PART II
THE POTENTIAL OF MITIGATION

of the Belizean forest sector

Belize could trade almost 600,000 tons of carbon in the international market, according to the study on estimated carbon sequestration potential conducted by the Forest and Climate Change in Central America Project.

This number is obtained by subtracting the Baseline (376,928 tons), which corresponds to the carbon sequestration produced without any Clean Development Mechanism (CDM) project, from the total carbon benefits of the national forest sector (1,854,078 tons). The 1,477,151-ton difference corresponds to the extra carbon credits generated by interventions geared specifically to achieve that purpose (additionality).

However, a certain percentage must be deducted to take adjustments, re-emission and risk into account. Regarding the adjusment for re-emision, the project assumes a rough average of one half the net carbon value bringing the net carbon storage value down to 738,576 tons of carbon (50% of 1,477,151 tons). In relation to the risk factors, this project uses a generic figure of 20% as the discount to apply to the national total carbon potential (20% of 738,576 tons). When this value is applied, the national total is further reduced to 590,861 tons of carbon. This is the final potential for mitigation in Belize.

The research also identified a total of 182,478,000 hectares in Belize qualifying as Kyoto Areas and appropriate for CDM projects.

The Conference of Parties held in Marrakech determined that the forestry projects that can be included under the Clean Development Mechanism (CDM) include afforestation and reforestation, as well as land use and management practices that increase carbon sequestration levels. However, these projects will only be allowed on lands deforested before December 31, 1989 and not yet reforested as of 2000 (Kyoto Areas for CDM). Only projects initiated in the post-2000 period will be eligible to claim emission reductions under the CDM.

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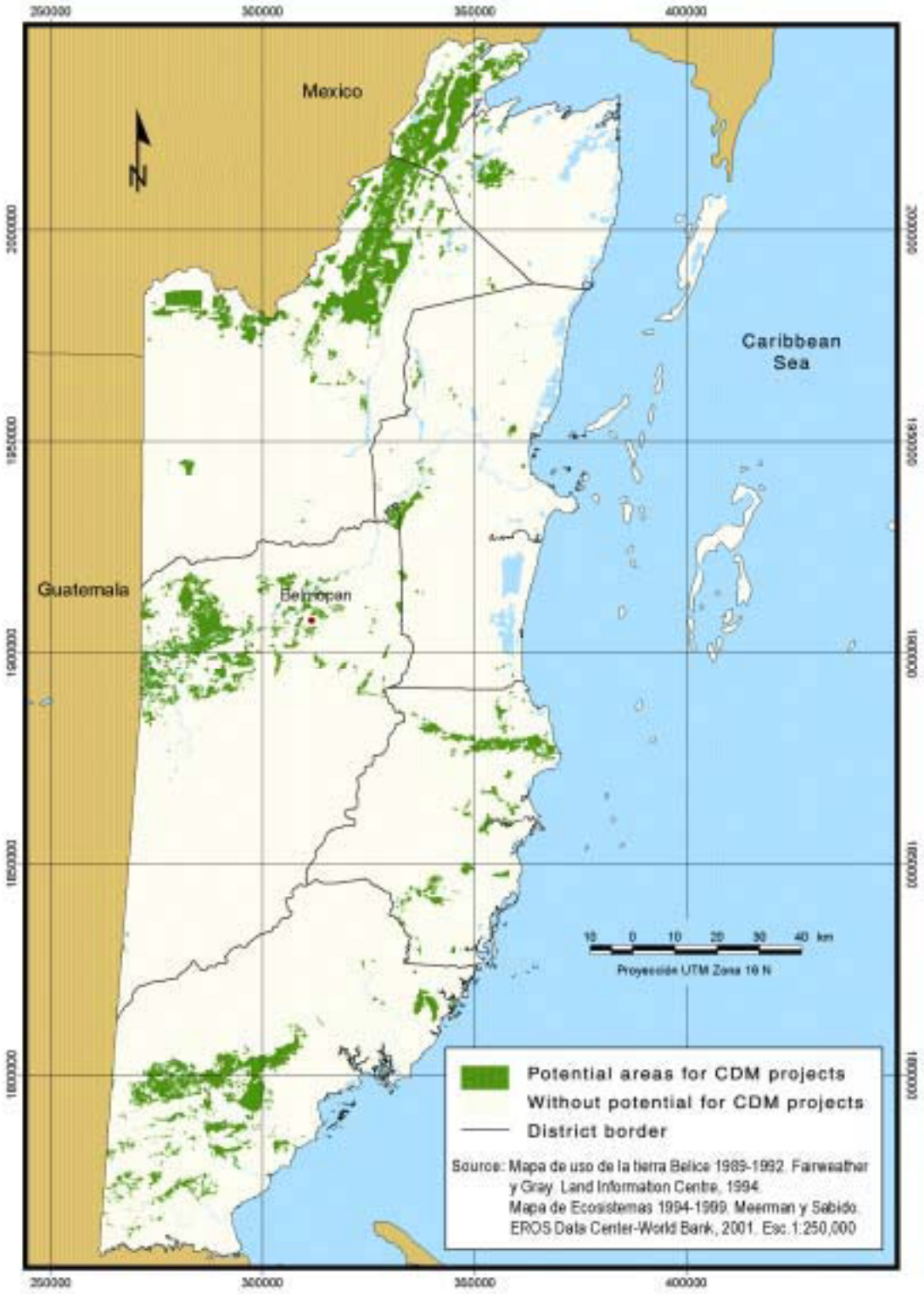
Belize-Potential Areas for CDM projects

