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Prospects of "Avoided Deforestation" as a Post Kyoto Instrument in Mitigating Climate Change

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1 Introduction

1.1 The Kyoto Protocol

The 1992 UNFCCC conference organized in Brazil to combat atmospheric warming could not set threshold limits. However inroads were made for updates to fix emission limits in the near future. The Conference of Parties (COP) met every year since 1994 to define and implement a framework. The third COP (COP3) slated in the Japanese city, Kyoto, became known as the Kyoto Protocol in 1997. COP3 was able to set binding targets for reducing GHGs for developed countries and countries in transition (*Annex 1 country*). These were adopted by the United Nations (UN) as a real bite to the 1992 treaty[1]. *Annex 1 countries* are expected to reduce GHGs emissions by an average of 5.2 percent below 1990 levels by the period 2012[2]. Quantitative GHGs reductions were also expected from developing nations by introducing the CDM[3] (*Clean Development Mechanism*). Nevertheless, COP3 ended with unresolved questions on the role tropical forest play in GHGs emissions mitigation.

1.2 Tropical Forest Ecosystem as Sinks verses threat of deforestation

Sinks are natural or man-made systems capable of absorbing and storing GHGs, (CO_2) from the atmosphere. Forest as sinks has the potential to sequester Carbon over longer periods. When forest increase in size, it absorbs atmospheric CO_2 as part of the process of increasing its biomass, thus acting as a sink (absorbing emissions). About two-thirds of global terrestrial carbon is sequestered through this process. When forest is cleared or harvested without replanting, stored carbon is released back into the atmosphere. Under the Kyoto Protocol Accounting (KP_A), clearance of forest without replanting is diagnosed as a *"source"*. Nevertheless, efforts made by topical countries towards mitigating deforestation rates are excluded from the treaty's commitment period.

1.3 Sustainable Forest Management (SFM)

SFM digress completely from the principle of managing forest for *"sustained yield"*[4]. To a school of thought (CAB, 2001; MacGregor, 2000; McCool et al., 2001; Ober, 1998), it is a management system that aims at maintaining forest's critical ecological functions, mindful of its biological diversity and at the same time concerned with adverse impacts of human activities on the resource so as to ensure its availability in perpetuity. Since the resource base is shrinking at a fast pace management perspectives has taken a global dimension. Issues dealing with its judicious use and conservation are tackled from a participatory point of view by identifying who constitute management stakeholders (Socio-economic dynamics, forest community, government and the international community) and what is required of them.

1.4 Study Objective

SFM has been pursued as part of meeting obligations under article 4.1 (a) of the UNFCCC treaty (commitment towards removal of sinks). The objective of this paper is to perform a measure of successes assessment on progress towards SFM over the last two decade and its implication for policy direction in Ghana towards combating climate change through avoided deforestation.

2 Study Area

The high forest zone (HFZ) of Ghana is tropical in nature with three (3) strata (emergent, canopy and under canopy). Its peculiarities are that of high biodiversity, high precipitation (1,000 mm-2,000 mm) and very warm temperatures (average of 26^{0c}) throughout the year. A greater share of the resources in question's bio-geographic affinity is associated with the Guinea-Congolian (TG-C) and confined to the south western part of the country. To the northern section is the Tropical Sudan (TS) type with the Dahomey-Gap running through the north south-east. Prevailing ecological dynamics above puts the major forest types into 6 main researchable categories, three (3) classes of evergreen and three (3) types of deciduous, each with its distinct association of environmental conditions and plant community.

2.1 Justification for Choice of Area

The choice of study area is justified by the fact that; favourable conditions exist in Ghana for achieving SFM as exemplified in its tall history of forest management documents, a well composed institutional and le-

[1] Satisfies article 2 of the UNFCCC in achieving atmospheric GHG stabilization
[2] In consonance with articles 3.1 & 4, for joint fulfillment of commitment to emission reduction
[3] CDM allows Annex I (developed) countries to meet their emission reduction targets by paying for green house gas emission reduction in non-Annex I (developing) countries.
[4] Harvesting the capital of forest stock

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gal framework, good governance and an impressive political will, committed to the recourse of natural resource management. More ever the HFZ, with a total area of 8.2 million hectares, is identified within the biodiversity hot spot regions in the tropics whose fast deteriorating status, over the few decades has been of global concern to environmental scientists and natural resource managers. The sector is also an important economic variable in Ghana's quest for sustainable development (Vision 2015)[5] equation in terms of employment, contribution to GDP, foreign exchange earnings and most importantly cottage industrialization.

