Gallery Forests Recovery and Carbon Credits

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Abstract

The loss of natural forest coverage reached 86% from total forested areas in São Paulo State until the year 2003. This scenario gets more critical when gallery forests are taken into account. This particular kind of forests offers ecological services even more important than normal forests. Even inside law protected areas as well as permanently protected areas (CPA) riverside forests have been progressively devastated. Clearing off riverside forests, besides other problems, causes water resources depletion as the rivers lose this kind of natural protection. A critical factor on riverside forest recovery is related to the high costs on planting and maintaining reforested areas. This work presents an analysis developed to evaluate the potential carbon sequestration on recovering gallery forests, aiming to obtain CERs (Certified Emission Reductions) from a CDM (Clean Development Mechanism) project, as foreseen in the Kyoto Protocol. The proposal is divided in four main steps. In the first step the target area is defined and the total CPA area is marked. Then, which part of the CPA area is still forested and which part is not are determined. During the third step the local gallery forest main characteristics are analyzed. In the fourth step the information regarding development duration, population size of each tree species and individual diameter at breast height (DBH) are used to calculate the amount of carbon accumulated in the reforested area. Finally the proposal is applied for the micro-basin of Jacaré-Guaçu River, in São Carlos (21°30´S, 47°30´W) region, São Paulo State, Brazil. The results show an accumulation of 69tC/ha considering only above ground and a cost for sequestered carbon of US$ 7/tCO2eq. Considering the actual CER´s market value, US$ 5/tCO2eq the carbon credits are not enough to meet the costs of reforestation but represents a valuable contribution.

Keywords: Carbon sequestration, riverside forests, Clean Development Mechanism.

1. Introduction

Increasing anthropic interference in the biosphere, through the search for food, fuels and raw materials is causing environmental quality deterioration, manifestation of which is the constant increase of greenhouse gas concentration in the atmosphere. This, in turn, aggravates the greenhouse effect that, according to scientific predictions, will increase the mean terrestrial surface temperature between 1.0 and 3.5 degrees Celsius and elevate the mean sea level between 15 and 90 centimeters during this century (IPCC, 1996). The IPCC (Intergovernmental Panel on Climate Change), also foresees that the atmospheric carbon dioxide concentration may double by 2050 (the atmospheric carbon concentration in the forties was 280 ppm, while today is 375 ppm) (DOE, 1999).

One way to control carbon emissions is by more efficient use of energy, thus diminishing the need for increasing its generation. Another way is to substitute energy generation based on fossil fuels by others emitting less carbon emissions per kW generated, as is the case with renewable sources (wind, solar, biomass, etc.). A third approach, aimed at sequestering and storing atmospheric carbon consists in absorbing carbon from the atmosphere by photosynthesis in plants and in the soil. More recently physical carbon capture from fossil fuel gases and its storage in deep ground wills or in the ocean is being considered.

The projects for mitigating the greenhouse effect around the world, have enphasized the first two alternatives cited. This is due mainly to the fact that the energy matrix in the developed countries, principally the U.S.A., is based on fossil fuels with large-scale use of mineral coal. Worldwide, 75% of the marketed energy derives from fossil fuels and, in the U.S.A., 84% of the energy consumed is fossil (IEA 2000).

In the case of Brazil, hydroelectric energy generation represents an important source of electrical energy production (more than 80%) (BEN, 2002). This reduces the potential of mitigation which is realized by substituting fossil sources by renewables (as a rule, emission in the interconnected Brasilian electric system is 0.02 tC/MWh, very low when compared, for example, with that of mineral coal (0.36 tC/MWh) (CENBIO, 2000). Even when we introduce into this scenario the thermoelectric plants planned for installation within the country, little will be altered in relation to CO_2 emissions, because the major fuel to be utilized, natural gas, presents low carbon dioxide emissions (compared with mineral coal): 0.11 tC/MWh when burned.

Otherwise, the country offers favorable conditions for carbon sequestration projects, due to the great extent of cultivable areas coupled with a favorable climate. In addition, a viable carbon sequestration project such as that proposed here, needs to be safe, monitorable, and measurable.

The State of São Paulo, according to the most recent survey done by the Forestry Foundation, owns 3.3 million hectares covered by native vegetation, representing 13.4% of the total state area. The remaining vegetation is distributed in heterogeneous form, concentrated in areas of greater declivity, in the Serra do Mar, and in publicly administrated conservation units. Nevertheless, most areas are almost devoid of native vegetation.

With respect to riverside forest the situation is especially alarming. Surveys by the Forestry Foundation estimate at more than 1 million hectares river-bordering areas lacking protective forest. Only to recuperate these areas, 2 billions plants would have to be produced, planted and maintained.

In the case of recomposing degraded area in riverside forests, elaboration of a carbon sequestration project brings with it additional difficulties. These are mainly due to the peculiarities of riverside sites, among them, dealing with a narrow long strip, and the great diversity of species encountered therein. Even though presenting additional difficulties, the environmental benefits, resulting from the recuperation of these sites, are proportionally larger since the ecological functions fulfilled by this kind of vegetation cover exceed in importance those of other forests types.

2. Materials and Methods.

The main metodology steps proposed in a riverside forest recuperation program according to the CDM criteria follow:

First Step – Definition of the study area and determination of existing riverside forest area existing within it. This determines the first boundary of the project. This task maybe done by different methods depending mainly on available information and size of the area to be analyzed.

