthen the participation and governance of those affected by these impacts, the social volley which calls for equality of access to resources and the right to a dignified life for all and lastly the satisfaction of human needs and welfare by the economic activities.

Democratic participation of the indigenous people, the companies and the authority is a very important way of seeking cohesion and adherence to decisions taken. It is very important to make all the stakeholders feel involved and concerned by the decisions being taken to enable the effective management. The legal linkage is also very important to compel acting companies within the regions to follow the set standards and goals; this will keep them awake given that they are faced with serious legal consequences if they do not respect their engagements. Equally, companies need to have eco-efficiency means of exploiting resources and the indigenous people who have access to these resources should also care about their activities and their negative impacts.

![Figure 5 The Prism of Sustainable Development (Source: the Wuppertal Institute, 1999)](image-url)
In relation to the need for conserving biodiversity in the Dja reserve and at the same time fighting for community development, the TBL will lead to evaluation of activities of all logging companies and mining companies in the area. They will carry out input-output analysis and life cycle assessments of the costs and impacts of their activities. This will lead to more transparency in their way of doing business and lead to accountability, increase desire to increase eco-efficiency of their technologies which they use in harvesting, reinvesting in local communities by building schools and other social amenities, carrying out ecotourism activities which have less impacts on the environment, continuous education of the local people, increase leisure and recreation. The above are expected fall outs if companies are obliged by law to carry out TBL reporting, accounting or assessments of their activities around the Dja biosphere reserve. Despite possible increases in the ecological performances of companies and an increase in living standards of local people if there is reinvest in the areas we should not forget that the main motive of these companies is profit making.

3.2.2 Adaptive Environmental Planning (AEP)
Environmental law approach is very necessary for protected areas. Adaptive environmental planning for long term goals set at the higher levels by policy makers is very essential. This has not been the case so far with the Dja biosphere reserve. We need AEP for the reserve so that goals set by policy makers can be legally operationalized and made binding for all the actors and stakeholders. Authorities charged with the role of managing the reserve have proven to be inefficient. Therefore for a country like Cameroon which is considered to be a democratic and a rule of law state, we need a systematic planning process over time where the question of whether we need certain environmental standards should be the role of policy makers at the top and the how to achieve the implementation and enforcement of these standards should come from the bottom.

AEP focuses on environmental planning and the principles that environmental goals are legally binding which can be easily operated on the basis of environmental quality standards and navigation rules (Carlman, 2005). It puts forward the notion of environmental law and the need for the proper use of the legal instruments in achieving certain environmental objectives. The concept encompasses a more systemic way of looking at environmental problems. It is a way of operationalizing environmental standards and goals and making them binding. This means that parliament decide or vote laws at the national level which boil down to the regional level taking into consideration regional environmental indicators and finally to the local level where the implementation is carried out. AEP entails the need in stressing the use of the legal environmental instrument in line with the planning by setting up environmental quality goals. The five main criteria of AEP in relation to our case will include;
The Environmental limit criterion; by this criterion certain environmental limits can be set with regards to what we want to achieve. Exploitation or use of resources can be outlawed or bound within certain limits in relation to the environmental standards or goals which have been decided by the parliament.

The Legal effect criterion; by this we set environmental limits and make them legally binding to all stakeholders, and making each one know what their rights and obligations are. Environmental goals and standards are made legally binding and enforceable against persons including companies.

The Adaptive criterion; here we should make it possible for dynamism in policies so that we are able, ready and compelled by law to adjust if we happen to notice that environmental goals and standards are not being met. Information, knowledge and economy can provide us with feedback that enables us to adapt in time.

The Hierarchy criterion; by this aspect we shall make sure that the goals and limits which we shall set at local level must be in line with those at the higher level. More stringent limits can be set by local authorities but goals and standards at the local level should not contradict those at the regional or national level. There should be an accord or a chain from the national to the regional and then the local levels.

The Development criterion; given that the aim of the above criteria are to ensure ecological sustainability, we need to also find a way to be able to promote development. Achieving a maximum level of development is the main aim of the adaptive environmental policy. This puts forth the notion of navigation within the development space which means that control and steering to achieve development can only go on within the development space and bound within the limits of standards which have been set to avoid compromising the ecosystem limits. This implies efficient planning within the development space.

Figure 6 Rule of Sustainability and Planning Adaptivity (Source; Carlman, 2005)

Figure 6(A) explains the model for adaptive environmental planning. Implementation efforts as laid down by planning are legal and can be adapted, whether the environmental situation
complies with the goal or not but Figure 8(B) is not advisable because in the case where implementation efforts are not productive, the goal can be abandoned.