Forests and Climate Change in Central America Project FAO - CCAD



METHODOLOGICAL FRAMEWORK TO IDENTIFY THE POTENTIAL FOR MITIGATION OF BELIZE

The "Forest and Climate Change in Central America" project has put great emphasis on the regional countries adopting a common methodology to evaluate the potential of the forest sector in the individual countries to mitigate climate change. The adopted methodology will serve as the basis for assessing greenhouse gas emission mitigation in the forestry sector at least for the first commitment period leading up to 2012.

Essentially, the framework for the estimation of the carbon storage potential of the forest sector within the definitions given under the Clean Development Mechanism (CDM) of the Kyoto Protocol consists of seven steps, which are given in brief below. At the heart of the methodology is the concept of additionality, which means that the extra carbon credits can only be generated by interventions geared specifically to achieve that purpose. It therefore follows that the net carbon offset of any given forestry project will be the difference between the *baseline* scenario (what would have happened without the project) and the project scenario (what will happen as a result of the project's activities).

The term reforestation is given below and throughout the rest of the report to mean both afforestation and deforestation since under the present arrangements there is no real distinction between the two definitions in terms of project implementation. Under the CDM, the only two land use activities allowable for emissions reduction are afforestation and reforestation, however there is broad interpretation as to the exact definition of these two activities. Articles 3.3 and 3.4 of the Protocol related to forest and land-use activities within developed countries and the negotiating text for these articles has given a working definition on afforestation, reforestation and forest. These definitions are:

- *Afforestation* is the direct human-induced conversion of land to a forested state through planting, seeding and/or the promotion of the natural seed sources, with the requirement that the land was not forested within the preceding 50 years.
- *Reforestation* is the direct human-induced conversion of non-forested land to forested land through planting, seeding or the promotion of natural seed sources on land that was forested but had been converted to non-forested land. In the first commitment period of the CDM (2008-2012) reforestation activities will be limited to those land that did not contain forest on 31st December 1989.
- *Forest* is defined within the negotiating text as a minimum area of land of 0.05 hectare with tree crown cover of more than 30% and with the potential to reach a height of 2-5 meters at maturity in situ. Forest was also defined to include young natural stands and all plantations that had not yet attained a crown cover of 30% nor had achieved a height of 2-5 meters.