Second Step: Determination of the areas requiring recuperation. Once the study area is defined, the length of the river estimated, and the width of the permanent preservation stripe determined according to the forestry code, it is possible to calculate total riverside forest area. This is done by multiplying the total length of the river by the width of the protection strip set in the forestry code (CONAMA, 2001) as a function of river width. The width of the protection strip usually varies from 30 to 50 meters.

Third Step: Determination of the species to be used in reforestation. Within the CDM, the main objective of the projects is to reduce/avoid carbon emissions or to withdraw carbon from the atmosfere, as is the case with carbon sequestration projects in reforestation. In restoring riverside forest, in addition to carbon sequestration other local benefits occur, e.g., hydric resource and biodiversity preservation. Successful implementation of a project demands that it be done with vegetation similar to that of the original cover.

Fourth Step: Determination of the carbon amount fixed with a given reforestation, the carbon amount in the area that will be reforested, net carbon change and consequent CER generation.

4. Results

The municipality of São Carlos is situated in the central region of São Paulo State. Occupying an area of 1132 Km^2, it has a population of 182,094 inhabitants, 93.6% of them in the urban area. The Jacaré-Guaçu River micro-basin is located in the southern-most part of the municipality, in which is found Lobo Reservoir, an important scenario in several studies in areas like limnology, applied ecology, and others.

First Step: definition of the study area and determination of total riverside forest area.

Initial work required use of Land Sat 7 images (2002) occupying bands 5R-4G-3B in UTM and Datum SAD 69 for the fuse 23 . The micro-basin limits were determined with the aid of the IBGE maps at the 1:50,000 scale. From the image analysis it was possible to define an APP (Area of Permanent Protection) with total area of 3,016 ha.

Second Step: Determination of the areas requiring recuperation.

Utilizing the same processed images employed in the first step, and aerial photos in the 1:10,000 scale, an area of 885 ha needing recuperation was estimated, i.e, the equivalent of 30% of the total area.

Third Step: Determination of species to be utilized in the reforestation.

For this purpose, field sample data taken from TUNDISI (2000) were used. Each sample is equivalent to a strip defined in a remnant area of riverside forest of the region. Each sample has an area of 300 m^2 (50m long and 6m wide).

From field research analysis results, 134 species were identified and coupled into classes of succession (LORENZI, 2000) as shown in Annex 1. Subsequently, the reforestation model was planned, having as its main criterion the largest possible diversity and the proportion of species in the different classes of succession (pioneers (P), initial secondaries (Si), late secondaries (St), and climax (C)) as 50% for P, 20% for Si, 20% for St, and 10% for C. The proportion of individuals of in each successional classes can vary according to the reforestation implantation strategy. For example, in this case of a region in which there are many remnants of riverside forest, the recomposition can be done just by introducing pioneers and occasionally groups from other classes.The number of individuals to be planted on each hectare also was defined as a function of the mean of individuals encountered in the natural available samples (1,551).

Thus, to simulate a reforestation for carbon sequestration, use was made of 1,500 individuals per hectare divided in 134 species, 50% primaries (P), 20% initial secondaries (Si), 20% late secondaries (St), and 10% climax.

Afterwards with the help of an allometric equation, whose pluviometry conditions were equivalent with those of the region under analisys, a fixed carbon amount stored in biomass form was estimated. The equation referred to BROWN et al.,(1989) was developed for regions where the pluviometric index is 1,500 mm, equivalent to that of the study area index which according to ESPINDOLA et al. (2000) is 1,400 mm/year:

$$Y = EXP(-1.996+2.32*\ln(D))$$

where:

Y= biomass above the soil in kilograms
D= diameter at the breast height

The breast-height diameters utilized in equation were obtained from field samples. All the values of the circumferences at breast height refering to trees of the same specie were grouped together and from them extracted a truncated mean (the smaller and larger values are disregarded and an arithmetic mean is calculated with the remaining values). These values are then employed to estimate the quantity of biomass in the reforestation, and subsequently, the carbon amount.

Through the procedure above described the carbon amount yield is approximately 78tC/ha reforested.

It is then necessary to estimate the carbon amount currently existing in the areas to be reforested. Using satellite images and data from field visits two main vegetation cover categories were identified in the areas to be reforested:

1. pasture, and
2. capoeira.

In pasture areas stored carbon amount in biomass form is between 2 tC/ha and 10 tC/ha, depending on the grass type cultivated, soil quality, and the period in which the area was abandoned. (In capoeira areas, this amount is approximately 8tC/ha). The next step is to determine the percentage of the area to be recuperated with each one of these two covers. This was performed with the help of satellite images and aerial photography in the 1:10,000 scale and, again, field visits.

From this analysis, it was found that 58% of the areas to be recuperated are presently covered by capoeira, and 42% by pasture. This means that in areas to be reforested, 4,848 tC exist in the biomass currently available.

After analyzing the simulation results and comparing them with the simulation results done with data obtained in the field and with the estimated carbon values in various ecosystems, it is possible to estimate that in one reforested hectare of riverside forest, in the municipality of São Carlos with 1,500 individuals per hectare, will contain an average of 75 tC. This implies a fixation of approximately 66,375 tC. Discounting the amount already existent the net total is 61,527 tC what represents approximately 69 tC/ha of carbon sequestration which should be fully completed in 30 years.

Considering the cost for planting one ha is US$ 1.500 and the amount of carbon fixed is 69tC/ha (250tCO_{2eq}/ha), the price of carbon credits for this project should be US$ 6/tCO_{2eq}.

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