3 Methodology

Measuring progress towards SFM is discordant to the traditional scientific process as in other state of the environment assessments. Since SFM is in the less tangible aspect, a criteria and indicator (C&Is) prognosis was administered.

3.1 Theoretical Construct

A theoretical model was proposed under the assumption that

- Development, in whichever form has the tendency to erode environmental resources, Socio-economic growth and development is therefore inseparable from environmental issues,
- Sustainability assessment is a measure for measuring sustainable development,
- Sustainable natural resource management is a key determinant of sustainable development,
- A progressively positive and sustained SFM over a given period of time will lead to sustainable development "all other things being equal".

The theoretical construct is that SFM is a function of an increasing environmental vitality, an increasing societal well-being, and an increasing economic growth and development. The simplified function, with variables defined is of the form; $SFM \equiv Sd = f(Eco_{gd} + Sty_{wb} + Env_{vt}) \rightarrow equation\ (1)$, where **Sd** = sustainable development, $\mathbf{Sty_{wb}}$ = improved societal well-being, $\mathbf{Eco_{gd}}$ = improved economic growth and development, $\mathbf{Env_{vt}}$ = improved environmental health and vitality, **Plus** (+) = improvement, **Negative** (-) = decreasing, Equation *(1)* represents an ideal situation difficult to achieve in a real world **Sd** dynamics. However, based on the light greens environmentalism's assertion and in consonance with the World Conservation Union and the World Bank's stands (1994) on the same reasoning[6], it is possible to improve societal well-being, economic growth and development and environmental health and vitality through appropriate selection of strategic resource management policies fig. 1. There is no zero-sum trade-offs between environmental vitality, societal and material well-being. In case of a disjoint policy application **Sd** can still be achieved along trade-off curves through resource substitution or compensation, eg;

- SFM can be achieved with improvements in material well-being, improvements in environmental vitality and a decreasing societal welfare; $[SFM \equiv Sd = f(Eco_{gd} + Env_{vt} - Sty_{wb})] \rightarrow equation\ (2)$,
- SFM can be achieved with increasing societal well-being, a decreasing economic growth and or development and a decreasing environmental vitality; $[SFM \equiv Sd = f(Sty_{wb} - Eco_{gd} - Env_{vt})] \rightarrow equation\ (3)$,
- SFM can be achieved with improvements in environmental vitality, improvement in societal welfare, and a decreasing economic growth and development; $[SFM \equiv Sd = f(Env_{vt} + Sty_{wb} - Eco_{gd})] \rightarrow equation\ (4)$,
- SFM can be achieved with economic gains, decreasing environmental vitality and decreasing societal welfare; $[SFM \equiv Sd = f(Eco_{gd} - Env_{vt} - Sty_{wb})] \rightarrow equation\ (5)$.

3.2 The Conceptual framework

Conceptually SFM is an input with the underpinnings of **Sd**. It is seen as the most important contribution the forest sector can make to the **Sd** objectives of Ghana's Vision 2015. The framework (fig. 1) is hierarchical in nature with three imperatives; a successful SFM as a means to achieving a sustainable development objective in Ghana; enabling and or reinforcing policies, programs-strategies and appropriate tools (P, C & I) for assessment. Its successes in meeting the new paradigm's objectives need to be intertwine with baskets of policies, strategies and programmes that are mindful of economic growth and development, the well-being of forest communities and critical ecological vitality that allows for possible trade-offs. This kind of game where policy baskets are tailored occurs in a *sustainability arena space* (fig. 1). In between the management tool (s) and achieving desired results (Sustainable Development) are policy optional fields (Shaded rings, path ways).