Relating AEP to the Dja biosphere reserve will mean that policy makers will have to set standards or limits to the amount of forest and wildlife which we are allowed to exploit. They will also consider setting limits to all other activities which in any way are considered dangerous to the ecosystem. Water, air, and biodiversity conservation laws will therefore need to be voted into law at the level of the parliament. The knowledge and experience of local people will be integrated into the enforcement process to enable smooth implementation of these goals. Exploitation can then be authorized only after EIA’s have been conducted and local people consulted during the process. Any logging or mining companies will be required to use the best available technologies before they are granted any exploitation permits. Ecotourism will also be encouraged and proper monitoring, steering and control will be carried out by the authorities of the reserve to get feedback and knowledge that will permit them to adapt easily. For example; all endangered and conservation dependent species are to be banned from being hunted until they are capable of reproduce in amounts that are not can be exploited without causing any significant threat to their existence.

3.2.3 Market Instruments (MI)
Economic growth and the materialistic pursuit of production above necessary limits without consideration for the assimilative capacity, bio-capacity or regenerative capacity of the environment has led to negative feedback loops of growth. Coupled with market failures and lack of markets for environmental externalities, the fact that it is not easy to price the indirect values of biodiversity, improper definition of property rights for public goods like the forest and national parks, has led to environmental degradation. Starvins (2003) considers market based policy instruments as a correcting mechanism. Market base instruments for environmental policy goals are mostly based on the Pigouvian tax model to tax market externalities and bring about equilibrium and solve the problem of under pricing environmental goods. Everything else being equal, placing more charges on the activities of companies will lead to a reduction in their activities and therefore the negative impacts of their activities on the society and the environment.

MI’s are therefore needed by authorities to steer and control development in the reserve area. Under market instruments, the Charge System and Permit System will be considered. General objectives will be to achieve technological advancement, internalize externalities, uphold producer responsibility, attain fiscal gains, enforcement and compliance and the ultimate aim which is to reach our environmental targets. The cost effectiveness of MI’s make them even more attractive to consider
3.2.3.1 Charge System
There are different categories of charge under this system, focus will be placed on those which can relate to our case.

- Effluent charges are based on the Pigouvian tax model to correct market failure caused by external impacts of activities (externalities).
- Insurance premium taxes are levied against potential risks from production activities.
- Administrative charges are used to raise revenue to help cover administrative costs of environmental programs.
- Tax differentiations make use of tax cuts, credits, and subsidies to serve as implicit taxes for environmentally undesirable behavior.

The use of the charge system for the reserve will mean that the state places extra charges to cover up for the external impacts of logging and mining companies. Also, insurance premiums and administrative charges should be levied to cover up risks of exploitation and help finance administration of environmental programs. However advocating for tax cuts and subsidies will mean encouraging further exploitation, so I do not recommend this category.

3.2.3.2 Permit System
The United States Environmental Protection Agency (1992) adopted the tradeable permit system to help control pollution. Under this system there are two main categories, the Credit Programs and the Cap-and-Trade.

- Under the credit programs, credits were created when emissions are reduced below the required levels.
- Under the cap-and-trade, an allowable overall level of pollution is established and allocated among firms as permits which can be exchanged among sources. Allocation can be carried out through free distribution or sale (auction) by the government.

In relation to the Dja reserve, we can apply the permit system by creating credits when firms significantly reduce the impacts of their activities on the environment. The credits created can be used to extend their exploitation permits or can be used as a criterion for granting them permits to exploit other areas. Also, under the cap-and-trade, the government can map out areas which it considers appropriate for exploitation, which is what is being done today. Permit allocation however should not be auctioned based on prices but on the technological and ecological efficiency of bidding companies.
4.0 Presentation of Findings
In this section all relevant data which was collected for the study will be presented. After each section data presented will be analyzed and used to answer the research questions.

4.1 Forest and Management Policies for the Reserve
Cameroon is a signatory of a good number of international conventions such as. World Heritage Conventions, Conventions on the protection of migratory species, Conventions on biodiversity, Conventions on the international trade of endangered fauna and flora species and Conventions on fighting desertification. The signing of all these conventions is a clear indication of the engagement of the government in the protection and conservation of biodiversity. We also have to know that signing these conventions is one thing and their implementation is another. Also looking at the legislative aspects, since 31st December 2005 the Dja Biosphere Reserve and other protected areas in Cameroon are under the tutelage of the Ministry of Forestry and Wildlife. This ministry is responsible for the elaboration of policies for the management of fauna and flora in the protected areas of Cameroon. At the national level, the principal legislative texts in this sector include the following:

- Law 94/01 of 20th January 2004 describing forest, wildlife and fishing regimes and the decrees for application of the laws.
- Decree 96/224/PM concerning the organisation of the Ministry of Environment and Forestry
- Decree 037/CAB7PM of 19th April 1994 putting in place of Operational Technical Units.
- Decree 95/6787PM regulating land use activities around buffer forestry zones.

