ECONOMIC COST-BENEFIT ANALYSIS OF CERTIFIED SUSTAINABLE COCOA PRODUCTION IN GHANA

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Abstract
Ghana is well endowed with premium bulk cocoa and is strategically positioned to capture significant market shares for the growing demand in specialty cocoa products on the world market. Consumers' taste and preference for differentiated or 'specialty' cocoa based on environmental- and ethically certified cocoa products have been rising over the years. This study uses an ex-ante analytical approach to explore the potential for smallholder cocoa farmers in Ghana to develop niche markets for an environmentally and sustainably produced cocoa, namely; Rainforest Alliance Certified cocoa as an alternative to Ghanaian bulk cocoa. Using NPV, BCR and IRR economic decision criteria, the profitability or otherwise of introducing this rainforest alliance certified cocoa in Ghana is assessed. Rainforest Alliance certification requires farmers to shift from low or no shade Amazon production systems (i.e., <20 trees per ha) to medium shade Amazon production systems (70 shade trees distributed over a minimum of 12 species per ha) as well as other standards. In the base case scenario, results of the hypothetical high certified production system are compared with the current low input landrace cocoa and high input no shade cocoa systems. Under these conditions the certified production system and the low input landrace cocoa are essentially breakeven propositions while the high technology full sun system was moderately profitable. Sensitivity analysis of changes in FOB shares revealed that increasing the percentage of producer price from 70 to 85 percent of FOB dramatically increases the profitability of Rainforest Alliance certified cocoa at all varying FOB price levels when fertilizer price is subsidized. Profitability did however not change from the base model when fertilizer subsidies are removed by the government and the producer price increases to 85 percent of FOB.

Keywords: Cocoa biodiversity, Ex-ante Cost-Benefit Analysis, Rainforest Alliance Certification, Differentiated cocoa production

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1. Introduction

Ghana is the world's second largest producer of cocoa, responsible for producing around 20 per cent of the world's bulk cocoa in 2005-2006 (ICCO, 2006). Cocoa is Ghana's dominant cash crop and single most important export product. Cocoa production in Ghana is the major economic activity for over 700,000 households, with around 6.3 million Ghanaians (representing around 30 per cent of the total population) depending on cocoa for their living. In 2006, exports of cocoa butter, powder, beans, paste, and waste totalled US$1,241 million, equivalent to more than 33% of Ghana's merchandise exports (WTO, 2008). Cocoa production and marketing accounted for 32.2 percent of export earnings (ISSER, 2007) and 8.5% of Gross Domestic Product in 2006, up from 4.9% in 1998 with the European Community being the main export destination for cocoa produced in Ghana (IMF, 2007).

The Ghana Cocoa Board (COCOBOD) provides phyto-sanitary support to farmers and regulates the marketing of bulk Ghanaian cocoa on international markets. This has helped to maintain the quality of Ghanaian bulk cocoa, which earns an international price premium of between 7 to 10% above the price paid for other West African bulk origins. Ghana's high quality cocoa and the good reputation of the COCOBOD allow it to sell up to 70 % of its cocoa on forward markets which allows it to hedge the price for the season. On the basis of this price, the COCOBOD's Producer Price Review Committee sets the producer price. Under pressure to liberalize cocoa marketing, the COCOBOD agreed with the World Bank and IMF to fix producer price at 70% of "net" FOB price. In the 2008/2009 main crop season, the producer price fell short of this price target.

Ghana's cocoa production is characterized by small-scale farming with an average productive cocoa area per household of approximately 2 hectares (Barrientos et al., 2008). The average yield per hectare is 450 kg (MMYE, 2008), which is low compared to on-station research trials. In cocoa producing households it is estimated that the mean per capita daily income from cocoa was US$0.42 out of a total income of US$ 0.63 (Barrientos et al., 2008), thus indicating a relatively high level of poverty. Hybrid cocoa varieties developed by the Cocoa Research Institute of Ghana (CRIG) have been adopted by approximately one-third of Ghanaian farmers who appreciate their high yielding nature (Padi and Owusu, 1998, *cf. Asare, 2005*). However, these systems, when not accompanied with fertilizer, can rapidly deplete soil nutrients and tend to have shorter production cycles because of the physiological stresses of higher yields.