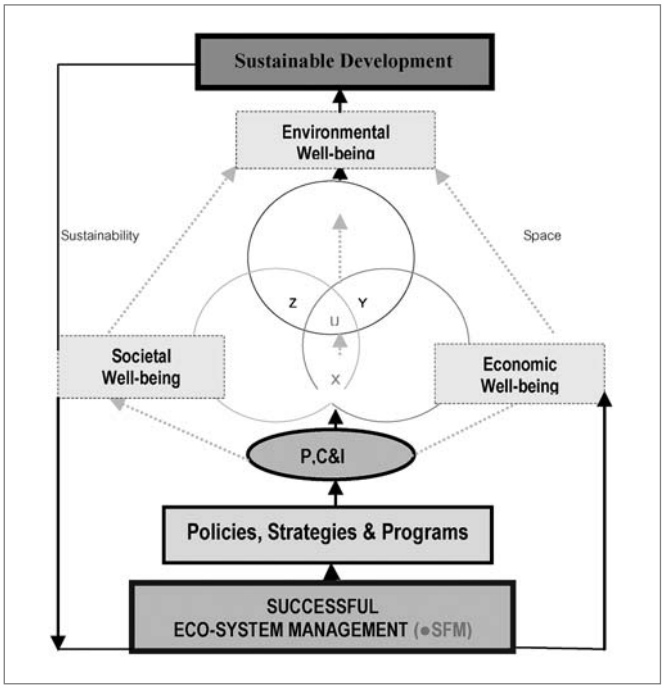

Figure 1:
A conceptual model for measuring progress towards SFM

[5] Ghana's vision of agenda 21

[6] Substitution between environmental and reproductive forms of capital would be sufficient to offset reductions in non-renewable stocks of environmental asserts produced by Socio-economic developments

3.3 Informed Decision on Possibilities of Policy Outcomes

From the conceptual model 7 bundles of policy outcomes (Policy baskets) are possible, ostensibly for the promotion of;

- improved economic gains,
- improved social welfare,
- improved ecosystem health and vitality,
- deep conservation (y),
- deep ecology (z) ,
- pure community development (x) and
- sustainable forest management (Z).

Table 1:
Informed decision on possible policy outcome

Policy baskets	Policy direction	Possible policy outcome
1	Economic inclined (Eco_{gd})	Improved economic gains
2	Ecology inclined (Env_{vt})	Improved ecosystem health & vitality
3	Society inclined (Sty_{wb})	Improved social welfare
4	Economic + society + environment (u)	Sustainable Forest Management (SFM)
5	Economic + ecosystem (Y)	Pure conservation
6	Ecosystem + Society (z)	Socio *Eco* -economy
7	Economic + Society (x)	Pure community development

3.4 Identification and Development of Criteria Set

A set of criteria was identified. These defined characteristics of the main aspects of SFM to be measured. The choice of criteria set was however influenced by the outcome of major global forest management processes such as UNCED, ITTO, FAO and the World Bank working documents on C & Is. This is to establish a basis that will allows for scope of comparison of the outcome with similar SFM initiatives in other countries.

Therefore in consonance with chapter 11 of Agenda 21[7] (UNCED, 1992), and structured under 4 thematic categories (Environmental health & vitality, economic growth & development, social-wellbeing, and enabling conditions), 10 criteria set were selected (fig. 2) for the study.

7 Chapter 11 of Agenda 21, "Combating desertification" called for "the formulation of scientifically sound criteria and guidelines for the management, conservation and sustainable development of all types of forests".

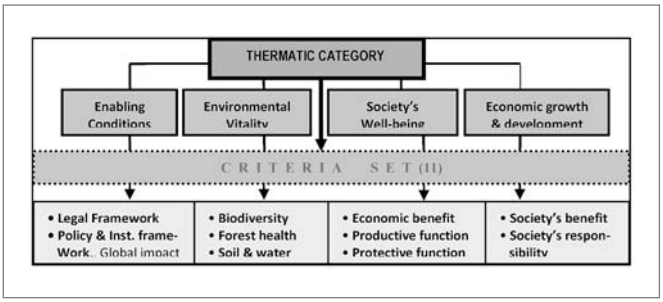

Figure 2:
Thematic groupings and selected criteria for SFM

3.5 Identification and Development of Indicator Sets

An indicator is the measureable aspect of a criterion. Together with stakeholders, including 6 selected forest communities, 53 indicators bordering on the thematic categories were identified. Indicators with attributes perceived to be simple, acceptable by all stakeholders, field tested and cost effective were accepted as feasible and applicable. Analysis to evaluate applicability also took into consideration availability of mechanisms and instruments to measure them. Methodology for the analysis and discussion of indicator applicability by stakeholders was evaluated using an indicator applicability litmus scale graduated from 0 to 100 with the following ratings (fig. 3).

