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## Comparative Multi-Criteria Assessment of Climate Policies and Sustainable Development Strategies in Cameroon: Towards a GIS Decision-Support Tool for the Design of an Optimal REDD+ Strategy

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**Abstract:** Cameroon is committed to reducing emissions from deforestation and forest degradation plus conservation, sustainable management of forests and enhancement of carbon stocks (REDD+). To achieve this goal, the government has introduced a series of policy reforms and formulated a number of key strategic planning documents to advance the REDD+ readiness process in Cameroon. This paper assesses the extent to which major cross-sectoral policies support or impede the development and implementation of an optimal REDD+ strategy in Cameroon from a comparative multi-criteria perspective. Study results reveal that a majority of the policy instruments reviewed appeared to be less prescriptive in terms of any tangible REDD+ strategy, as they do not have provisions for tangible measures to reduce deforestation and forest degradation. Given the lack of adequate flexibility, prompt review and responsiveness of these cross-sectoral policies to adapt themselves to new realities and respond to a changing environment, this paper introduces a GIS-REDD+ decision support system (GIS-REDD+DSS) that is necessary to support the adaptive element of an adaptive REDD+ strategy in Cameroon. The

GIS-REDD+DSS, an electronic REDD+agri intermediary hub, serves the following purpose: (1) host a database of locally-relevant climate information, improved input technologies, best practices as well as land use and forest cover geo-spatial maps; (2) host a virtual economic tool that performs economic valuations (costs and benefits) and financial analysis of REDD+agri projects to aid investment decision-making; and (3) host an electronic marketplace to mediate any-to-any transactions among REDD+agri project developers, service providers, input suppliers, private and institutional investors and buyers (wholesalers and retailers), thereby creating value in two ways: aggregation and matching. This decision support tool, we argue, is a fundamental prerequisite for “policy and REDD+ safeguard integration” innovation that allows new scientific findings to be integrated into REDD+ strategies in a short period of time.

**Keywords:** multi-criteria analysis; policy instruments; GIS; REDD+; decision-support tool; Cameroon; Congo Basin

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## 1. Introduction

Until the 1980s, protecting the environment was not a key priority and played an insignificant role in the decision-making process in Cameroon [1]. After signing the 1992 United Nations Framework Convention on Climate Change (UNFCCC), however, the government of Cameroon formulated and adopted a series of cross-sectoral policies to meet the requirements of the Kyoto Protocol [2]. As a signatory of the Kyoto Protocol in 1992, Cameroon is committed to help stabilize concentrations of greenhouse gases (GHGs) in the atmosphere [3] in keeping with Kyoto’s objectives of “stabilizing greenhouse gas concentrations in the atmosphere at a level that would stop dangerous anthropogenic interference with the climate system” [4–7]. Reducing emissions from deforestation and degradation is seen as a potential measure to achieve such an objective [8,9], with sustainable agricultural intensification seen as especially promising [10]. Despite this potential, there is currently no comprehensive national approach to reduce deforestation and forest degradation in Cameroon [1]. While a number of initiatives (e.g., REDD Readiness Preparation Proposal (R-PP) and REDD Readiness Plan Concept Note (R-PIN), national workshop for the validation of R-PP) and institutions (REDD+ Steering Committee, Creation of a National Observatory on Climate Change (ONACC), creation of a National REDD Civil Society Platform) have been designed to advance REDD+ readiness in Cameroon, the lack of a coordinated approach has been a major setback [11]. The process is addressed in a piecemeal fashion complemented by major initiatives and projects implemented by multiple agencies and levels of government [12]. Thus, structural factors, such as financing, benefit sharing mechanisms and the monitoring of forest cover, which are basic in REDD+ initiation and implementation, are left behind [13–15]. These factors pose a major challenge to the current REDD+ readiness framework in Cameroon [11].

Following a sustainable development approach, in line with greenhouse gas emissions reductions, a comprehensive emissions-reduction strategy that integrates emissions from all land-based economic sectors is necessary [16]. While emissions reduction strategies are likely to vary from country to

country, without tackling emissions from all land-based economic sectors, climate policy discussions, such as the REDD+ readiness discussions in Cameroon, run the risk of not delivering an equitable climate regime [17]. Thus, a national approach to land-based emissions-related problems should pursue the integration of emissions reduction strategies into all land-based policies, rather than the formulation of a specific policy [18]. While traditional strategic adaptation planning in Cameroon has for the past decade relied heavily on the formulation of key strategic documents [2], these documents lack adequate flexibility, promptness and tolerance to adapt themselves to new realities and respond to a changing environment [19]. This paper attempts to address this issue by introducing a spatial decision support system (SDSS) that is necessary to support the adaptive element of an adaptive REDD+ strategy.

