# The economics of cocoa-fruit agroforests in southern Cameroon

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*Key words*: External economies, carbon trading, risk, subjective discount rates, equity.

## Introduction

The complex cocoa-fruit agroforests of southern Cameroon are among the most sustainable land use systems in the forest zone of West and Central Africa. These systems have evolved over the last 60 to 70 years to meet the revenue and consumption needs of households living along the forest margins. The mid- and upper strata provide shade for the cocoa, recycle nutrients and yield many useful products. Indigenous fruit trees such as the African plum (*Dacryodes edulis*), bush mango (*Irvingia gabonenis*) and *njansang* (*Ricinodendron heudolotii*) along with exotics such as (*Citrus spp.*, mango (*Mangifera indica)*, guava (*Psidium guajava)*, and avocado (*Persea americana)* make an important contribution to local diets and provide additional revenue sources for many households. Commercial timber species in these forests provide lumber used in local rural construction, while oil palm (*Elaeis guineensis*) provides cooking oil, wine and spirits. Lower strata include useful vines such as rattan which supports a large cottage industry of furniture and basket makers and *Gnetum africanum* whose leaves are highly prized as a leafy vegetable dish in many parts of Cameroon, Nigeria, Gabon and the Congos. Many medicinal plants are also maintained.

These systems generate significant economies, external to the household, that benefit society at large. These include the maintenance of the local hydrological cycle, landscape functions including control of soil erosion, and the conservation of important genetic resources particularly for indigenous fruit trees. They are also good stores of C, capable of sequestering up to 60 percent of the total C pool of the original forest. In sum, the cocoa-fruit agroforests of southern Cameroon provide a solid foundation for the maintenance of ecosystem stability and should be the focus of directed international, national, provincial and local policies to maintain these economically and environmentally important systems on the landscape.

The cocoa agroforest offers the region a broadbased and equitable rural development pathway. In the Center and South Provinces of southern Cameroon, approximately 75% of rural households produce cocoa and the median agroforest is 0.87 ha. These land use systems, unlike timber exploitation or large scale rubber and oil palm plantations, are in general accessible to even resource constrained rural households. Unfortunately, farmer incentives in recent years have been weak and have had negative consequences on the welfare of cocoa producing households and the environment.

Cocoa and cocoa agroforests play a central role in Cameroon's economic history. First introduced on German-controlled plantations in 1886 on the lower slopes of Mount Cameroon, cocoa production remained a large-scale plantation activity through the start of WWI. By 1913, the cocoa sector of Cameroon consisted of 58 different plantations grouped around present day Limbé (ex-Victoria) in the Southwest Province. The sector employed over 17,000 workers, and cocoa beans were the leading agricultural export. Among these plantations, the *West Afrikanische Planzung Victoria (WAPV)* was at the time recognized as the largest single cocoa producer in the world.

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Profitability was however limited by black pod fungal disease (*Phytophthora palmivora*), an insufficient supply of willing labor, and low product quality due to difficulties in properly fermenting and drying cocoa under the humid conditions of Mount Cameroon. As a result, plantation owners as early as 1905 were already becoming disillusioned with cocoa and began turning their attention to other plantation crops such as oil palm and rubber. By the mid 1920s, cocoa production in Cameroon had shifted from an enclave plantation model to small holder-based systems. The early development of smallholder cocoa in southern Cameroon was linked to merchandise trade conducted by German merchants operating out of the port town of Kribi. Porters carrying their goods to the hinterlands were paid in kind with cocoa pods that literally sowed the seeds of the cocoa industry in southern Cameroon.

Over the course of the last 80 years numerous factors have shaped the way farmers plant and manage their cocoa agroforests, many of which were originally created more than 60 years ago. These factors have included directed initiatives, such as those of the now defunct state marketing apparatus the *Office National de Commercialisation de Produits Bruts* (ONCPB) and the Cocoa Development Society *(SODECAO)*. Other indirect factors such as climate, road infrastructure, market institutions and demographic pressure have also shaped the structure and function of the southern Cameroon agroforests.

The intensity of production tends to be correlated negatively with available forested land and positively correlated with population pressure and market access. Where land is still abundant, population pressure low, and market access poor, farmers earn higher returns by managing larger cocoa plantations in an extensive fashion with relatively low yields per hectare. Conversely, when land becomes scarce, roads improve and the rural economy becomes more commercialized, the management of the various strata within the cocoa agroforest tends to intensify and the yields per ha of both cocoa and fruit crops increases.