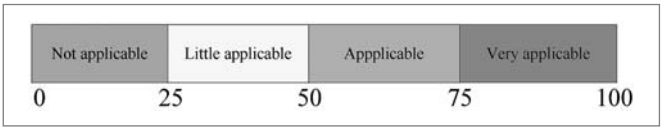

Figure 3:
Indicator applicability ratings litmus scale (IARLS)

Indicators whose score ranged 50-74 and 75-100 were identified as applicable. In all 29 applicable indicators were adopted. Those that could not make up to the 50th (0-24 and 25-49) mark were rated as not applicable and not accepted for the analysis.

4 Results

Performance scores were determined for each indicator by determining their maximum threshold levels ($MaxT_I$), minimum threshold limits ($MinT_{Imt}$) and the actual performance levels (AP_I). Based on the formulars below weighted indicator scores were established (see tab. 2).

a. With best is the maximum value and worst the minimum value,

$$\left[\left(\frac{AP_I - MinT_{Imt}}{MaxT_I - MinT_{Imt}}\right)\right] \times 100$$

b. Best as minimum value and worst as maximum value,

$$\left[1 - \left(\frac{AP_I - MinT_{Imt}}{MaxT_I - MinT_{Imt}}\right)\right] \times 100$$

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Table 2:
Weighted indices, Field data analysis, 2008

Thematic Criteria					
a. Environmental vitality (Env_{vt})		**b. Societal well-being (Sty_{wb})**		**c. Economic growth & development (Eco_{gd})**	
Indicators	Σ of mean Score	Indicators	Σ of mean Score	Indicators	Σ of mean Score
1	80	1	39	1	51
2	43	2	75	2	50
3	05	3	09	3	43
4	04	4	61	4	63
5	19	5	50	5	33
6	24	6	62	6	95
7	17	7	61	7	49
8	32	8	13	8	22
9	51	9	31	9	95
10	38	10	09	10	-
Total	313	Total	410	Total	501
Weighted Score	**31.3**	**Weighted Score**	**41.0**	**Weighted Score**	**56.0**

Table 3:
Indicators for measures of successes towards SFM

Criteria	Nr.	Indicators	Score
Environmental health & vitality	1	Degree of Control over management of forest resources	80
	2	Number of appropriate tech. for monitoring and evaluation	43
	3	Extent of area under natural forest	05
	4	Extent of primary forest	04
	5	Extent of area by forest type	19
	6	Extent of area for special management provisions	24
	7	Habitats and population levels for known forest species at risk	17
	8	Extent of natural area disturbed (logging, fire, insects, diseases)	32
	9	Extent of area harvested using good tree technology	51
	10	Net mass carbon per unit area accumulated in the HFZ	38
Societal Well-being	1	Financial commitment to SFM	39
	2	Adequacy of professionals to manage resources	75
	3	Extent of area under plantation	09
	4	Mean annual increment of resources	61
	5	N0. of households that depend on forest as sources of fuel-wood	50
	6	Number of households with forest-based employment	62
	7	Access to environmental information	61
	8	Degree of community participation in forest management	13
	9	Equitable sharing of forest proceeds (stumpage)	31
	10	Employment in each forest based activity	09
Economic growth & development	1	Degree of land tenure and property rights	51
	2	Number & Adequacy of institutions to support SFM	50
	3	Number of appropriate tech. for harvesting	43
	4	Contribution to GDP	63
	5	Extent of area available for timber production	33
	6	Extent of area conserved for recreational activities	95
	7	Contribution to employment levels	49
	8	Number of timber related industries	22
	9	Extent of eco-regions in protected area	95

The weighted scores were feed into MoFRUSS developed specifically for this work to determine extent of SFM. MoFRUSS is a 0-100 end point scale graduated into 5 bands of 20 points each on the *Y*-axis for measuring forest resource use sustainability. The *X*-axis is represented by the trio sectors (Ecosystem, Society and Economy). It is a modified version of the barometer of sustainability (BoS) developed by Allan Prescot for Conservation International Union for assessing the well being of nations. The results are exhibited by fig. 4. From the C & I prognosis, Env_{vt} indicators performed abysmal. With a mean score of 313 and weighted index of 31.3 it registers its performance within mid-section of the potentially unsustainable segment of MoFRUSS (fig. 4). Comparatively Sty_{wb} indicators show a much more improvement in individual score points than the former to accumulate a total of 410 points.