Previous studies on the REDD+ mechanism in Cameroon have focused on REDD+ benefit sharing mechanisms [1], REDD+ preparation [13], advancing REDD+ social safeguards [20], opportunities and challenges of REDD+ [21], REDD+ governance framework [12], design options [22], as well as land tenure and stakeholder participation [23,24]. The analysis of alternative REDD+ scenarios has emphasized the synergies between the forest policy and clean development mechanism (CDM) [15] and REDD+ implementation [14]. However, a multi-criteria analysis of the extent to which cross-sectoral policies, with greater incidence on REDD+, support or impede the development of a REDD+ strategy in Cameroon has not been formally conducted. Taking the foregoing into consideration, five cross-sectoral policies were examined, specifically: the climate and energy policies, agricultural and rural development strategies, as well as the forest policy; with specific reference to their impact on deforestation and forest degradation.

The choice of these cross-sectoral policies was significant. The agricultural sector remains the main proximate driver of deforestation and forest degradation in Cameroon, with over 90% of the rural population engaged in small-scale agriculture [25]. The forest sector occupies about 42% of the total land area of the country [26] and has the potential to sequester carbon [27]. It possesses enormous carbon stocks and sequestered about 2.6 million tonnes of carbon in its vegetation in 2010 [28]. The energy sector relies heavily on traditional biomass, accounting for about 70% of the total energy consumption [29]. With over 90% of the population relying on fuel wood for lighting, cooking and heating, fuel wood harvesting has become an important source of deforestation and forest degradation, which has been growing at an annual rate of 1% per year [30]. Taking the foregoing into consideration, this paper is aimed at investigating the climate change impacts of five cross-sectoral policies on the socio-economy of Cameroon, focusing on an analytical framework for the design and implementation of an optimal REDD+ strategy. Specific objectives are to: (i) conduct a content analysis of selected cross-sectoral policies with greater incidence on sustainable economic development and natural resources management; (ii) propose a set of adaptive criteria to analyse the extent to which selected cross-sectoral policies support or impede the development of a REDD+ strategy in Cameroon; and (iii) utilize the proposed criteria to develop a spatial decision support system (SDSS), capable of integrating and analyzing the social, environmental, technological and technical aspects and the economic factors essential in planning and implementing an adaptive REDD+ strategy. The spatial decision support system, it is argued, is a fundamental prerequisite for “policy and safeguard integration” innovation that allows new scientific findings to be converted to new policies in a short period of time.

The paper is organized accordingly. In the Introduction, the context, rationale and objectives of the study are presented. In Section 2, the different levels of developing adaptive criteria, analysing cross-sectoral policies and designing a spatial decision support system are presented, as well as the methodology to be applied for each of these levels. In Section 3, we outline our findings, which we unfold in three steps. First, we provide a content analysis of selected cross-sectoral policies with greater incidence on sustainable economic development and natural resources management. Second, we offer a set of adaptive criteria to assess the extent to which selected cross-sectoral policies support or impede the development and implementation of an optimal REDD+ strategy in Cameroon. Third, we make use of the proposed set of criteria to construct a GIS decision-support tool to aid the planning and implementation of an optimal REDD+ strategy. In the final section, we provide our concluding remarks and the way forward. While this paper focuses specifically on Cameroon, the findings are relevant to other countries in the Congo basin (like the Democratic Republic of Congo, Central Africa Republic, the Republic of Congo, as well as Gabon and Equatorial Guinea) with similar geographical and socio-economic conditions, as they are likely to face similar challenges in planning and implementing an effective REDD+ strategy.

## 2. Materials and Methods

Since all of the regions in Cameroon are not autonomous in formulating their own climate policies and sustainable development strategies, our analysis of cross-sectoral policies and strategies has mainly focused on a national scale. Thus, five policy and planning documents have been identified as relevant regarding deforestation and forest degradation due to their incidence in sustainable economic development and natural resource management. The policy and planning documents analysed throughout this paper are the following: (i) the Growth and Employment Strategy Paper (GESP) of 2009; (ii) the Poverty Reduction Strategy Papers (PRSPs) of June, 2003; (iii) the Forest and Environment Sector Programme (FESP) of June, 2012; and (iv) the First National Communication to Climate Change (FNCCC1) of August, 2005. In addition to the selected policy instruments, it has been considered necessary to incorporate the Energy Policy into the assessment given that the African energy model has, for the past decade, been an important issue of debate. Thus, the use of solar energy and forest biomass has acquired renewed relevance as a renewable source of energy, though they exhibit positive and negative impacts on deforestation and forest degradation, respectively. The methodology employed for this study was based on 3 major steps. These include:

- Identification and assessment of cross-sectoral policies;
- Multi-criteria analysis of cross-sectoral policies; and
- Developing a GIS decision-support tool for planning and implementing an optimal REDD+ strategy.