Areas which are normally covered by forest but are temporarily under stocked due to such human interventions as timber harvesting, among others, but are expected to revert back to forest are also included as forest under the working definitions.

A final decision is expected on these definitions at the COP 9 to be held in 2003, in the meantime however, it is not expected that the final definitions will differ considerably from those given above if at all. It should be noted that the definitions given are very restrictive as to the scope of activities that will be allowed under land use of the CDM and in their present strict definitions would preclude many worthwhile and needed forest intervention measures. Belize in particular with its low levels of land degradation and deforestation would not qualify for projects involving forest rehabilitation, revegetation and enrichment planting if they did not involve in some way the conversion of non-forest vegetation to forest vegetation. It is clear that developing countries such as Belize will have to form a regional negotiating block and deal hard for a relaxation of the strict definitions and to insist that the CDM pursue a more liberal approach in which the host country itself will be able to decide on the definition that best fit its particular circumstances.

The seven steps

The methodological framework for estimating the carbon storage potential of the forest sector in Belize will follow the steps outlined below.

1. Step One: Identification of potential project areas using the following criteria.
   a. Identification of the areas eligible under the Kyoto Protocol. However this must include only those areas deforested before 1990 and will exclude all areas now covered by forest under the definitions given for forest in article 3.3 of the Protocol. These areas can be represented by maps of forest cover or soil use before 1990 of scale 1:250,000 or larger.
   b. Identification of areas with real potential for forest projects, which are defined as follows:
      i. Areas that can feasibly be reforested under prevailing biophysical conditions.
      ii. Areas that are socio-economically feasible for reforestation.
      iii. Baseline carbon content of the potential project area in the absence of project activities show an appreciable capacity for increased biomass levels.
   c. Areas with combined favorable biophysical and socio-economic characteristics.

2. Step Two: Estimation of the carbon content of the baseline using the following approach:
   a. Determine the areas having different types of vegetation cover.
   b. Calculations of carbon content per hectare for each vegetation type in the baseline.
3. Step Three: Identification of the specific project activities.
4. Step Four: Estimation of the carbon content per hectare resulting from each activity undertaken in the project.
5. Step Five: Calculation of net carbon sequestered under the step two scenario of project activities.
6. Step Six: Calculate the potential production of carbon credits for the country.
7. Step Seven: Readjustment of the figures to account for the risks associated with the project.

About 40% of the dry biomass of a tree is carbon and calculations are available from previous research projects for individual species within the region using mathematical formulas. The calculation of carbon biomass for individual trees however is time consuming, expensive and requires considerable expertise. Researchers have therefore extrapolated the values for the various species found under different forest types and have devised formulas which allows for much quicker calculations of the carbon biomass. For the estimation of the carbon content of a given forest type there are several models available, some of which are flexible in their application over a wide range of situations and others, which are specifically tailored to meet the needs of certain geographical areas under set environmental conditions.

Observations on the methodology

Despite the best efforts at standardization of the methodology, there remain real differences among the Central American countries in the availability of the necessary inputs such as maps and other resource materials, which in many cases differ from country to country. There are also vast differences in the national circumstances in regards to levels and extent of land degradation, socioeconomic factors and the institutional capacities.

In some cases the resources required may not be available at all, or may not cover the periods required by the Kyoto Protocol, while in other cases where the information exists, it may not be available in the specifications called for in this study. It therefore follows that the analysis of the potential project areas will require the adaptation of whatever tools are available locally, which will yield results that are qualitative in that they are based on reasoned assumptions and calculations. However, they also are subjective in that they are based in part on definitions that are not yet agreed to by the Conference of the Parties; likewise, are also dependent on the definitions that the potential host country apply to their situation. This is acceptable as long as it falls within the scope of the definitions that have so far been given under the Kyoto Protocol and

the CoP 7. The establishment of clearer rules and definitions that is expected to be an outcome of CoP 8, may result in a need to further refine the analysis.