The department of fauna and protected areas defines the fauna policy management plans and therefore it is directly placed over all other ministerial services in charge of the management of protected areas which are present on the field. It is the case of the Conservation Service which is decentralised and based on proximity to the protected areas for the efficient coordination and follow up of policies. This service is also charged with the implementation and respect of the laws decided by the Department in charge of protected areas. The Conservation service of the ministry has four main stations (south, north, east and west) located around the reserve. Each station is headed by a Chief of Station who is the direct representative of the Conservation service. Each station has two posts except the North station which has which has four. The Chief of stations are directly appointed by the Ministry of Forestry and Wildlife. The actual structure in charge of the management of the Dja Biosphere reserve, the Conservation Service has 45 eco-guards recruited through the ECOFAC program, an Engineer of water and forests, an Agricultural technician, one Secretary, one Treasurer, plus the Conservator.
Table 1 Government spending on protected areas on average since fiscal year 1986 (Source; Culverwell, 1998)

<table>
<thead>
<tr>
<th>Protected Area</th>
<th>Area sq.km</th>
<th>Average spending in US Dollars</th>
<th>Required spending in US Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dja</td>
<td>5260</td>
<td>8506</td>
<td>105 826</td>
</tr>
<tr>
<td>Campo</td>
<td>3000</td>
<td>9201</td>
<td>271 892</td>
</tr>
<tr>
<td>Korup</td>
<td>1259</td>
<td>19 653</td>
<td>110 604</td>
</tr>
<tr>
<td>Banyang Mbo</td>
<td>385</td>
<td>0</td>
<td>63 375</td>
</tr>
</tbody>
</table>

Less than 10% of the required amount was being spent on the Dja reserve since 1986.

Figure 7 National Forest Estate of Cameroon (Source; Bernad F., 2001)

Funding which the Conservation Service gets from the government is very small compared to the extent of the protected areas to be covered and another issue is that eco-guards get very little salaries and this exposes them to take bribes when they catch defaulters. Table 1 shows financial resources allocated for different reserve areas in Cameroon. We can see that despite the immense nature of the Dja reserve and its importance with regards to the variety of species and its status as a world heritage site, there are still problems of sufficient funds to help support the conservation efforts. With regards to the coverage of the reserve by eco-guards it means that we have just one eco-guard for 11680 hectares of forest. This is far from the IUCN
recommended one agent for 5000 hectares. Worst still agents have limited means (vehicles, motorcycles, radios, GPS, camping equipment, etc.) to enable help them in the exercise of their duties.

Figure 7 shows the division of Cameroon forest into permanent forests (forest reserves, protected areas and council forest) and non-permanent forest (communal forest, private forests and communal forest) according to the 1994 forest laws. Different logging permits under this law were instituted to act as a check, the permits include: sales of standing volumes of forest, exploitation permits, individual felling authorizations, concessions, state exploitation, and wood recovery permits. The obtention of permits is through an auction process, based on prices and technical capacity as a factor. Standing Volumes are most exploited and only Concessions require the formulation of forest management units which are to be formulated by the companies and most often species which are most harvested are not included in the management plan of some companies (WRM, 2001).

Replanting, wildlife protection, non-timber products, social demands with regards to local communities through the payment of loyalties or building of infrastructure are requirements which law 94/01, of 1994 stipulates for logging companies. Forest management units (FMU) are created, auctioned and winning companies are supposed to create Forest management plans (FMP) for the units within 3 years after a company has obtained rights to exploit and the FMP are supposed to be reviewed after every 5 years. The FMP must ensure that production takes place without; endangering the intrinsic value and future production of permanent forest, creating unwanted effects on the physical, social and environmental landscapes. Rotation periods cover is after 30 years and companies get 15 year exploitation right over the FMU, renewable once. FMP must consist of at least 20 species in the area which cover up to 75%, According to the law, the formulation of these plans is a prerogative of the state but given the lack of financial and human resources, the state has handed the responsibility to logging companies. Also, defaulting companies in most cases are not excluded from the bidding processes and even when they are excluded, they are not stopped from sub-contracting with local companies (Paolo et al., 2008).

The administrative and management set up of the from the Ministry of Environment and Forestry right down to the Chief of control stations on the reserve is full of unnecessary bureaucracy. The hierarchical situation makes the attributions of the chief of stations vis-a-vis that of the service of conservation unclear. There is need to scale down or completely eliminate some of the posts. Due to the structural loopholes as a result of several posts policy formulation and resource use has been very inefficient. At each stage of the administration, adjustments are being made or resources allocated are being deviated from the mainstream goals for other purposes. It is alleged that some companies are even responsible for paying
transportation to controllers when they are coming around to inspect the activities of these companies, with these kinds of practices there is no way that transparency can be guaranteed.