The main sources of information used to develop the criteria were: (i) the UN-REDD Programme's Social and Environmental Principles and Criteria; (ii) the World Bank's Safeguards and Strategic Environmental and Social Assessment (SESA) framework; (iii) REDD+ Social and Environmental Standards (REDD+ SES); and (iv) the Forest Stewardship Council (FSC) Principles and Criteria. The choice of these information sources used to develop the criteria was equally of major importance. The study confirms and builds on recent international learning about the importance of social,

environmental and sustainable intensification safeguards as essential components in the development and implementation of an effective REDD+ strategy. By so doing, the study ensures that the proposed criteria and subsequent decision-support tool are aligned with the UN system requirements and safeguards agreed upon at the UNFCCC meeting in Cancun on December 2010.

The criteria were defined by the research team and then modified and validated through a combination of internal deliberations with 12 REDD+ experts currently working on several projects in Sub-Saharan Africa. Information was elicited using questionnaire interviews that were sent to 1 official at the Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED), 1 at the Ministry of Forests and Fauna (MINFOF), 1 expert at the University of Buea, 1 expert at World Wide Fund for Nature (WWF), 4 at the International Union for the Conservation of Nature (IUCN), 3 at United Nations Development Programme (UNDP) and 1 at the Food and Agricultural Organization (FAO).

By combining experts' answers and eliminating overlaps, a comprehensive set of 8 attributes and 40 criteria were finally selected, which, in the authors' view, constitute the most important dimensions in the design of an optimal REDD+ strategy. The criteria covered formal REDD+ attributes in the following areas: (i) policy support schemes; (ii) policy coherency; (iii) democratic governance; (iv) social safeguards; (v) environmental safeguards; (vi) sustainable intensification safeguards; (vii) protection of safeguard integrity; and (viii) the safeguards' economic performance assessment. These attributes consist of 40 criteria addressing issues such as: policy support schemes; policy coherency to adaptation and mitigation; poverty alleviation and job creation; stakeholder participation, equitable distribution systems; gender equality; respect for traditional knowledge; consideration of stakeholder livelihoods; coherency with other developmental and environmental policy objectives, both nationally and internationally; avoidance of natural forest conversion; minimization of natural forest degradation; ecological, genetic and socio-economic intensification; and the conservation and minimization of indirect adverse impacts on biodiversity and ecosystem services.

These criteria, we argue, ought to be central to the planning and implementation of an effective REDD+ strategy and the route to get there. They are the key dimensions in which reducing deforestation and forest degradation should perform well on. They also constitute a yardstick against which the effectiveness of the selected cross-sectoral policies were assessed and measured, while ensuring that REDD+ activities are aligned with the UN system requirements and safeguards agreed upon at the UNFCCC meeting in Cancun in December 2010. Starting from the identified criteria, five selected cross-sectoral policies were then assessed. Although the analysis was done with some level of subjectivity, as the case with other interpretive studies on multi-criteria analysis (see [31–36]), the authors took reasonable precautions to ensure that the criteria, which were validated by a few experts, were aligned with the UN system requirements and the safeguards agreed upon at the UNFCCC meeting in Cancun in December 2010.

The GIS decision-support system was developed in ArcGis, a GIS feature under Windows 2009. It integrates all of the proposed criteria that are essential in REDD+ planning and implementation into a computerized system in order to automate cartographic processing and related analyses. The system is comprised of four sections:

- a geo-climatic database;
- a criteria database;
- an electronic marketplace database;
- a set of processing scripts; and
- an interface for piloting all the operations.

The geo-climatic database contains locally-relevant climate information, such as temperature and precipitation, as well as basic geo-spatial maps of land use change and forest cover in shape file format. It is also designed to store spatial maps produced using 10-m pixels. The criteria database is contained in a Microsoft Access file. It is used to store all the criteria together with the main quantified results linked to the spatial maps produced. The electronic marketplace database is equally contained in a Microsoft Access file and serves the following purpose: to mediate any-to-any transactions among REDD+agri project developers, service providers, input suppliers, private and institutional investors and buyers (wholesalers and retailers), thereby creating value in two ways: aggregation and matching. The processing scripts are used to select country-specific criteria, geo-climatic and market information embedded in the database, as well as aggregating criteria and market information, linking them to the spatial maps produced. All geospatial maps created and the related analysis are stored in an interface accessed via the ArcMap environment of ArcGIS, version 9.1.