The rapid expansion of extensive low shade systems has been a major cause of deforestation in West Africa (Obiri et al., 2007; Gockowski and Sonwa, 2008). The remaining forest cover in West Africa constitutes only one-fifth of its original extent and the average annual deforestation rate for Ghana between 1990 and 2005 was 2 percent with the forest area decreasing from 74,000 square kilometers in 1990 to 55,000 square kilometers in 2006 (Niesten et al., 2004; World Bank, 2008a; World Bank, 2008b). In Ghana, the Western Region remains the last frontier for the expansion of cocoa due to the presence of patches of non-reserved and reserved forest in the country (Asare, 2005; Gockowski and Sonwa, 2008). Given the absence of a 'New Forest Frontier', sustaining cocoa production in Ghana will require external soil amendments to replace nutrients lost through episodes of deforestation and forest degradation (Gockowski and Sonwa, 2008). Consequently, smallholder cocoa production systems in Ghana are low yielding and have experienced little innovation or productivity growth over the last twenty years. Additionally, concerns over the environmental impact of cocoa farming and its sustainability have been raised. To address the lack of innovation, low returns and perceived lack of production sustainability, a new environmentally friendly production system are examined for Ghanaian smallholders. This study estimates the costs and benefits of producing Rainforest Alliance-Sustainable Agricultural Sustainable (RA-SAN) certified cocoa and compares it with those generated by typical smallholder production systems as well as intensified systems that have emerged from research efforts and promotion by the Ghanaian cocoa authorities. Rainforest Alliance (RA) certified cocoa production systems are distinguished by their adherence to a set of production and social standards promulgated by the Sustainable Agriculture Network (SAN). On the world market, there is a spectrum of health-, environmental- and ethically-conscious consumers who patronize differentiated cocoa products that may be based on organic production systems, environmentally sustainable practices, and ethical trade practices (fair trade cocoa). Cocoa output within this category is differentiated by a certificate issued by a recognized certification body that ensures standards have met. There may be no difference in the quality characteristics of the cocoa from that of bulk cocoa. The difference may not even lie in the social and environmental characteristics of the production process, but rather it lies in the certification of those characteristics.[1] RAC cocoa is differentiated on the basis of practices that are deemed environmentally sustainable and conserving of biodiversity.

[1] For example, the 2001 baseline STCP survey revealed that over 50% of Ghana producers used no agrochemicals and were in essence *defacto* organic producers; another example is seen in the extant cocoa

The Rainforest Alliance (RA), a coalition of independent non-profit conservation organizations in Latin America, promotes social and environmental sustainability of agricultural activities through the development of standards (Divney, 2007; SAN, 2008). Its mission is to protect ecosystems and the people and the wildlife that depend on them by transforming land-use practices, business practices and consumer behavior (Ventura, 2007; Rainforest Alliance, 2005). The RA works to implement global standards at the field level for sustainable management practices; to monitor and evaluate progress and compliance through on-site investigation and certification; and build market demand for sustainability-produced products. Rainforest Alliance follows the Sustainable Agriculture Network (SAN) standards, an independent certification body and issues it's farmers with the Rainforest Alliance certification seal. The first certification in Africa was in early 2006.