The national perspective

There will be differences in the regional interpretation of the definitions given in the Protocol since the socioeconomic and environmental situation in all the countries will vary. A good example of this will be found in the area of potential land use. Except for Belize and Nicaragua (which use a system of five classes to define the soil potential) all the other Central American countries use a system comprising eight classes. A system will therefore have to be devised that will allow for a broad correspondence between the five classes used for these two countries and the other countries in the region. In addition it is generally assumed that forestry activities will fall into classes IV–VII. The idea being that grade VIII is too poor to support forest without great outlays of financial resources, while grades less than IV are considered agricultural land and if earmarked for forestry will sooner or later be taken over for agriculture with a loss in investment. Again, while this general guideline may be applicable to most of the rest of Central America, in their strictest sense, it does not necessarily apply to Belize. Because of its low population density, demand for agricultural land is less severe with much good grade I, II and III agricultural land under forest cover and in many cases already dedicated to this type of land use in perpetuity (e.g. where they occur in statutory protected areas). It therefore follows that plantation forestry in some of the areas with better soils will be more acceptable to the Belizean population than would be expected elsewhere in the region. This general tendency will also be aided by the fact that it will be possible for a project developer to acquire larger tracks of land hence improving the prospects for his enterprise through economy of scale.

POTENTIAL FOR MITIGATION IN THE LAND USE AND FOREST SECTOR OF BELIZE

Socioeconomic trends

Belize is the least densely populated Central American country having an average population concentration of only 10.88 persons per sq. Km. (CSO, 2000). When the population is segregated into rural and urban, the rural population densities between the districts averages out at about 5.6 persons per sq. Km., however most of the population lives within the coastal areas, and the northern one-third of the country.

The population of Belize is almost evenly divided between urban (48%) and rural (52%) dwellers. These figures indicate an interesting trend of recent times, in which the rural proportion of the population is increasing when compared to the urban population and contradicts the scenario in most developing countries where rapid urbanization is the norm (see Table 5). Most of this growth has been due to immigration from Central American countries, but the statistics also show a high internal birth rate of 2.6%. If the population continues to increase at present levels it will double in the next 26 years (CSO 2000).

At the national level, the rate of social development is almost evenly distributed across the country. However, the Toledo district has tended to score lower than the other districts for most categories investigated. The Belize district has the highest socioeconomic indicators, while the Corozal district is the most densely populated and Toledo the least. A word of caution in interpreting the population density figures is that a large portion of the Cayo, Stann Creek and Toledo districts are covered by protected areas where people do not live; therefore the population density in the populated areas is much higher than indicated in Table 6.

Table 5
Demographic patterns in Belize over the last 30 Years
Urban/rural population as a percentage of total population

Year	Urban (%)	Rural (%)
1970	54	46
1980	51	49
1990	52	48
2000	52	48

Some human development indicators in the six political districts of Belize

	Population density (per sq.Km)	Poverty (%)	Children with growth retardation (%)	Unemployment Rates (%)	Education to Primary level
Corozal	17.48	26.7	15.8	12.7	51.2
Orange Walk	8.54	24.9	16.8	11.8	55.0
Belize	16.33	24.5	4.1	13.1	51.0
Cayo	9.52	41.0	17.8	13.7	46.1
Stann Creek	9.38	26.5	13.5	11.8	52.5
Toledo	5.13	57.6	39	12.0	47.4

Land potential and land use trends

It is generally believed that some 79% of the country is still under some form of natural vegetation cover, but this amount may now need to be revised in light of deforestation that has taken place since the late 1990's and the first three years of this decade. As of June 2000, about 45.9% of the total land area of the country was under some form of protection (CSO, 2000). This figure includes both public and private protected areas. The private ones constitute a sizeable portion of the total protected areas network but except for the Río Bravo Conservation and Management Area do not have a legal underpinning; however their contribution to biodiversity conservation, education and research is immense.