### 3. Research Findings and Discussions

This section of the paper presents a systematic assessment and multi-criteria analysis of the five selected cross-sectoral policies and emphasizes how the provisions of these policies support or impede the development of an optimal REDD+ strategy in Cameroon. Based on this analysis, the paper introduces a spatial decision support system (SDSS) to aid regional planners in planning and implementing an optimal REDD+ strategy.

#### *3.1. Analysis of Cross-Sectoral Policy Instruments Shaping Sustainable Economic Development and Natural Resources Management in Cameroon*

The main policy instruments reviewed include: (i) the Poverty Reduction Strategy Papers (PRSPs) of June, 2003; (ii) the First National Communication to Climate Change (FNCCC1) of August 2005; (iii) the Growth and Employment Strategy Paper of 2009; (iv) the Forest and Environment Sector Program (FESP) of June, 2012; and (v) the Energy Policy (EP). These policy documents were crafted in order to promote sustainable economic development and natural resources management in Cameroon. From the five policy instruments reviewed, the following observations were made.

##### 3.1.1. The 2003 Poverty Reduction Strategy Papers (PRSPs)

The 2003 poverty reduction strategy papers (PRSPs) have provisions for both social and fiscal policies that are intended to improve economic development and combat poverty. Increasing agricultural output and improving the economic conditions of the underprivileged are the main priorities of the fiscal and social policies in PRSPs. This is because social malaise and fiscal deficits are themselves a cause of unsustainable growth that could potentially erode the country's social capital

and undermine its competitiveness in the global economy [37]. To avert these dilemmas, PRSPs provide for a stable socio-economic framework aimed at revitalizing the agricultural sector, through improved farm-to-market access, thereby facilitating the integration of vulnerable groups into the economy. Nevertheless, the PRSPs recognize that achieving these goals are not without major challenges. These include inadequate structural changes, such as a non-competitive agricultural sector, low production capacities and dilapidation of energy and road infrastructures that undermine the country's social and fiscal fabrics. In recognition of these deficiencies, the Government of Cameroon, in association with the World Bank, requested a revision of the PRSPs, with the main objective of rectifying the implementation hurdles identified during successive evaluations of the papers. This revision ultimately resulted in the 2009 growth and employment strategy paper (GESp) [38].

### 3.1.2. The 2005 First National Communication on Climate Change (FNCCC1)

The 2005 First National Communication on Climate Change (FNCCC1) to UNFCCC, however, appears to provide for climate change mitigation and adaptation strategies particularly along the coastal region and the Sudano-Sahelian zone; the two major zones of climate change vulnerability in Cameroon [38]. Adoption of these strategies encourages the use of low impact technology-transfer opportunities and non-technological strategies, particularly in the agricultural sector and other land use patterns, which account for the majority of the country's emissions [39]. Among the technologies and strategies specifically outlined in FNCCC1 are: (i) the development of sinks, such as afforestation and sustainable forest management, to sequester carbon from the atmosphere; (ii) the uptake of energy-efficient technologies to reduce energy consumption; and (iii) the adoption of renewable energy technologies as substitutes to fossil fuel.

### 3.1.3. The 2009 Growth and Employment Strategy Paper (GESp)

The provisions of GESp form the basis for a vibrant and sustainable economic growth. From that premise, a series of policy instruments have been adopted by the Government of Cameroon to enable effective implementation of the Millennium Development and National Goals. They include: reducing extreme poverty and hunger, eradicating illiteracy through guaranteed education for all, and promoting gender equality and women's empowerment. Additional provisions include: reducing child mortality, improving maternal health and combating HIV/AIDS, malaria and other diseases. By having provisions for environmental sustainability, GESp seeks to leverage renewable energy to reduce the current national energy deficit and satisfy rural energy needs. It also entails massive investments to improve road infrastructure and information communication technology, as well as establishing a global development partnership to control and reduce youth unemployment rates. Although GESp is the most recent of all of the policies reviewed, it makes no mention of the word climate change nor has any provisions to address the impacts of climate change. This indeed portrays a disconnect between GESp's major objective of promoting a vibrant and sustainable economic growth, and the need for such development to adapt to climate change.