The Obala cocoa-fruit agroforests to the north of Yaoundé are perhaps the most intensive agroforestry systems of southern Cameroon. Three types of cocoa agroforest are distinguishable. There are relatively simplified plantations of improved cocoa varieties at relatively high densities (over 2,000 trees $ha^{-1}$) and low densities of fruit trees in the canopy. This type of system contrasts with a more complex agroforest composed of an intermediate density of cocoa (800 to 1000 trees $ha^{-1}$) under a relatively dense shade canopy of mid and upper story fruit trees, oil palms and timber species. The third type has a mix of cocoa and citrus in the lower stratum with a more open upper canopy of fruit and timber trees. The species diversity in the enriched cocoa agroforests of Obala is remarkable. A field study conducted in 1998 found the following average tree composition per hectare: 495 cocoa, 35 timber predominantly *Terminalia superba*, 22 mango, 22 avocado, 22 African plum, 21 Clementine mandarines, 18 other *Citrus* spp., 15 oil palms, 56 *Musa* spp., 18 pineapples, 5 *Cola* spp., 3 papayas, 3 guavas, 1 soursop, 1 bush mango.

Models of discounted costs and returns over a 30 year planning horizon were estimated for four types of typical mixed agroforest. The Obala agroforest model was compared to an extensively managed plantation with no commercial exploitation of the shade canopy; an intensively managed cocoa plantation with intermediate commercial exploitation of shade canopy, and an intensively managed cocoa agroforest using recommended management practices and improved germplasm material. Overall the highest returns were estimated for the high input, intensively managed agroforest using improved germplasm. The constraints preventing farmers from implementing the best management practices include a lack of credit and access to markets.

The variability in cocoa revenues has increased greatly with the liberalization of cocoa marketing and the abolishment of the cocoa stabilization fund, which controlled producer price. The price risk of revenue fluctuations for the four systems was analyzed using annual price series (yield variation was not possible due to lack of data). The most stable revenues (lowest price variance) are generated by extant Obala cocoa agroforests. The recommended best practice agroforest had slightly higher variance because of lower species diversity in the canopy, but the mean revenues were much higher. The extensive cocoa agroforest with no commercial exploitation of the shade canopy had the highest revenue risk.

The Alternatives to Slash and Burn program conducted a biophysical assessment of environmental parameters such as C stocks, biodiversity and greenhouse gas emissions for the dominant land use systems of southern Cameroon. C stocks and biodiversity of cocoa agroforests were found to be intermittent between those of short fallow annual crop land use systems and primary forests. This finding suggest the importance of establishing cocoa agroforests on short fallow land if possible. Such a strategy could, if successful, address global and national environmental concerns while building on a development model that has proven itself an engine for growth with equity.

Establishment in short fallow presents problematic issues of a technical and economic nature. Poor farmers with limited resources generally have short planning horizons and high subjective discount rates and do not have the option of waiting for long term investments in tree stock to yield fruit. The issue was examined by varying the discount rates used to evaluate the profitability of the Obala agroforest from 8 to 25%. At the lower discount rate, net present value was estimated to be \$3100 $ha^{-1}$ and the perennial component of the agroforest accounted for 90% of total discounted gross revenue. At the highest discount rate (representing the subjective discount rates of poorer farmers), net present value was \$100 $ha^{-1}$ and annual crops grown during the establishment phase of the plantation contributed 40% of total gross revenues. This highlights the importance of addressing the land and labor productivity of annual crops during the establishment phase if poverty alleviation is among the targeted objectives.

Soil fertility and weed pressure are technical problems to overcome if cocoa agroforests are to establish in the *Chromolaena odorata* thickets that characterize short fallow land uses in West Africa. Fertilizer supplements and increased labor for weed control particularly during the establishment phase will be required. However fertilizer use in the cocoa agroforests of southern Cameroon is not currently practiced as both cost and availability limit their use. The labor issue is also likely to be constraining particularly in more remote regions of lower population density. Capital inputs that could substitute for labor are one option. These include herbicides and motorized slashers. The use of capital inputs however runs into another common institutional constraint across much of West Africa, namely the lack of rural credit markets for small capital purchases.

The capacity of small farmers to finance the establishment of cocoa agroforests in short fallow degraded lands is limited. To assist farmers, the government of Cameroon and others in West Africa might propose cocoa agroforests as a source of C sequestration in the international arena. As the global community moves closer to C emissions trading, small farmers in West and Central Africa could be encouraged to participate by converting their degraded lands to cocoa agroforests through payment of planting subsidies financed out of C receipts. The scope for those subsidies is perhaps larger than one might expect. ASB-Cameroon calculated that the permanent conversion of one hectare of short fallow to a cocoa agroforest would remove about 70 tons of C from the atmosphere. With current estimates that the equilibrium price of C would trade somewhere around \$10 $ton^{-1}$ farmers could potentially receive a lumpsum payment of \$700 for this land conversion.