Producers wishing to become RA certified are required to implement good agricultural practices in accordance with the standards of the SAN. In the Western Region of Ghana where most of the cocoa is grown either with no shade or very little shade (<20 shade trees per ha) this would entail, among other things, planting compatible indigenous tree species in these full sun and light shade systems to increase biodiversity and other environmental services (the current proposed SAN shade standard is 70 shade trees per ha distributed over a minimum of 12 species). Producer benefits will depend *inter alia* on: 1) the extent to which consumers are willing to pay premiums for quality and process attributes; 2) the efficiency of market actors in adapting to the demands of differentiated markets; and 3) the productivity of the proposed system. The development of RA production systems will require new institutional mechanisms for cultivation the shade trees and other requirements needed to meet the RA-SAN environmental standard. There are also knowledge gaps in the farming population concerning FF and RA-SAN cultivation practices that would likely require some investment in extension. The returns to such institutional investments will depend on the added value to the economy from the adoption and spread of the RA-SAN certified production system. If farmers do not earn positive returns with the system there is no reason to further invest in seed distribution systems or farmer training. As such, assessing the farmgate profitability of the system is the prime focus of the proposed analysis.

In West Africa, cooperative farmers in Cote D'Ivoire have already been certified by Rainforest Alliance. In Ghana RAC is in the process of being introduced by the Agro Eco-

agroforests of the Center and South Provinces of Cameroon where the mean number of shade trees per ha is more than double the RAC proposed standard.

Louis Bolk Institute. Based on experiences with RAC in Cote D'Ivoire, the institute has developed local indicators for the certification process to be implemented in Ghana. Ghana has a proven comparative advantage for the production and supply of good quality bulk cocoa. Whether or not it could also be competitive in the production of RA-SAN certified cocoa is the main focus of this study. The objectives of the study are to determine:

a. The economic returns per ha under best management practices of
    i. High Input Medium Shade Certified Cocoa (HIMSCC) production
    ii. Low Input Landrace Cocoa (LILC) production
    iii. High Input no Shade Cocoa (HINSC) production
b. Estimate the minimum number of producers needed to achieve an economically feasible output for the certification export model.

2. Research Methods and Data

2.1 The Study Area

The costs and returns of producing certified cocoa are estimated for the deforested cocoa belt of the Western region of Ghana. Cocoa here is mostly grown under full sun systems with associated deforestation and destruction of wildlife habitat. The Western Region covers an area of approximately 23,921 square kilometers, representing about 10 percent of Ghana's total land area and 10 percent of the country`s population. With a population growth rate of 3.2%, the region's population is expected to double by 2020. The region has about 75 percent of its vegetation within the high forest zone of Ghana and accounts for 44 percent of the total closed forest in the country. It is also the wettest part of Ghana with a bi-modal rainfall pattern averaging 1,600 mm per annum.

Results from several studies at CRIG in which shade and fertilizer levels were varied led to extension recommendations to reduce or entirely eliminate shade trees and apply fertilizer (Ahenkorah et al., 1974, Ahenkorah et al., 1987; and Cunningham and Arnold, 1962). While the low shade recommendation was widely followed in the rapid expansion of the sector in the Western Region in the 1980s and 1990s fertilizer recommendations have largely been ignored due to a combination of underdeveloped fertilizer and credit markets in Ghana (Gockowski and Sonwa, 2008). A survey conducted in 2001/02 showed that in the Western Region of Ghana there are more cocoa systems with light or no shade and less cocoa systems with medium to heavy shade cocoa compared with the national average (Gockowski and Sonwa, 2008; Ruf et al., 2006). Only 16 percent of cocoa farms are established through the selective thinning of forest trees. The majority of farms are established through the felling

and slashing of the forest trees, the burning of biomass and the cultivation of food crops concurrently with cocoa for the first few years after establishment. The cultivation of cocoa under no-shade or low shade conditions common to the Western Region may not be sustainable without fertilizers. Nutrient stocks in the forest biomass are eventually depleted through plant exports and leaching. Given the relative underdevelopment of fertilizer markets underlying the sustainability concerns associated with full sun cocoa systems, the inclusion of higher densities of shade trees is expected to prolong the agronomic sustainability of these systems through processes of nutrient cycling associated with litter fall. At the same time it is expected that higher shade levels will negatively affect yields. The assumptions used to model these relationships are based upon a review of the CRIG shade-fertilizer trials conducted at Tafo from 1958 to 1982.