### 3.1.4. The 2012 Forest and Environment Sector Program (FESP) Document

The Forest and Environment Sector Program (FESP) document of June 2012, provides the legal framework for sustainable forest management in Cameroon. It has a considerable number of provisions to improve rural development and economic growth, but fails to address the impacts of climate change and adaptation. These provisions are summarized as follows.

It focuses primarily on harnessing the synergies and strengthening the interplay between national institutions, local communities and the private sector in the sustainable management, conservation and development of forests and other natural resources. In addition, the policy seeks to meet the dual objectives of poverty alleviation laid out in the 2003 Poverty Reduction Strategy Program and the conservation of wildlife and protected areas as depicted in the National Biodiversity Strategy and Action Plan [40]. It also has provisions for monitoring and evaluating the social and environmental impacts of national forest policies and programs, as well as public consultation mechanisms and collaboration with civil society. Despite the provisions for public consultation and collaboration with civil society, FESP does not provide for adequate access to information on the environment and the management of public environmental goods. Besides, the policy is devoid of a comprehensive incentive framework to stimulate and engage local communities in tree planting and the management of protected areas and hunting zones. In addition, the adoption of community-based wildlife and woodland management plans is still a major call for concern, while illegal logging practices, specifically in protected areas, still remains widespread, although forest management practices are deeply rooted in FESP. One such forest management practice includes biodiversity protection measures, by forest logging companies, in concessions located near ecologically sensitive areas, though its implementation has not been forthcoming.

### 3.1.5. The Energy Policy (EP)

Despite the technological potentials outlined in FNCCC1, there is no comprehensive national energy policy to promote renewable energy and energy efficiency technologies in Cameroon [41]. These technologies are addressed in a piecemeal fashion complemented by *ad hoc* regional and sectoral initiatives by multiple agencies and levels of government [42]. While much of the focus has been placed on exploiting the huge potential of hydroelectricity, other forms of electricity generation, such as biomass, wind and solar energy, are left behind [43]. Thus, major initiatives, such as the Renewable Energy Fund, the National Biogas Program and the Rural Electrification Master Plan, have taken central stage [29]. The Renewable Energy Fund, on the one hand, seeks to increase availability and access to capital and expertise to generate electricity through small hydroelectric stations. The National Biogas Program, on the other hand, seeks to increase the uptake of biodigesters and energy-efficient stoves in the country. Despite these major initiatives scattered all over the country, regulatory and policy uncertainty, lack of dedicated institutions and renewable energy tariffs, as well as inadequate funding and infrastructure are significant barriers to promoting renewable energy in Cameroon [43].

### 3.2. Comparative Multi-Criteria Analysis of Cross-Sectoral Policies vis-à-vis REED+ Planning and Implementation in Cameroon

Table 1 below summarizes the main strengths and weaknesses of the five cross-sectoral policies vis-à-vis their impacts in planning and implementing an optimal REDD+ strategy in Cameroon.

**Table 1.** Comparative multi-criteria analysis of cross-sectoral policy instruments.

<b>REDD+ Attributes</b>					
<b>REDD+ Criteria</b>	<b>GESP</b>	<b>PRSP</b>	<b>FESP</b>	<b>EP</b>	<b>FNCCC1</b>
<b>Policy Support Schemes</b>					
(1) Provide Tax Incentives, Subsidies, Grants and Training	Y	Y	Y	Y	Y
(2) Provide Climate Funds and Credit Schemes	N	N	N	N	N
(3) Provide Government Guarantees	N	N	N	N	N
(4) Set Offset Quotas and Standards	N	N	N	N	N
(5) Monetize Tradable Emission Certificates	N	N	N	N	N
<b>Policy Coherency</b>					
(1) Consistent with low-carbon, climate resilient and sustainable development strategies	Y	Y	Y	Y	Y
(2) Consistent with poverty alleviation and job creation	Y	Y	Y	Y	Y
(3) Compatibility with other policy instruments	Y	Y	Y	Y	Y
<b>Democratic Governance</b>					
(1) Require broad stakeholder participation and consensus decision making	Y	Y	Y	N	Y
(2) Ensure timely access to information	Y	Y	Y	N	Y
(3) Ensure transparency and accountability	Y	Y	N	N	Y
<b>Social Safeguards</b>					
(1) Protect indigenous people's legitimate right to free prior and informed consent	Y	N	N	N	N
(2) Protect indigenous people's culture and interdependence on resources	N	N	N	N	N
(3) Minimize loss of traditional territories and exclusion from natural resources	N	N	N	N	N
(4) Define land tenure and property rights	Y	N	N	N	Y
(5) Define benefits sharing and dispute resolution mechanisms	N	Y	N	N	N
<b>Environmental Safeguards</b>					
(1) Require protection and conservation of natural resources	N	Y	Y	N	Y
(2) Define mechanisms to halt trade in illegal resources	N	Y	N	N	N
(3) Enforce natural resources' laws	Y	Y	Y	N	N
(4) Promote certification schemes	N	N	Y	N	N
(5) Protect and conserve sensitive areas	N	N	Y	N	N
(6) Protect and conserve biodiversity, soil and water	N	Y	Y	N	Y
(7) Ensure permanence in emissions reduction and sinks	N	N	N	N	Y
(8) Define reference levels for emissions reduction and sinks	N	N	N	N	N