**4.2 Maps Showing the Extent on Intrusion into the Reserve**

![Satellite Image of Congo Basin Forest Area](source)

*Figure 8 Satellite Image of Congo Basin Forest Area (Source; Modis Data, Ispra, 2003)*

![Extent of logging concessions and protected areas in Cameroon 1959-2002](source)

*Figure 9 Extent of logging concessions and protected areas in Cameroon 1959-2002*
Figure 9 shows how the earmarking of forest concession exploded in Cameroon over less than a 50 year period. This brings us to the issue of asking ourselves what forest will be left behind for the future generations. Given the rate at which we are exploiting the forest, we need to be very careful because in the long run may be even this generation might not be proud of the outcome.

Figure 10 Illustration of the activities of logging companies around the Dja Faunal Reserve (Source: Forest Monitor, 2002)

Figure 10 clearly shows the nearness of logging activities to the protected area. Saw mills are located not too far from where the logs are being exploited. Paths created by logging activities are further used by local populations to enter the forest and carry out farming or hunt animals.
Figure 11 Illustration of mining activities around the Dja Faunal Reserve (Source; Pincock et al., 2006)

Mining in this forest not too far from the reserve raises serious environmental questions. Sulphuric acid plants constructed to enable the exploitation of cobalt and nickel in the area are a threat to the health of the ecosystem if serious precautions are not taken. Deforestation, landscape destruction and most importantly leaching and contamination of ground water that flows around the reserve area are very high risks not to be considered.
Figure 12 The Map of the Dja Reserve and Surrounding Villages
From figure 12 of the reserve we can see the existence of population settlements around the protected areas. Gartlan (1989) came out with a 1.5 inhabitants /sq.km. Something needs to be done to check population growth in the area. Logging and mining activities have a potential of causing a serious population increase over time.

4.3 Important Indicators for the Dja Biosphere Reserve

Figure 13 Annual Fire Density within 25km-50km of the Protected Area (PA), (Source; World database on protected areas, site code=1240)

Figure 13 shows an increasing trend for forest fires which means more deforestation, specie destruction and a threat to some species within 25-50km of the protected area.
Figure 14 Estimated Agricultural Pressure ranking for the Dja Biosphere Reserve (Source; World database on protected areas, site code=1240)

Figure 14 shows agricultural pressure index for the Dja area in relation to Cameroon. We see that the value is small but then we must notice that increase agricultural land for commonly unsustainable slash and burn practices and land for plantation agriculture will mean that land conversion activities to be able to feed increasing populations will over time close up on the protected area

Figure 15 Estimated Population Pressure ranking of the Dja Biosphere reserve (Source; World database on protected areas, site code=1240)

Population pressure index on figure 15, though low but will mean that increase population pressure will exert even a higher pressure on resource harvesting. Therefore the population indicator is also very important to be considered if we want to look at the extent of deforestation activities and harvesting of resources from the reserve.
Figure 16 Estimated ranking of Habitat Irreplaceability for the Dja Biosphere Reserve (Source; World database on protected areas, site code=1240)

Figure 16 for habitat irreplaceability means that the higher the irreplaceability of the habitat the higher the risks of non-regeneration of forest ecosystem and its species which makes it unhealthy and liable to be degraded and destroyed in the long term.

Table 2 Categories and Examples of some Species at Risks in the Dja Biosphere Reserve, (Source; World database on protected areas, site code=1240)

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>Mammals</th>
<th>Amphibians</th>
<th>Birds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critically endangered</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Endangered for example; Gorilla, Chimpanzee, Red Colobus</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vulnerable for example; Black Colobus, Mandrill, Golden Cat</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Conservation dependent for example, African Buffalo</td>
<td>14</td>
<td>13</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Least concern</td>
<td>99</td>
<td>33</td>
<td>66</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>52</td>
<td>61</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2 above shows the different categories and examples of species from those critically endangered, to those that are endangered, to those which are vulnerable in relation to the impacts on the protected area, to those which depend on conservation for survival and finally those which receive least concern. Basically Mammals, Amphibians and Birds were those considered. Table 2 shows that there are no critically endangered species within the Dja faunal reserve but then we can clearly see that the gorilla, chimpanzee and red colobus are endangered species and about 14 other different species are dependent on conservation to
enable them survive. This means that conservation efforts are crucial and need to be given a higher priority because if nothing is done to protect these species, they will become endangered and the endangered ones might become critically endangered making them liable to extinction in the future.