About 38% of the statutory protected areas are dedicated to biodiversity conservation, education, visitation, and research while the rest are located within areas allowing for managed extraction of resources including timber. Of the 17 forest reserves, four are under controlled management regimes for timber harvesting and one has been certified for sustainable timber production under Forest Stewardship Council guidelines.

Of the total land area of the country, about 16.5% is suitable for sustained agricultural production with minimal additional inputs to enhance soil properties (Grades I and II soils). Currently, about 34% of this land is dedicated to agricultural production while the rest is held as undeveloped land by the government and private landowners. The most heavily cultivated lands lie along the Río Hondo to the north, the Belize River Valley Plains to the west, and along the southern foothills of the Maya Mountains. According to the Ministry of Agriculture, the main agricultural crops in 1999 were sugarcane (approx. 23,085 ha.) which is cultivated in the two northern districts of Corozal and Orange Walk; citrus (approx. 11,300 ha.) which is grown principally in the Stann Creek district; and bananas (approx. 2,400 ha.) which has as its center of production the Stann Creek and Toledo districts. Most of the remaining agricultural land is devoted to traditional and non-traditional crops and pastures.

Although a sizeable proportion of farmers still engage in shifting cultivation, this practice is waning as more and more farms convert to mechanized agriculture with a commensurate consolidation of small farms into larger holdings. Shifting cultivation is centered in the south of the country and around the numerous communities that have sprung up as resettlement sites for Central American refugees. In some of these areas there is a pressing demand for good agricultural land as populations increase ensuing in shorter fallow periods and a resulting degradation in soil fertility and structure.

Table 7
Land Use Summary
(1989 - 1992)

Class	Subclass	Percent of total	Area in hectares
Urban Areas		**0.4**	**8,362**
	Built Up	0.262	
	Non- built up	0.122	
Agricultural Land		**10.0**	**216,990**
	Herbaceous Crops		
	Annual Crops -mechanized	1.848	
	(with pasture)	0.856	
	Annual crops – non mechanized	0.901	
	(with milpa and thicket)	0.165	
	(with Herbaceous and Scrub Secondary regrowth)	0.134	
	Bananas	0.095	
	Sugar-cane	2.943	
	(with herbaceous and Scrub secondary regrowth)	0.972	
	Tree Crops		
	Citrus	0.595	
	Mango	0.076	
	Cocoa	0.009	
	Cashew	0.002	
	Shifting cultivation (milpa style)	1.71	
	(with thicket)	0.203	
	Pasture	1.64	
	(with mechanized annual crops)	0.29	
	Clearing for farming	0.135	
	Shrimp farming / aquaculture	0.012	
Range Land		**8.8**	**192,341**
	Savannah (herbaceous, scrub or tree)	8.827	
	(with thicket)	1.371	
Forest and other Wooded Areas		**79.0**	**1,721,398**
	Broadleaf Forest (including secondary)	65.12	
	(with thicket)	0.680	
	(with pine)	0.260	
	Open Broadleaf Forest (woodland)	0.552	
	Pine Forest	2.64	
	Open Pine Forest	0.34	
	Thicket and other degenerated Broadleaf Forest	3.89	
	Herbaceous and Scrub, secondary regrowth after farming or clearing	0.86	
	Bamboo and Riparian Vegetation	0.529	
	Coastal Strand Vegetation	0.114	
	Mangrove (Medium – Tall)	0.359	
	Mangrove (Dwarf)	1.077	
	Saline swamp vegetation with palmetto and mangrove	1.583	
	Marsh Swamp	1.926	
Unproductive Land		**1.8**	**39,976**
	Bare Land	0.0351	
	Water Bodies	1.800	
Totals		**100.0**	**2,179,067**

Table 8
Potential agricultural land use
(by districts and totals in hectares)