Table 1. Cont.

<b>REDD+ Attributes</b>					
<b>REDD+ Criteria</b>	<b>GESP</b>	<b>PRSP</b>	<b>FESP</b>	<b>EP</b>	<b>FNCCC1</b>
<b>Environmental Safeguards</b>					
(9) Define protocols for issuing carbon credits	N	N	N	N	N
(10) Prevent against reversals and leakage of emissions	N	N	N	N	Y
<b>Sustainable Intensification Safeguards</b>					
<b>Ecological Intensification</b>					
(1) Promote integrated pest management	Y	Y	N	N	N
(2) Promote integrated soil fertility management	Y	Y	N	N	N
(3) Promote integrated water management	Y	Y	N	N	N
<b>Genetic Intensification</b>					
(1) Promote higher yield germplasms	Y	Y	N	N	N
(2) Promote drought resistant germplasms	Y	Y	N	N	N
(3) Promote pest resistant germplasms	Y	Y	N	N	N
<b>Socio-economic Intensification</b>					
(1) Promote capital investments	Y	Y	Y	N	N
(2) Catalyze climate-indexed insurance	N	N	N	N	N
(3) Develop input and output markets	Y	Y	Y	N	N
(4) Build social, human and financial capital	Y	Y	N	Y	N
(5) Build adequate infrastructure	Y	Y	N	Y	Y
(6) Promote sustainable livelihoods	Y	Y	Y	Y	Y
<b>Protect Integrity of Safeguards</b>					
(1) Require monitoring, verification and reporting protocols	Y	Y	Y	N	N
<b>Economic Performance Assessment</b>					
(1) Require cost-benefit analysis of safeguards	N	N	N	N	N

GESP: Growth and Employment Strategy Paper; PRSP: Poverty Reduction Strategy Paper; FESP: Forest and Environment Sector Programme; EP: Energy Policy; FNCCC1: First National Communication to Climate Change; YY: major fulfilment of criterion by policy (major strength); Y: moderate fulfilment of criterion by policy (moderate strength); N: no fulfilment of criterion by policy (weakness).

All of the policy instruments analyzed provide comprehensive coverage of all criteria corresponding to policy coherency: poverty alleviation, job creation, low-carbon, climate resilient and sustainable development. Out of the five cross-sectoral policies, three (*i.e.*, GESP, PRSP and FNCCC1) do consider the criteria related to social safeguards. GESP and FNCCC1 tend to emphasize promoting land tenure and property rights, while PRSP requires that mechanisms for benefit sharing and dispute resolution be clarified. Apart from the energy policy that is still to be developed and enacted, the other policy instruments require broad stakeholder participation and timely access to information for better decision-making. PRSP, FESP and FNCCC1 require that natural resources, sensitive areas, biodiversity, soil and water be protected and conserved, while none requires a flexible country-specific approach to defining reference levels for emissions reductions or conducting an economic performance assessment of safeguards.

Just FESP and PRSP promote certification schemes and mechanisms to halt illegal trade of natural resources, respectively. Besides, all of the policies require that the livelihoods of indigenous peoples be enhanced, although none requires a flexible country-specific approach to protecting their farming systems through the promotion of climate-indexed insurance. FNCCC1 is the only policy document that requires permanence in emissions reductions and sinks, as well as preventing reversals and leakage of emissions. Just GESP and PRSP considered all of the criteria corresponding to ecological, genetic and agricultural intensification, while GESP, PRSP and FESP require a flexible country-specific approach for periodic third-party audits/monitoring, reporting and verification of safeguards.