Table 3 Irreplaceability and Pressure Indicators for Dja Biosphere Reserve (Source; World database on protected areas, site code=1240)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Country ranking (out of 18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammal irreplaceability</td>
<td>6</td>
</tr>
<tr>
<td>Bird irreplaceability</td>
<td>6</td>
</tr>
<tr>
<td>Amphibian irreplaceability</td>
<td>8</td>
</tr>
<tr>
<td>Habitat irreplaceability</td>
<td>9</td>
</tr>
<tr>
<td>Agricultural pressure</td>
<td>6</td>
</tr>
<tr>
<td>Population pressure</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3 shows the different indicators and their ranking for the Dja reserve compared to Cameroon. We can clearly see that the indicator parameters for the Dja Biosphere reserve are much lower compared to other protected areas in Cameroon.

Table 4 Amount of bush meat seized by Eco-guards (Source; World Heritage Report on the Dja, 2006)

<table>
<thead>
<tr>
<th>Elephant tusks</th>
<th>Duiker s</th>
<th>Blue Duikers</th>
<th>Bush pigs</th>
<th>Monkeys</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>517</td>
<td>338</td>
<td>143</td>
<td>188</td>
</tr>
</tbody>
</table>

Table 4 shows the amount of bush meat which was seized by eco-guards in 2006 around the Dja reserve. This confirms the phenomenon of increased poaching and illicit harvesting of species.
Figure 17 Threat reporting trends of the Dja Biosphere Reserve, adapted from http://whc.unesco.org/en/list/407/threats/

Threat reporting trends are based on 0-100 reports over the period 2001-2008.

According to the UNESCO world heritage site, about 90% of the forest area in the Dja biosphere is still untouched. Reports of the follow up mission by experts from the IUCN on the state of conservation of the Dja biosphere reserve between 23-30 June 2006 asserted that there was no significant damage to endanger the site but that threats were increasing and much needed to be done in terms of policy implementation by the government and increase allocation of resources for purposes of conservation. This is a very encouraging figure but then it should not give room for inaction considering the increase in threat reporting trends as we can see from figure 17.

4.4 Importance of the Reserve to Local People

Table 5 Principal Activities in Nlobesse’e village around the Dja Forest Area (Source; Emmanuel A. et al., 2007)

<table>
<thead>
<tr>
<th>PRINCIPAL ACTIVITY</th>
<th>PERCENTAGE OF ACTIVITY BEFORE 1995</th>
<th>PERCENTAGE OF ACTIVITY IN 2000</th>
<th>NUMBER OF OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunting</td>
<td>90</td>
<td>15.2</td>
<td>68</td>
</tr>
<tr>
<td>Rearing of domestic animals</td>
<td>77.1</td>
<td>53.2</td>
<td>68</td>
</tr>
<tr>
<td>Collection and gathering of Fuel wood</td>
<td>99</td>
<td>98</td>
<td>68</td>
</tr>
<tr>
<td>Professional Hunters</td>
<td>90</td>
<td>26.7</td>
<td>68</td>
</tr>
<tr>
<td>Commercial Fishing</td>
<td>8</td>
<td>11.2</td>
<td>68</td>
</tr>
</tbody>
</table>

Table 5 shows that over the years hunting and professional hunting between 1995 and 2000 in Nlobesse village (one of the surrounding villages of the Dja biosphere reserve) has decreased considerably but also we notice that less animals are being reared and the collection of fuel
wood has decreased from 99% to 98%, commercial fishing increased however from 8% to 11.2%.

**Figure 18 Importance of Activities that fetch household income in Nlobesse’e village in 2000 (Source; Emmanuel A. et al., 2007)**

Figure 18 shows the sources of household income in Nlobesse village and what we can see is that most of household income comes from plantation and farming activities, followed by fishing and hunting and then money made from fuel wood trade. This shows that even if the people get more money from farming and plantation work, they still depend on the harvesting of forest resources to make money.

**Table 6 Commonly harvested natural resources in the Nlobesse’e village around the Dja Forest Area (Source; Emmanuel A. et al., 2007)**

<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>SCIENTIFIC NAME</th>
<th>LOCAL NAME</th>
<th>USES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moabi</td>
<td>Baillonella toxisperma</td>
<td>Adjap</td>
<td>1,2,3,4,5</td>
</tr>
<tr>
<td>Honey</td>
<td></td>
<td>Weh</td>
<td>1,2,5</td>
</tr>
<tr>
<td>Bush mango</td>
<td>Irvengia gabonensis</td>
<td>Ndöo’oh</td>
<td>1,5</td>
</tr>
<tr>
<td>Red milky fruits</td>
<td>Trichoscrypha arborea</td>
<td>Mvut</td>
<td>1</td>
</tr>
<tr>
<td>Raffia</td>
<td>Raphia vinefera</td>
<td>Nzam</td>
<td>2,3,4,5</td>
</tr>
<tr>
<td>Indian bamboo</td>
<td>Oxythernantera</td>
<td>Miann</td>
<td>3,4</td>
</tr>
<tr>
<td>Rattan</td>
<td>Lacosperma spp</td>
<td>Nlon</td>
<td>3,4</td>
</tr>
</tbody>
</table>

