Farm forests seen as commercial carbon sinks

A new carbon-sequestration study in Indonesia could pave the way for farmers to be paid for re-planting and maintaining forests

BY ROBIN TAYLOR

The concept of developing carbon markets to help lower greenhouse gas emissions by placing a tradable value on practices that offset emissions is gathering momentum around the world.

Of particular interest for agriculture is the role it can play in carbon sequestration—the process of removing carbon dioxide (CO_2) from the atmosphere and 'storing' it in plants that use sunlight to turn CO_2 into biomass and oxygen.

As far back as 1999, ACIAR initiated a carbon sequestration project that looked at its potential in Indonesia, addressing questions related to infrastructure, bioeconomic models and skills required.

That initial interest brought together Dr Oscar Cacho, an environmental economist at the University of New England (UNE), NSW, with expertise in developing market solutions to environmental problems, and a team at the Centre for Economic and Social Research in Forestry (CESRF) in Indonesia, led by Dr Erwidodo. CESRF had been discussing opportunities for carbon-emissions-trading research with ACIAR so, between the then ACIAR project manager Dr Ken Menz and the two groups, a second project to explore the economics of smallholder agroforestry in Indonesia to offset carbon emissions was developed.

Dr Cacho says the objective of this project is to find a way to encourage smallholders in Indonesia to plant trees and gain the multiple benefits of reducing deforestation, reducing CO_2 emissions from slash-and-burn agriculture, and reducing health problems from smoke inhalation.

Within the Kyoto Protocol, the clean development mechanism (CDM) is an arrangement that already allows industrialised countries with a commitment to reduce greenhouse gases to invest in emission-reducing projects in developing countries as an alternative to more costly emission reduction in their own countries.

Smallholder agroforestry systems, which address smallholders' livelihood needs and store large amounts of carbon, are viable

PHOTO: BRAD COLLIS

Smallholder farmers are starting to be encouraged to adopt practices that do not require deforestation, such as this, and instead start to replant trees to be part of future commercial carbon trading.

project types under the CDM, with its dual objective of emissions reduction and sustainable development.

The Intergovernmental Panel on Climate Change has identified change from cropland and grassland to agroforestry as the land-use change with the most potential for carbon sequestration globally.

The team from UNE worked with researchers from the CESRF (part of Indonesia's Forest Research and Development Agency) to examine the merits of different agroforestry systems for smallholder farmers and, on the policy side, to investigate how to link farmers with the international carbon market.

The focus was on large areas of

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Indonesia

PARTNER COUNTRY: Indonesia

PROJECT: PLIA/2002/066: Economic potential of land-use change and forestry for carbon sequestration and poverty reduction

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Carbon trading

Over millions of years, the Earth has managed to regulate concentrations of greenhouse gases through a system of sources and sinks. Carbon, in the form of carbon dioxide (CO_2) and methane, is emitted by volcanoes, rotting vegetation and other organic matter (collectively called 'sources'), and CO_2 is sequestered or absorbed by trees (the so-called 'sinks').

In modern times, the burning of fossil fuels combined with accelerated land clearance has led to unprecedented levels of greenhouse gas emissions. Carbon sinks cannot keep up and concentrations of greenhouse gases in the atmosphere have risen dramatically. Most scientists say that, as concentrations of these gases continue to rise, there will be a general and very rapid warming of the world's climate.

Carbon-emissions trading is seen as a way of cutting concentrations of atmospheric greenhouse gases and, at the same time, promoting reforestation. Carbon markets function by placing a cost on carbon emissions and a value on emissions reductions, and enabling trade of the resulting allowances or credits.

There are two ways to measure the amount of carbon sequestered in trees. The most accurate is to fell a tree, measure its total biomass and analyse all tree parts for carbon content. While this is not a practical method for calculating carbon stored in whole forests, it provides measures that can inform more general estimates. The second method is based on allometrics, the relationships between certain tree attributes—such as height and stem diameter—to the amount of carbon stored in trees. Groups in Australia, such as CSIRO and the Cooperative Research Centre (CRC) for Greenhouse Accounting, are working out these relationships for different species in different environments.