2.2 Data Sources

Secondary data from various sources was augmented with primary data on input and output prices and labor estimates from purposive and expert interviews conducted in several communities in the cocoa belt in March of 2009. The data collected was used in building the representative counterfactuals and hypothetical RA-SAN cropping systems. Secondary data were essentially obtained from various sources. Production (yield) data, specifically the effects of shade and age on the yield of cocoa were obtained from CRIG as reported in various issues of the institute's annual report. Also the list of desirable trees to be included in cocoa agroforestry systems especially trees native to the Western Region of Ghana. Productivity growth of timber species over time and estimated volume of timber obtained from Forestry Research Institute of Ghana (FORIG) and Forestry Commission of Ghana were used to calculate the timber value in the RA-SAN systems at the end of its assumed twenty year production cycle. From the Ghana COCOBOD, time series production figures and farmgate producer price data and information on potential institutional marketing price were obtained. COCOBOD buys all the cocoa produced in Ghana and then sells it overseas to mainly European buyers. The small quantities of RA-SAN cocoa available relative to bulk cocoa and the need to segregate these differentiated products from the bulk cocoa of Ghana will entail additional marketing costs. The STCP also provided a secondary data set from its baseline survey of over 4,500 cocoa producers from across West Africa in 2001 and 2002. Farmers from both the Ashanti and Western regions of Ghana were included. In addition, an Impact Assessment survey data of graduated Farmer Field School (FFS) trainees was

conducted in 2005 and compared to a control group of non-FFS trained farmers. Data from these sources were used to develop the representative farms.

2.3 Estimation of Farmer Costs-Benefits

An ex ante feasibility analysis of RA-SAN certified cocoa production systems was conducted for the Western Regions of Ghana. The counterfactuals are based on net present value (NPV) analysis of the typical cocoa production systems in the entire cocoa belt of Ghana. The NPV analysis for all cocoa cropping systems was conducted over a 20-year production cycle with resource endowments typical for a representative cocoa farm of the Western region. The representative cocoa farm was constructed using results from the 2001/2002 STCP baseline survey augmented with baseline data of STCP farmer field school graduates from 2005 to 2008 and primary data collected from farmers in the cocoa belt of Ghana.

The concept of NPV and the Benefit Cost Ratio (BCR) were used to evaluate the economic returns to FF and RA-SAN certified cocoa in Ghana. Benefits and costs are linked to the age of the cocoa trees (Nkang et al., 2007). At the early stages of cocoa, there are high establishment costs which are then followed by annual benefits that are non-linear over the life of the trees (Nkang et al., 2007). The benefit components included income from food crops (cassava, plantain and cocoyam) and timber. Perennial crops like cocoa generate a stream of costs and benefits over a given time period. Due to the time value of money, future cost and benefit values were discounted to enable comparison with present values. This leads to the concept of discounting and compounding. Discounting is a technique by which one can 'reduce' future benefit and cost to their 'present worth'. An ex-ante analysis involves projections of costs and benefits associated with the production per ha throughout the assumed 20-year life span (t=20 years) of the farm. The costs and benefits were be discounted using the appropriate interest rate and the Net Present Value calculated on a per ha basis.

$$NPV = \sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t}$$

Where B_t = benefit per ha in each year;
C_t = cost of production per ha in each year
t = 1, 2, 3, . . .n;
n = number of years;
i = interest rate

The study also estimated the Benefit Cost Ratio (BCR):

$$BCR = \frac{\sum_{t=0}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=0}^{n} \frac{C_t}{(1+i)^t}}$$

We use the Labor Internal Rate of Return (LIRR) as opposed to the standard Internal Rate of Return (IRR) for our analysis. The IRR determines the discount rate that makes the net present worth of the incremental net benefit stream or incremental cash flow equal zero. It represents the maximum interest that a project could pay for the resources used if the project is to recover its investment and operating costs and still break even (Gittinger, 1982). As labor is often the smallholder's most scarce and most productive resource of the smallholder, high returns to labor are often critical in the adoption process. The LIRR is the level of wage which makes BCR unity and NPV equal to zero and is found by doing a grid search over different wage rates. It represents the maximum wage rate that a project could pay, if the enterprise is to breakeven. For households where all the labor is supplied by the family, it represents the value of a day's labor.