Looking at the adequacy of the five major policy documents that are the subject of this review, none appears to be very prescriptive in terms of any tangible REED+ strategy. In case after case, we observed that the provisions of all of the five policy instruments are not optimal from an REED+ perspective and tend to focus only on a small set of criteria; ignoring the impacts of other major criteria. All of the policy instruments seem not to have provided for attainment measures to address many of the UN REDD+ system requirements and safeguards agreed upon at the UNFCCC meeting in Cancun in December, 2010; thus accounting for major weaknesses in their provisions and unintended negative consequences with respect to the development and implementation of an optimal REDD+ strategy. Given the lack of adequate flexibility, prompt review and responsiveness of these cross-sectoral policies to adapt themselves to new realities and respond to a changing environment, the next section of the paper introduces a GIS-REDD+ decision support system (GIS-REDD+DSS) that is necessary to support the adaptive element of an adaptive REDD+ strategy in Cameroon.

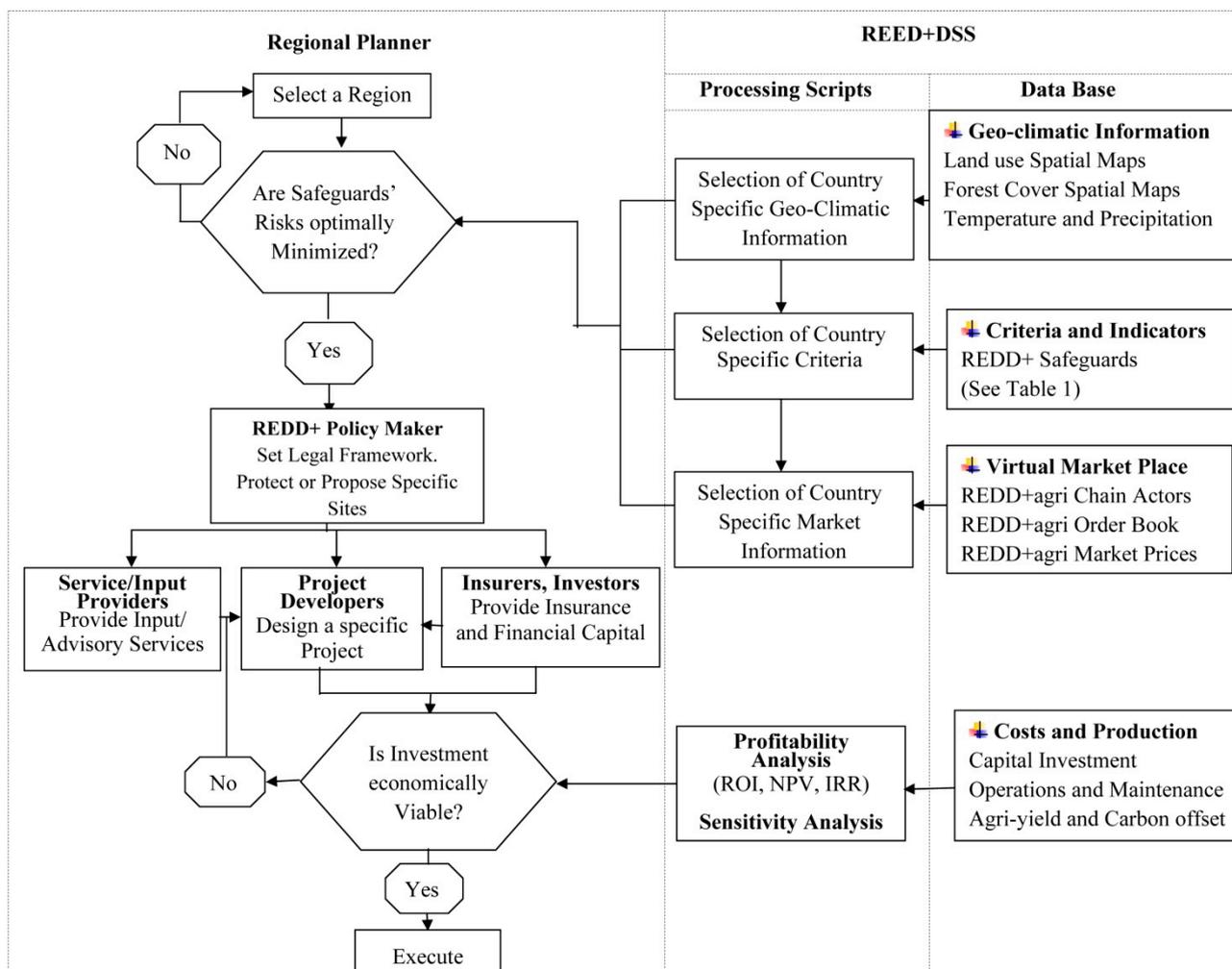
### *3.3. A GIS Decision-Support Tool for Planning and Implementing an Optimal REDD+ Strategy*

The proposed GIS-REDD+ decision support system (GIS-REDD+DSS) is applicable to different types of stakeholders, such as REDD+ planners, service providers, private investors, institutional financiers, insurance agencies and REDD+agri project developers, spanning smallholder farmers to large businesses. It has the capability to provide the different types of information needed by each stakeholder and offers a common framework for comparing decisions and evaluating proposed actions. It allows for promptness, responsiveness and flexibility in adjusting the database to new scientific findings. An overview of the core elements of the GIS-REDD+DSS algorithm is presented in Figure 1.