Additionally, the Australian Greenhouse Office, the CRC for Greenhouse Accounting, the Australian National University and others have developed methods to measure greenhouse gas emissions from activities such as soil cultivation, fire and electricity generation. These methods are evolving and improving.

Through this market-based approach to the problem of reducing emissions, participants buy and sell permits for emissions or credits for emissions reductions through regulated or voluntary markets.

More information: www.greenhouse.crc.org.au/tools/calculators/treecarbon

previously forested land in three regions—Jambi, East Kalimantan and Sulawesi. The researchers estimated the flow of carbon fixed by trees above ground and flows in soils and roots.

"We basically came up with a set of spreadsheet models that allow economic analysis of different agroforestry systems and also allow us to estimate how much carbon could be produced," Dr Cacho explains. "We looked at 26 different agroforesty systems. Some were complex, with more than five or 10 different species—trees that produce fruits, timber or resin—whereas others were just individual tree species."

Dr Cacho says the researchers found that some of these agroforestry systems could be quite profitable in certain areas of Indonesia and have already been developed by various farmers who would be well placed to earn carbon credits—in theory.

The researchers also identified a number of problems that were preventing smallholders from planting trees, the main one being a lack of credit. It costs money to establish trees and takes some years before income is generated. Another hurdle is a lack of technical expertise. It is, for example, easier to grow cassava than to manage a complex forest system.

Another problem for millions of smallholder farmers in Indonesia is lack of security over land tenure because of conflicting land claims. Farmers are unlikely to plant a long-term crop, such as trees, if they do not have secure tenure.

The researchers found that project viability is also sensitive to transaction costs (the costs of doing business), the trees' carbon-sequestration potential and the size of the participating farms. Transaction costs are quite substantial in projects where there are a large number of smallholders, compared with planting one large forest.

The researchers studied comparative transaction costs for marketing carbon from smallholder operations. They concluded that smallholders operating on an individual contract basis would require certified emission reduction prices ranging from $12 to $18 per tonne of CO_2 to profitably participate in carbon trading.

But by forming farmer groups and pooling land resources they could improve the viability of the project. For example, where a two-hectare farm requires $18 per tonne of CO_2 to be viable, if several farms are concentrated into 20-hectare units the project becomes feasible at a price of $10 per tonne of CO_2.

The project results also show how factors such as tree growth rates and the baseline condition of sites affect the project's viability. Carbon credits are measured relative to a baseline (business as usual) scenario. Only carbon captured above the baseline (that is, additional carbon absorbed) is eligible for credits.

Results from the project suggest that the best strategy for success with tree planting is to concentrate on degraded lands, which have low profitability and low carbon stocks (that is, a low baseline) relative to an agroforestry enterprise.

"Indonesia has millions of hectares of *Imperata* grasslands that may be ideal candidates for CDM projects," Dr Cacho says.

It is expensive (in terms of labour and materials) to clear these lands and establish trees. Carbon credits could provide the funding. In addition, the incentive to participate would be enhanced if communities and individuals were offered tenure of degraded state land that they restore. According to the project's findings, technically smallholders could be competitive with other activities in terms of carbon sequestration, but institutional constraints make it difficult.

Potentially, money from carbon-credit funds could be used to help farmers establish agroforestry and provide them with training, with a positive impact for poverty alleviation and the environment. ■

TreeSmart

For people wanting to plant trees for carbon credits, timber or other purposes, a useful output of the ACIAR project is a database called 'TreeSmart', which contains 110 Australian species with agroforestry potential in medium to low-rainfall areas (less than 600 millimetres) and data on tree growth, soil type and climate from various trials. The database can be adapted to include other species for other climates or geographic areas, making it a useful tool for forestry researchers in many countries.

TreeSmart is being prepared for public access through the internet. Management of the program and distribution will occur through the NSW Department of Primary Industries.

Agroforestry systems may have many uses, such as the collection of resin.

PHOTOS: OSCAR CACHO

A young agroforestry system in Malang, Java.