The formal selection criterion for the net present value is to accept investments with NPV greater than zero. However, if the net present value works out to be negative, then at the chosen discount rate, the present worth of the revenue or benefit stream is less than the present value of the cost stream. Hence, the revenues are insufficient to allow for recovery of the investment. An investment is technically and economically feasible if the NPV is positive. The decision rule for BCR is that for any project to be economically viable, the ratio must be greater than unity. The discount rate used in calculating a project's worth is very crucial. The discount rate determines the value today of an amount received or paid out in the future. Obiri et al. (2007) for example used the NPV, BCR and IRR for an ex-ante financial analysis of shaded cocoa in Ghana. A 10% discount rate was assumed and the findings revealed that, in general, cocoa production in Ghana is profitable. The results further show that a change from the traditional system to hybrid cocoa production raised the IRR from 31% to 57% with planted shade and 67% under the full sun production system, although additional costs incurred for agrochemical usage would tend to reduce profitability of unshaded hybrid cocoa in particular. Nkang et al. (2007) also used the NPV and BCR to analyze the investment in cocoa production in Nigeria. The study examined costs and returns in cocoa production in Cross River State in the context of three identified management systems of cocoa production in the area, namely owner-managed, lease-managed and sharecrop managed systems. The results show that cocoa production is a profitable business irrespective of the management system employed, since all of them had positive NPVs at a

10% discount rate. However, Gittinger (1982) stated that no one knows what the opportunity cost of capital really is. Therefore in most developing countries, it is assumed to be somewhere between 8% and 18% in real terms. For this study, a discount rate of 20% is assumed as the upper limit that currently best reflects the time value of money in Ghana.

2.4 Computation of Labor Inputs and Wage Rates

Labor estimates were obtained from field data for 40 cocoa farmers in the Western Region by the Sustainable Tree Crop Program (STCP) of IITA. Farms were measured using GPS handsets which reduced measurement error in the estimates of person-days per ha for the various cultural tasks. Average labor requirements for the various activities per hectare and per ton of cocoa were estimated in 6 hour person-days for the various tasks involved in cocoa production. Data on tree felling and cutting into logs and insecticide application were lump-sum labor activities evaluated on a per ha basis.

One of the criteria for RA-SAN certification is the 'Fair Treatment and Good Working Conditions for Employees'. According to this criterion: *"Workers must receive pay in legal tender greater than or equal to the regional average or the legally established minimum, whichever is greater, according to their specific job. ..."* A wage rate of GH¢ 3.50 per 6-hour person-day of work was used which is more than the government-approved minimum wage, pegged at GH¢ 2.25 for an eight hour task but similar to the agricultural wage rate, which in some areas are pegged to the cost of a cutlass. In accordance with the above stated RA-SAN requirements, the daily labor wage rate for both RA-SAN and FF production systems was assumed to be GH¢ 3.50 for 6-hour person-day.

2.5 Bulk Cocoa Price Estimation

The bulk cocoa price was used in the calculation of all production budgets. RA-SAN certified cocoa, premiums were added to the bulk price based on historical experiences. The mean of ICCO reference prices for the period 1997-2006 was adjusted by a 10% premium that Ghana receives for its bulk cocoa on the world market and an estimated shipping cost of $20 per metric tons to arrive at an estimate of mean FOB price from the shipping ports in Ghana. In the low input landrace and full sun intensified systems, 70% of this estimated FOB price was calculated to represent the value received by Ghanaian cocoa farmers from the Ghana COCOBOD as agreed to with the World Bank. In the sensitivity analysis, we also consider an alternative price of 85% of FOB, where it is assumed that Ghanaian farmers received a competitive market price as opposed to the monopoly producer price offered by

the Ghana COCOBOD. Sensitivity analysis of farmgate price for bulk cocoa considered price levels one standard deviation above and below the mean estimated price.