From the processing scripts, the user selects specific country criteria, geo-climatic and market information from a drop down menu. The scripts are determined by land use change and forest cover spatial maps, temperature and precipitation data, REDD+ safeguards, as well as REDD+agri chain actors, an order book and market prices embedded in each level of the database. The computer model, which forms the essential part of the overall toolbox, simulates different scenarios and determines the maximum acceptable safeguard risks of a proposed project, which is the information required by regional planners. Next, the model estimates the profitability of a specific investment, which is the information required by project developers, private investors, institutional financiers and insurance agencies. The profitability or feasibility is determined by the return on investment (ROI), net present value (NPV) and the internal rate of return (IRR), which is estimated after a project developer designs a specific project and sets the costs and policy support schemes under which the project is developed. A sensitivity analysis on the discount/interest rates and capital cost provides additional information on

financial performance. Thus, the need to consider alternative projects or strategic interventions when ROI, NPV and IRR are not acceptable. In such cases, a comparison between different alternatives should point out an acceptable solution.

Figure 1. GIS-REDD+ decision algorithm.



The electronic marketplace creates value in two ways: aggregation and matching. The aggregation mechanism, on the one hand, brings together a large number of REDD+agri project developers, service providers, input suppliers, private and institutional investors, as well as brokers and buyers (wholesalers and retailers) under one virtual roof; thereby automating transactions, reducing transaction costs, expanding market access and choices of chain actors by “one-stop shopping”. The matching mechanism, on the other hand, relies on an electronic order book that records bid prices and specific quantities of interested buyers and sellers in a search engine that determines which orders or trades can be fulfilled or executed based on quality and market prices.

#### 4. Recommendations and Conclusions

Five cross-sectoral policies shaping sustainable economic development and natural resources management in Cameroon were reviewed for information about their potential influence on REED+ planning and implementation in Cameroon. These policy instruments were, in principle, designed to

meet the requirements of the Kyoto protocol after the signing of the 1992 United Nations Framework Convention on Climate Change (UNFCCC).

Despite the government's efforts to meet the Kyoto requirements, most of the policy instruments reviewed appeared to be less prescriptive in terms of any tangible REDD+ strategy. They do not have provisions for tangible measures to reduce deforestation and forest degradation. In this sense, climate policies and sustainable development strategies that have been subject to this review have generally been fast and *ad hoc* reactions to specific situations instead of proactive adaptation and mitigation measures, as depicted in Table 1. In this situation of ineffective policies that have resulted in the increase of ecological and socio-economic risks, and in the proliferation of deforestation and forest degradation, the need to integrate democratic, ecological and socio-economic safeguards into all land-based policies, rather than the formulation of a specific REDD+ policy, becomes clear. It would contribute to giving coherence to the very diverse existing policy instruments.

There have been significant contributions and advances in international climate discussions, which provide an interesting starting point for introducing a comprehensive REDD+ strategy in Cameroon. This is a concept for planning and operational systems that include the social, economic, democratic and ecological safeguards highlighted in Table 1, with the main objective of minimizing deforestation and forest degradation and maximizing the sequestration of carbon. Consequently, a spatial decision support tool to achieve this objective has been set out. This tool box should favor and improve the efficiency of an REDD+ strategy adapted to a specific national context. It covers the democratic, ecological and socio-economic gaps that presently exist in the diverse policy instruments. While this paper focuses specifically on Cameroon, the GIS-REDD+ decision algorithm highlighted in Figure 1 is applicable to other countries in the Congo basin (like the Democratic Republic of Congo, Central Africa Republic, the Republic of Congo, as well as Gabon and Equatorial Guinea) with similar geographical and socio-economic conditions, as they are likely to face similar challenges in planning and implementing an effective REDD+ strategy.

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## Author Contributions

All the authors contributed to the conception and design of this research. Kehbila performed the research, analyzed the data and drafted the paper. All the authors contributed in addressing the comments of the reviewers, read and approved the final manuscript.

## Conflicts of Interests

The authors declare no conflict of interest.

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