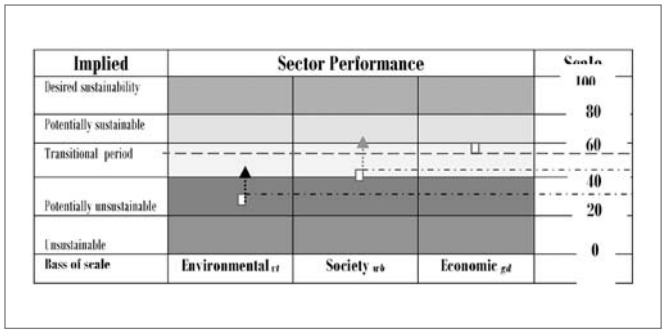

Figure 4:
The Measure of Forest Resource Use Sustainability Scale (MoFRUSS)

The weighted index (41.0) was however strong enough to put it only at the inception of the transitional zone point (fig. 4). *Eco*$_{gd}$ indicators performed much better than the affore-mentioned. With a total score of 501 points and weighted index of 56.0 it registers an impressive position within the upper limits of the transitional zone on the scale. The likely explanation to this may be linked to the fact that until the mid-nineties policies with regards to forest management were all economic centred. From the foregoing analysis, it is evident from MoFRUSS (fig. 4) that measures of successes towards SFM in Ghana over the last 2 decades have not achieved desired sustainability. However with weighted cumulative index skewed towards mid-section of the scale, extent to which progress towards SFM has been achieved so far translates to that of the transitional period.

4.2 Policy Implication

The transitional period zone, once reached, become a launching pad for decision makers to either concretize efforts made so far (launch into the potentially sustainable zone) or negates all efforts (fall back in the potentially unsustainable zone) achieved. From the conceptual model it is established that equilibrium will occur in the sustainability arena if the 3-tier sector (Ecosystem society, economy) indicators rise (become positive) or has the potential to rise through shifting of resources from one sector to the other (compensation). From MoFRUSS such compensation should be made from the economic sector to that of the ecosystem and social fabric (policy interventions).

Since the conceptual model (tab. 1) postulates 7 bundles of policy baskets for decision makers the appropriate policy intervention should draw on policy basket six (6), which has ecosystem and societal well-being as its policy direction and a Socio*Eco*-economy as the possible policy outcome to tackle the issue of raising societal well-being and ecosystem vitality levels. A forest management policy with a forest eco-society as a goal to achieve is one which encourage forest communities to maximise resource – use to improve standards of living and commits same to be mindful of the forest ecosystem's ability to sustain itself over the next reasonable period of time through the collaborative efforts. An opportunity for improvement associated with the outcome of the research, which policy makers could explore to effectively achieve stated objectives mentioned above is embedded in the concept of avoided deforestation.

5 Prospects of Avoided deforestation (ADf)

Avoided deforestation is reducing damaged CO_2 that would have occurred in tropical forest to offset GHGs emissions levels under the Kyoto protocol. As much as the Kyoto protocol recognize forest as sinks in mitigating CO_2 emission levels the agreement does not recognize conscious efforts undertaken by tropical countries to reduce national rates of deforestation as stipulated under articles 4 (section 8c) 6.1b, and 6.1d of the UNFCCC Convention. Measure of successes towards SFM is a necessary condition for AD_f. The studies established daily deforestation rates in tropical countries at 86,000 hectares. In the case of Ghana annual loss is pegged at 65,000 hectares. Annual cost of degradation to the Ghanaian economy of Ghana, according to Morgan (2007) take about 10 percent of her gross domestic product (GDP). Measures of successes towards SFM in Ghana has made some positive impact in reducing deforestation rates as gleaned from tab. 4 over the two-decade period (1980-2010).