For Uses: 1=Medicinal, 2=Cultural, 3=Construction of houses and other articles, 4=Artisan, 5=Food

Table 6 shows the importance of forest resources to the local people who harvest it for multiple purposes such as; construction, medicine, artisan, culture, and most importantly for food. This shows the importance of the forest to the local people given the extent to which they depend on the forest resources for their own survival. Their cultural and sentimental connection with the forest cannot be over emphasized.
Figure 19 Fraction per volume of timber exploited by individual logging companies around the Dja Reserve (Source; Jean. L. B., 2007)

Figure 20 Fraction per volume of plant species exploited as timber from 2000-2003 (Source; Jean. L. B., 2007)

Figure 19 and 20 show us the extent of logging done in the area by certain companies.

Looking at the uses to which local people put the forest resources, we can measure its importance and the reasons why they exploit the forest. Over time the relationship between the forest people and the forest itself has been that of co-existence for survival and the people have made use of forest resources as a means of subsistence and livelihood. Today with the coming of the money economy, there has been the introduction of a different kind of vision and the people see the forest more as a resource base from which economic gains can be made.
Despite the change of picture and way of seeing things, conservation efforts have increased in the area. Resource use and dependence on forest resources for subsistence are the major reasons why the local population harvests these resources. Recently commercial purposes are taking an upturn in terms of reasons for exploitation. The government makes money from selling exploitation permits and also increasing economic gains from royalties, infrastructure from logging companies to the local populations help the government in development efforts. Subsistence, development motives and the drive for economic profits are the major reasons for forest exploitation.

4.5 Systematic Illustration of Major Concerns in the Dja Biosphere Reserve

Figure 21 Major Areas of Concerns in the Dja Biosphere Reserve
On figure 21 above we can clearly see the extent of complexity and interaction between socio-cultural issues, economic activities, environmental concerns and negative impacts of deforestation activities caused by anthropogenic activities and the loops in government policy. This brings about a very complex picture hard to come to a compromise. We have the government on one hand whom with the institution of inefficient management of the protected area by underpriced forests resources considering the granting of permits and non-recognition of the externalities from logging and other deforestation activities over time, non-respect of certain forest laws, poor monitoring of protected areas, weak or lack of political will to implement policies, weak ownership and land tenure arrangements which are helping to increase land exploitation, too many exploitation permits given out for companies to exploit forest and destroy resources, corruption and non-transparency in the delivery of permits and punishing of defaulters. We can see that the economic aspects has more to do with the action of those who pursue economic gains through logging activities (legal and illegal), mining activities, fuel wood trade poaching for commercial purposes and plantation agriculture. What the social aspects are in this case represent struggle for survival and pursuit of new model of life, loss of cultural identification which the local people used to have with the forest, growing population pressure in the area and increase pressure on resource use, possible conflicts of interest between logging companies and amongst certain individuals in the communities. Lastly and most important is the fact that we need to consider what impacts these previous aspects have on the environment which provides the resource base on which all these people depend on. The environment through deforestation will face challenges of soil degradation, increase temperatures, silting of streams and decrease in flow of water bodies and most importantly the aspect which is of great interest in this study id the pressure that this interactions will have on biodiversity.
Figure 22 Possible Impacts of Deforestation on Biodiversity in the Dja Biosphere Reserve

As illustrated on figure 22, there are very possible impacts which the event deforestation can cause on the biodiversity in general and in our case, there are specific impacts which deforestation will have on biodiversity in the Dja reserve. Increase logging, land conversion activities and resource harvesting in the area though considered insignificant to affect the existence of the Dja biosphere reserve if not checked will over a long period of time lead to: decrease in species, species which are endangered will become critically endangered and possibly extinct, species which depend on conservation for survival will become endangered, increase loss of forest cover and vegetation due to deforestation, silting, low flow of water bodies which will possibly affect regeneration capacity of plant and animal species, decrease in seed dispersal and pollination by birds if forest canopy is being cut, habitat and ecosystem survival will become thwarted and in the long run we can see that the existence of the reserve
in general will become a big problem to solve. Examples can be taken from other world heritage sites within the same eco-region like in the Congo which due to logging activities, increase population pressure and mining activities especially by rebels has led to their degradation and inclusion in the red list of critically endangered world heritage sites. Mining in the Dja area means that there is need for a sulphuric acid plant to enable the exploitation of cobalt and nickel and one has been constructed 40km to the reserve area. The risks of environmental degradation during and after the mining processes with the presence of heavy metals and eventual contamination of water bodies both on the surface and beneath of water bodies are a big threat to the reserve.