2.6 Description of Cocoa Production Systems

In order to understand the market potential for differentiated cocoa, we develop for comparison, estimates of the returns to typical cocoa production systems on the landscape. A total of 2 counterfactual and 1 hypothetical production systems were analyzed. A medium shade high input technology conforming to RA-SAN standards is compared with a low input Amelonado production technology typical of most Ghanaian bulk cocoa and a high technology full sun Amazon technology that is currently being promoted by COCOBOD. Crops used by farmers as temporary shade at the early stages of cocoa establishment commonly include plantain among other crops. Plantain intercropped by cocoa farmers during the first two years of the establishment phase of their farm had an assumed yield of 4,500 and 2,500 kg per ha in year 1 and 2 of the production cycle for all systems analyzed. The production cycle for all systems was 21 years.

2.6.1 Low Input, Landrace Cocoa (LILC)

Costs and returns are estimated for 1 ha of unimproved cocoa planted at 3 x 3 m spacing (1,100 plants/ha). No nursery costs are incurred as the farm is directly seeded (i.e., planted at stake) with unimproved local landrace cocoa varieties. Plantain and cocoyam are planted one year prior to the cocoa seeding and then intercropped for the first two years of the cocoa production cycle. Typical of most farmers we assume no use of agrochemicals other than those provided by the Government of Ghana's mass spraying program. Shade levels are assumed to be moderate.

2.6.2 High Input, No Shade Amazon Cocoa (HINSC)

Costs and returns are estimated for 1 ha of mixed Amazon hybrids planted at 3 x 3 m spacing (1,100 plants/ha) with no permanent shade. Cocoa pods are obtained in November from COCOBOD seed gardens operated by the Seed Production Unit and cultivated by the farmer in a nursery for 5 months. Of the 1,400 seedlings started, 1,100 are planted after rouging out the off types. An 80% seedling survival rate requires an additional nursery effort of 280 seedlings for replacement in the second year. Plantain and cocoyam are planted one year prior to the cocoa planting and then intercropped for the first two years of the cocoa production cycle. In addition to the chemicals provided by the Government of Ghana's mass

spraying program, the farmer applies 1.8 kg/ha of copper oxide plus metalaxyl to control black pod disease and 480 ml per ha of imidacloprid for capsid control and 371 kg per ha of compound fertilizers are applied annually to maintain production..

2.6.3 High Input, Medium Shade Amazon Certified Cocoa (HIMSCC)

Costs and returns are estimated for 1 ha of mixed Amazon hybrids planted at 3 x 3 m spacing (1,100 plants ha^{-1}) with permanent shade provided by 12 indigenous tree species in accordance with SAN standards. Cocoa and timber trees are sown under the temporary shade canopy provided by plantains planted at a density of 1,600 per ha. Rational use of agrochemicals adhering to the SAN standards includes the application of 371 kg ha^{-1} of compound fertilizer, 1.8 kg ha^{-1} of copper oxide plus metalaxyl to control black pod disease and 480 ml per ha of imidacloprid to control capsids. Fixed costs associated with the standards include personal protective equipment and a suitable storage facility. The study assumed that from the trees planted, 56 m^3 of *Terminalia spp* would be produced and commercialized in the 21st year of the production cycle. A value of \$100 m^{-3} was assumed. The yield was based on growth rates proposed by the Forestry Commission of Ghana (2009). Although recent revisions to the Ghana Forestry Law accord property rights to those planting timber on their cocoa farm, the procedures for legally certifying that a timber tree was planted are not yet clear. The costs associated with this certification are arguably assumed to be covered by the \$75 m^3 unit cost of harvesting. The RA-SAN analysis considers the costs and benefits of becoming RA-SAN compliant. Given the paucity of marketing data on certified cocoa, the analysis assumed a fixed certification premium.

