ENVIRONMENTAL SERVICES IN SILVOPASTORAL SYSTEMS

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The deforestation in the tropics has occurred due to a number of forces. Among them count the policies that encouraged clearing of the land, before titling could be granted by governments. High import duties on substitutes for wood and the view that the forest was a free resource, added to the list of incentives to cut the forest. In addition, there were subsidized interest rates, guaranteed prices and subsidized inputs, which favored short cycle crops in former forest' lands. Pastures were grown usually after the land was too poor to provide reasonable yields on grains. In many cases however, pastures were grown right after deforestation.

Although the reasons for extensive cattle ranching need to be known, they are no argument to justify this practice in the future. Cattle production can be made more intensive, profitable and conscious with the conservation of the forests relying on more intensive systems, sustained in the multifunctional use of the land.

Current Land use

Lands in the tropics have been placed at many other uses than its original one, the forest; however there are some patterns: Monoculture, mixed farming systems and pastures. Monoculture in the tropics is a practice limited to plantations such as those for banana, sugar cane and soybeans. Mixed farming systems are common among small producers; they include pastures, fruit trees an short cycle crops.

In the case of pasture' lands, there are two systems of production. The first refers to pasture lands cleared of trees, quite common in the sabanas and the dry tropics. Remaining trees are usually scarce, overgrazing is a common practice and the land is exposed to heavy rains in the wet season and winds in the dry season. As a result, soil erosion; low productivity and loss of biodiversity are common indicators. Fires usually add to the destructive forces.

The other system of production in grasslands in the tropics is the one in which trees are kept or planted for multiple purposes and pastures are managed in a way in which there is no overgrazing. As a result, biodiversity increases, soil erosion does not occur and productivity is high. These practices are not very common.

The Multifunctionality of Agricultural Lands in the Tropics

Cattle production under extensive degrading systems is becoming to an end, because of its very low productivity. On the other hand, although the situation is not as severe in intensive systems, they are facing the problems of high production costs and the limitations of selling only live animals, milk or in some cases both, milk and live animals. Their prospects are limited, thus some producers are opting for selling the land, while others are trying other crops. In this latter case, the prospects are not as bright, due to uncertain prices, production risk and the usually high marketing costs.

There is need for a multiple use of the grazing lands in other to generate and sell new products and services. The key is to create a mix that allows an optimal use of the land, in order to increase net income, lower risk and improve capitalization.

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The potential for a multiple use of the grazing lands appropriately managed, is high and in includes the following options: Cattle production for dairy or beef or a dual purpose system; wood production for its conversion into durable goods; carbon sequestration in trees and pasture roots and soils; biodiversity and watershed protection. In addition, additional investments and special management would allow agrotourism or agro-ecotourism. The system that allows this Multifunctionality is referred as Silvopastoral.

Carbon Sequestration
Carbon is sequestered from the atmosphere by growing trees and pastures with deep and extensive root systems. In the first case the carbon remains in the aerial parts, and the total amount sequestered per day, depends on the number of trees per hectare, the species and the weather conditions. In the case of pastures the Carbon sequestered is stored in the roots and in the soil. The net amount sequestered depends on the specie, the soil type, and humidity, the management of the pasture and the cattle, availability of microorganisms in the soil, losses by leaching and other causes.

In both cases the farm is providing a service to society, as it is taking from the atmosphere the Carbon that others generate. When global markets for Carbon services develop, then producers will be paid on the basis of the net amount of Carbon taken away. It is most important to recognize that this service is to be paid on the basis that the Carbon is sequestered at perpetuity. Also, it is expected that the price paid by sequestered ton of Carbon reflect the risk of loss; that is to say that farms exposed to risk of fire (partial or total loss) will be paid less than when the risk is absent.