**Table 7 Stakeholders and their roles in the Dja Biosphere reserve**

<table>
<thead>
<tr>
<th>ACTORS AND STAKEHOLDERS IN THE DJA BIOSPHERE RESERVE</th>
<th>CONTRIBUTIONS/ROLES/AVTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government (Ministry of Forestry and Wildlife, Department in charge of Protected Areas, Conservation Services, Administrative authority)</td>
<td>In a democratic and rule of law state the government has the responsibility of setting the environmental policy objectives, goals, policies, limits to exploitation, property rights, amelioration of living conditions of local population, monitoring and checking to make sure that target objectives towards the conservation of the reserve and betterment of lives of the local people is met.</td>
</tr>
<tr>
<td>UNESCO/UNEP/IUCN/International conservation Agencies like Green Peace, Living Earth foundation, Friends of the Earth, WWWF etc.</td>
<td>Under the World Heritage Initiative, it encourages the conservation of such a great ecosystem filled with biodiversity. As such, it helps in promoting monitoring activities supported by the international union for the conservation of nature to help check exploitation and set up an alarm system to warn against overexploitation of fauna and flora in the reserve</td>
</tr>
<tr>
<td>Local People (represented by village heads and local councils)</td>
<td>The local people depend on the forest to be able to make a living. They have been living in this area for over a long period of time. They have been able to be in harmony with the forest without causing any major damages, but however the intruding by logging companies and increasing demand for forest resources have increased the extent of their impact on the forest. The forest for them has historic, cultural and symbolic values which have nothing to do with the economic benefits which they derive from its resources. So somehow, the conservation of the forest is very important for their survival.</td>
</tr>
<tr>
<td>NGO’s and sub-regional initiatives</td>
<td>Examples of sub-regional initiatives include ECOFAC (EU sponsored), REIMP, CBFP-CARPE (US AID sponsored) etc help to build a coordinated network for the management of the resources in the forest of central African region.</td>
</tr>
<tr>
<td>Private sector. Examples include; logging and mining companies</td>
<td>The private sector is also involved in the protected area and their activities mostly fall within the domain of exploitation. Most of the actors here are foreign even though some licenses are owned by local individuals they end up in partnership with foreign companies who have machinery and expertise to enable them exploit the forest resources. They have helped to open up the forest and increase access to forest resources, they also encourage the illegal trade in poaching by using their lorries for transportation. They are also a considerable source of demand.</td>
</tr>
</tbody>
</table>
The issue of considering future generations as stakeholders needs to be taken into consideration. In attempting to balance our interests we should not forget that future generations also have the right to the inheritance of an undamaged environment. Stakeholders in the case of the Dja biosphere reserve as we can see on table 7 are mostly the government agency, the international community, local administrators, local population, NGO’s and private sectors consisting mostly of the companies involved in this area. The government as the overriding body through the ministry of environment and forestry can set significant goals and bring about policies for effective management but then we have the hand of the international community which can also exert pressure on the government if things are done the wrong way. NGO’s can go a long way in working at the grassroots with local populations and helping to reshape perceptions and get them actively involved in the protection of their own forest. There is need for local communities to effectively participate in the processes of conservation because they are on the ground and have more experience over the years. The private sector activities really need to be checked and brought under scrutiny.

4.6 Suggested Management Planning Model

After looking at the present situation illustrated by the data presented above, it shows that the reserve is at about 90% untouched but then threat reporting trends based on reports have increased over the years due to the fact prevailing living conditions of local people needs to be improved upon due to poverty. The industry is exploiting the resources for the markets and government policies have shown many loopholes. Increase protection of the reserve depends on resources both human and financial, given that the economic situation is corrupt and the legal system inefficient, International donors and other associations which provide funding for the protected areas will definitely show less interest. Because critical speaking, any funds provided might end up in the pocket of an individual rather than for the protection of biodiversity in the reserve.

Theories on sustainability are both weak and strong. Those that are considered weak are based on balancing between economic, social and the environment. The triple bottom line concept falls within this category because it deals with balancing. Adaptive environmental planning though anthropocentric, it represents a new paradigm shift given its radical environmental law approach. It considers that any development should be bound within the limits of the development space to permit proper navigation through steering and control. Market instruments offer us the possibility to steer and control all actors within the Dja biosphere reserve.
As illustrated in figure 23, a policy model which considers application of TBL by the industries operating in the area, AEP by the authorities and politicians and the application of Market Instruments to enable the control of individual and company activities will help in protecting the biodiversity of the Dja reserve and also improving development by encouraging other small scale subsistence activities like ecotourism, rearing of animals, efficient farming methods, etc. given that in most cases it is a question of survival by the local people it is very important that any policies put in place should prohibiting hunting or significant cutting down of forests, an alternative means of living should be provided.