	Grade 1	Grade 2	Grade 3	Grade 4 & 5	Grade Total
Corozal	0	74,622.47	25,855.61	85,639.28	186,117.34
Orange Walk	641.52	121,883.94	155,586.82	185,885.28	463,997.56
Belize	17,369.64	26,371.17	66,978.90	320,357.43	431,077.14
Cayo	41,598.36	26,207.96	80,074.98	372,107.11	519,988.41
Stann Creek	12,778.56	18657.54	19,281.24	204870.06	255,587.40
Toledo	26,621.05	11,973.83	100,783.03	302,327.23	441,705.15
National Total	99012.38	279716.89	448,560.58	1,471,186.30	2,298,473.00

Source: Central Statistical Office

Of all the various forms of land use, agriculture is most widely associated with land degradation in Belize. The clearing of forestland for agricultural purposes has resulted in loss of biodiversity values in certain areas and has left the landscape exposed to such agencies of land degradation as water erosion, soil acidification and the loss of natural soil structure and fertility. The clearing of forestland is also responsible for the majority of the country's GHG emissions.

In the future it is not expected that the acreages for Belize's main export crops such as sugarcane, citrus and bananas will increase significantly given the depressed world market prices for these commodities, which does not appear to be abated any time soon.

Land tenancy and rate of deforestation

The national territory is divided into a mix of private lands, lease national lands, national land, forest reserves and other protected areas under different management designations. Within this area, deforestation is highest on the lease national lands. This is probably a reflection of the proviso that to assume ownership of such lands, the lessee would have to prove development, which in most cases meant deforestation for a variety of uses. It is not known what the current rate of deforestation is, or where it is most manifested, however it is assumed that there is no abatement in the trend observed in Table 9.

Table 9
Deforestation by Land Tenure Category
Estimated Rates of Forest Clearance per Annum
(1989 – 1991)

Tenure Type	Approximate Land Area (hectares)	Approximate Rate of Clearance (% per annum)	Approximate Area Cleared (hectares per annum)
Private Property	774,725	3.8	58,725
Leased National Land	243,162	5.9	30,375
National Land	540,999	0.5	10,125
Forest Reserve	578,032	0.2	1,782
Wildlife Reserves	86,411	-	-
Private Reserves	75,006	-	-
Total	2,298,335		101,007

Sources and sinks in the land use and forestry sector

The land use and forestry sector produces more GHGs than any of the other sectors. Even so, as previously noted, it is also the most important carbon sink and accounts for the country being a net remover (sink) of GHGs from the atmosphere. While logging, fuel wood removal, and deforestation for a variety of purposes but mostly to accommodate agricultural expansion releases CO2, and to a lesser extent CH4, N2O, NOx and CO into the atmosphere, other forestry practices lock up this carbon in the woody biomass of plants. Forest management activities such as enrichment planting, reforestation, afforestation and forest plantations are particularly associated with this mode of sequestration. Other management interventions such as fire suppression, thinning, and related silvicultural practices help to increase the amounts of carbon sequestered.

Table 10
Climate mitigation potential of forest sector
Land use change and forestry sector as GHG source and sink

	CO_2 Emission	CO_2 Removal	CH_4	N_20	NO_X	CO	NMVOC	SO_2	HGFC	PFC	SF_6
Changes in Woody Biomass Stocks		-5750.72									
Forest and Grassland Conversion	1666.54		6.473	0.044	1.608	56.639					
Abandonment of Managed Lands		-415.14									
CO_2 Emissions / Removals from Soils	325.061										
Other											

Most emissions from the forest and land use sectors come from the clearing of land for agricultural development. This practice is responsible for releasing about 1,700 Gigagrams on an annual basis. This constitutes approximately 58% of the national output of CO2, the most abundant GHG. As Table 11 shows, the use of firewood as fuel source is waning in the country; however many families in the Toledo districts (54.8%) and many immigrant communities continue to use wood as their main fuel source.

Table 11
National trends in the use of wood as cooking fuel

Year	Type of Cooking Fuel			
	Wood	Butane	Electricity	Other Fuels
1980	31.3	60.5	1.1	7.1
1990	29.2	62.0	0.9	7.9
2000	15.8	79.5	0.6	2.3