Table 4:
*deforestation rates in Ghana from 1980-2010, Source: Field data analysis, 2008, * projected figure*

Period	1980	1985	1990	1995	2000	2005	2010
Deforestation rates (000 ha/yr)	60	86	120	135	138	115	65*
Marginal deforestation rates	0	26	34	15	3	-23	-50

Within a decade of the *Economic Recovery Progamme* (1980-1990)[8] deforestation rates doubled with a marginal deforestation rate of 34 by 1990 (tab. 4). By early 1990 concerns for environmental care had become a global cry and therefore embracing SFM principles in Ghana necessitated the 1994 wildlife and forest policy. The initiative to manage resources on sustainable basis paid off. Data analysis show that between the period 1990 and 2000 deforestation rates were still of concern to policy makers but was increasing at a decreasing rate. Over the same period marginal rates decreased from 34 to 3. By 2005 marginal rates had recorded negative digits (-23) and it is projected that by the end of the era under study (2015) this figure will be stablized around -50 or less.

5.2 How Much Land Will this Translate to?

Considering the period between 1995 and 2005, with the former as the base year, avoided deforestation will correspond to 20,000 hectares of land (fig. 5) over the ten year period expressed as; (d_f*baseyr* - d_f*currentyr*) = 135,000 - 115,000 = 20,000 ha, where **a.** d_f*baseyr* = deforestation level at base year, **b.** d_f*currentyr* = deforestation level at current year.

[8] Directives from the Briton Woods institutions to developing nations to salvage their economies in the 1980s through export oriented initiatives. The HFZ of Ghana was raped for its round logs.

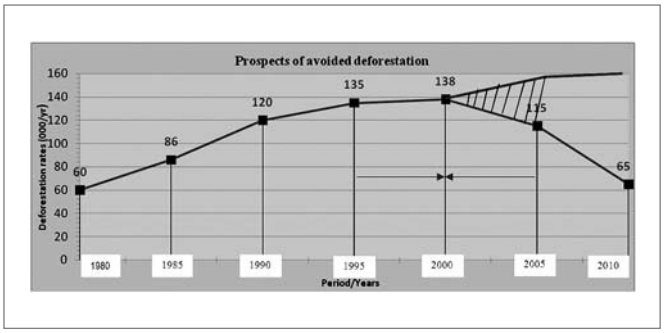

Figure 5:
Prospects of avoided deforestation, 1980-2010, Source: Field data analysis, 2008

5.3 How Much Damaged Carbon will this Represent?

The study also established that a hectare of undisturbed tropical forest, on the average, harbours 140 metric tons of carbon (140 mtc) in above-ground biomass and 64 metric tons (64 mtc) of carbon in below-ground biomass. It imply that over the same period under consideration avoided deforestation could mitigate; **a.** 20,000 x 140 = 2,800,000 metric tons of carbon on the higher side and **b.** 20,000 x 64 = 1,280,000 metric tons of carbon on the lower side.

5.4 How much Money will this Quantify?

The economic argument for avoided deforestation is how much this translates into quantifiable monetary terms. From the statistical data (tab. 4), and given a world market price of 17 euros per metric tons the following scenario will persist; **a.** On a high side avoided deforestation could generate 2,800,000 x 17 = 47,600,000 euros over the period under review. **b.** On a low side avoided deforestation could generate 1,280,000 x 17 = 21,760,000 euros over the same period.

6 Conclusion

From the foregoing examination, opportunities associated with measure of successes towards SFM as identified under the case of avoided deforestation presents some laudable prospects. A successful SFM could minimize deforestation rates and sustain annual timber yields through implementation and enforcement of harvesting standards and threshold. This could safeguard biodiversity and preserve other ecosystem services. It has the potential to mobilize financial support and other needed logistics to forest communities as means of diversifying their stereotype subsistence way of living. It could form the legal basis for tropical countries to make a case for carbon financing under the Kyoto protocol and satisfy obligations under Article 4.1(a) of the UNFCCC treaty by helping to fight climate change at a relatively minimum cost.

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