5.0 Discussion
The study came out with interesting findings which showed that the Dja biosphere reserve endowed with a rich spectre of fauna and flora is important for the subsistence of local population. Also, the state of the reserve is stable but the threats due to deforestation activities are increasing. Reasons for deforestation are diverse and some are very understandable given the fact that development is a necessary evil. However, the Impacts of deforestation need to be clearly understood to enable us best decide the tradeoffs to make between our environment and development. Involvement of all stakeholders is very necessary in helping the government better protect the area. Sustainable planning given the current situation of the Dja biosphere reserve with regards to the administrative setup and inefficiency in management of the reserve is very vital. The study confirms the point that there are increasing threats due to deforestation activities in the reserve, this falls in line with previous studies which report an increasing trend in the threat of degradation facing the Dja biosphere reserve. Some studies even attest that there is a higher degree of deforestation or loopholes in management policies than actually thought. This study can be a way forward to help raise consciousness about the dangers that
the Dja biosphere reserve is facing. It can contribute in helping policy makers, owners of logging companies and local populations to better understand what impacts their activities can have on the Dja biosphere reserve. This work is not however without any limitations, this should only give room for further research and studies about the impact of deforestation in the Dja biosphere reserve.

Application of the TBL Concept shows that we could only achieve weak sustainability meaning that it was more actor oriented giving less importance to the resource base and focused more on balancing between the environmental, the economic and social aspects. This concept can however be useful if we want to use it and achieve development within environmental limits. The triple bottom line concept considering the balancing of the interests of this generation and that of future generation still poses a problem because it seriously compromises the resource base which we leave for future generations. Also if we need to balance the interests of the community which live in and around the Dja reserve, the interest of exploiters and that of the whole nation, we shall see that there will be conflicts in the long run.

AEP Concept is a new paradigm shift and sets the basis for modern management planning considering its systemic approach. It is a way of achieving long term ecological sustainability. It emphasis the importance of the resource base as the most important and therefore we should not always think we can balance things by trying to minimize impacts on economic activities on the environment. New technologies, environmental impact assessments are they way forward because over exploitation and too much pressure on the resource base in an attempt to fight poverty have not helped developing nations so far. We are however not advocating for abrupt changes to the already established ways but action planning with goals and standards that goes over time to enable their achievement. It is for reasons of precaution and avoiding action as last resort that I advocate for adaptive environmental planning for the Dja biosphere reserve.

Blending market instruments of charge and permit systems can also help in reaching certain targets such as getting companies to comply with decisions, making biodiversity conservation cost effective, achieving fiscal objectives, applying best available technologies and helping us to internalize externalities from deforestation activities. Market instruments stand no chance on their own and therefore will need legal backing either within the AEP Concept or the TBL Concept for a better efficiency.
5.1 Recommendations
Important recommendations from this study include the following points:

- For the suggested management model to work properly it is very necessary to consider the autonomous management for the protected area. The new management will help reduce all unnecessary bottlenecks and bring administration closer to the reserve.
- The creation of a special where all proceeds from the market instruments are deposited to enable availability of funds for conservation programs in the reserve.
- Application of the EIA tool with proper public participation as part of the AEP.
- Compulsory corporate reporting of all assessments by companies based on life cycle assessments and input-output analysis of all their activities.
- The needs of local people need to be looked at carefully in the future.
- Proper training of ecoguards to uphold their morals followed by salary increases.

Limitations of this study include the fact that no practical applications or quantitative analysis were being carried out. Some of the data was dates back to two decades and this calls for concern about their relevance today given that there could be significant environmental changes or increase in deforestation activities in just a few years. This study opens up an area for further research into the application of the management model given that it was just proposed and described in the study. Scientific research is encouraged into the Dja biosphere reserve to help increase knowledge of the species and their health.

6.0 Conclusion
The study was aimed at looking at the impacts of deforestation on biodiversity of the Dja biosphere reserve. Though insignificant, the impacts are real and can grow over time. In conclusion, the time to act is now if we want to achieve ecological sustainability for the Dja biosphere reserve. The instruments are at our disposal and all we need is not just to sign conventions but also show our commitment by enforcing and implementing them. We have a basis to plan for the future to enable us and the future generations achieve development which does not go beyond the carrying capacity of our resource base. From the Bruntland report (1987) to the Rio Earth Summit (1992) and the Johannesburg summit (2002), the concept of sustainable development has shifted from weak to strong and focusing more on systemic planning based on long term goals and objectives. Consideration for our resource base which we cannot survive without should come first before economic or materialistic pursuits.
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