At mean time, there are some ongoing arrangements to pay farmers for these services, while markets work at the global level. In some cases there have been inter country agreements (Costa Rica-Norway) and in others, there are pioneering efforts supported by the World Bank Global Environmental Facility and LEAD (Nicaragua, Costa Rica and Colombia). In these cases the price paid per ton of Carbon sequestered varies from 5 to 10 US Dollars, and the amount sequestered per hectare varies from 5 to 50 tons per hectare per year.

Woods destined to durable products
The production of wood is a means to increase income, however, if the interest to provide an environmental service, there must be assurance from the producer that the wood will be conserved and do not become a source of fire. On this regard the farmer does not have control over the use that the buyer will give the wood that leaves the farm.

However, wood that at the farm level is transformed into handcrafts has a much lower probability of going to waste that the one that leaves in bulk form. The production of handcrafts in the other hand, I achieved through clean production and transformation practices may gain certification. Altogether, this will provide a higher income and it will allow an important generation of employment.

Biodiversity as a source of Wealth and Income
Properly managed silvopastoral systems allow a great deal of biodiversity. This includes a compendium of microorganisms in soils and plants, insects, birds and mammals. Biodiversity as such becomes a source of wealth when adequately managed, thus it is important for farmers to understand how to do so. Nevertheless it should be mentioned that in some cases biodiversity can become bioadversity, due to poisonous snakes, scorpions, spiders and other animals.

Biodiversity can be exploited for example renting the land to a Research Center interested in discovering interactions among species, processes that allow reproductive patterns of animals, behavior of wildlife, etc. In other cases it may serve as an entertainment to bird watchers or farm could be integrated as part of a biological corridor. In all these cases there will be a contribution to a better environment and there would be a possibility to generate income.

Cattle and wildlife (except for some predators) live in perfect harmony. Thus the use of a cattle farm to exploit biodiversity is very feasible. In addition good practices at the farm level (pertaining the use of chemical products) is usually good for the higher quality of pastures and natural herbs.

Watershed Management
Farmers, urban centers and reservoirs located in the lower part of a watershed, depend on waters that to a great extent flow from the hillsides. The amount, distribution and quality of the water they receive, depends substantially from the management done by farmers in the hillsides of the watershed. Very

unfortunately, deforestation, inappropriate agricultural practices, and mining contributed to a deterioration of the watersheds.

In some cases it has been evidenced that adequate management of hillsides, including the one pertaining to silvopastoral systems, allows substantial improvements in the supply of water. The adequate soil coverage allows the water to entertain in its flow downhill, thus there is a better distribution over time. In addition the water does not carry sediments. Further gains in quality are achieved if farmers uphill do not use chemical products for cultivation.

In this case the payment for the service provided does not require from a market relation. It will be enough an agreement among the interested parties, to assure that the conditions up hill are maintained. In this case the agreement can be revised annually on the basis of improvement on practices and performance in the previous year depending on weather conditions.

Agrotourism and Agroecotourism
In cattle ranches managed with environmental commitments, the benefits can be achieved through some or all of the above mechanisms. However, there is an additional option that pertains to agrotourism, which is not necessarily an environmental service.

A clean, safe and well-managed cattle ranch allows offering tourists an opportunity to learn the facts of ranching. Visitors can enjoy horseback riding, appreciation of cattle and wild life behavior and taking part in some of the ranch daily practices. Special tours are arranged also for children to appreciate cow milking, cow deliveries and entertaining as calve roping, etc

Visitors for day pay a entrance fee and sometime there are charges for specific entertainments. In some cases visitors can stay for longer periods of time if accommodations are available.

A brief Comment on Management
Not all the referred options are open to all producers, as each one requires particular technologies, management skills and financial resources. Some options may be limited by the location of the farm, while others by size and topography. Besides, in some cases there may need time, before the new system is in a condition to generate income. In any event, if all these options were possible, their potential contribution to the three goals (income, risk reduction and capitalization) would be specific to each particular case.

From all these limiting factors, the most important one is management. Thus, if there is government interest to promote these new ways for more profitable and environmentally friendly way of doing cattle farming, the capability of people must receive special attention.