3. Results

3.1 Farm budgets and Returns

Budgets for the baseline situation are estimated based on the estimated mean price for bulk Ghanaian cocoa from 1997 to 2006 and 2009 input prices gathered in local markets. The farmgate price of bulk Ghanaian cocoa is assumed to equal 70% of the mean FOB price. Finally, the difference between the certification costs and a premium of 280 GHc per ton is assumed to be shared equally by the producer and Local Buying Company (LBC). Thus 72 GHc per ton is added to the producer price for good fermented Ghanaian certified cocoa. Fertilizers are sold to farmers at a subsidized price of 14.70 GHc per 50 kg bag.

Table 1 presents the financial measures of profitability for the three systems under consideration. The results show that the low input landrace system which is widely

representative of extant cocoa systems in Ghana had a negative net present value. This result is not surprising as other efforts to estimate farmer returns have also revealed low to negative returns. Of the new systems evaluated, only high input no shade system has marginal profitability whiles the High input medium shade certified cocoa was essentially a breakeven proposition. Unlike other West African cocoa producing countries, Ghana maintains state control over the determination of prices paid to producers. Historically, producers received between 50 and 60% of the export FOB price with the remaining 40-50% used to cover marketing costs, agro-chemical subsidies and as an important source of government revenue. Since 2002, the Ghanaian government has stated it's desired to pay cocoa farmers 70% of FOB price.[2]

Table 1. Profitability estimates for five cocoa production systems with discount rate equal to 20% and farm-gate price equal to 70% of FOB.

System	*NPV*	*BCR*	*Labor IRR*	*Annual net return at t=10*
Low input landrace cocoa (LILC)	-79	0.97	3.35	128
High input no shade cocoa (HINSC)	179	1.05	3.71	215
High input medium shade certified cocoa (HIMSCC)	14	1.00	3.52	213

Although this represents an increase for Ghanaian farmers over previous levels of pricing by the COCOBOD, in the liberalized markets of Nigeria and Cameroon, farmers regularly receive between 80 and 85% of the FOB price. To simulate a competitive price outcome, we assumed that producers received 85% of the FOB price instead of the 70% target. We also simulate a price regime where COCOBOD reverts to a 60% target. The results of the first of these simulation exercises show a significant improvement in the profitability of all systems (Table 2). The income at year 10 of the low input land race system is more than double that achieved under Cocobod's policy-determined price of 70%. As this is the most typical of the five systems analyzed, we conclude that increasing the producer's share of FOB price would have a major impact on rural poverty.

Conversely under the 60% price regime all systems generate negative NPVs and had a negative return in year ten by which time the cocoa tree should be mature and high yielding. Given positive supply price elasticity, the reversion to a 60% price regime would call into question the feasibility of achieving the stated target national output of 1 million tons by

[2] Actual producer price in July of 2009 was $1.14 per kg while the cif price of cocoa on July 27th was $2,94. With the shipping and insurance cost to Europe usually not exceeding $0.30 per kg the 70% target was not being met.

2010. Thus, the ability of COCOBOD to sustain national output at its current levels may be difficult.

Table 2. Sensitivity analysis of an increase (decrease) in farm-gate price from 70% to 85% (from 70% to 60%) of FOB price.

System	*NPV*	*BCR*	*Labor IRR*	*Annual net return at t=10*
LILC competitive market (85% FOB)	221	1.09	3.91	271
HINSC competitive market (85% FOB)	469	1.12	4.00	362
HIMSC competitive market (85% FOB)	307	1.07	3.82	353
LILC (COCOBOD price regime 60% FOB)	-280	0.89	2.98	33
HINSC (COCOBOD price regime 60% FOB)	-15	1.00	3.48	117
HIMSC (COCOBOD price regime 60% FOB)	-181	0.95	3.28	120

The certified cocoa production system results presented above were estimated under the assumption that there were no changes in productivity. However many of the certification standards concern adherence to good agricultural practices and provide training to producers on those practices. We assumed that the training provided by the certification agency results in a 25% improvement in yield and re-estimated using the baseline set of parameters. Under such assumptions, the certified cocoa system goes from a breakeven proposition (Table 1) to assume a profitable system (Table 3).

Table 3. Profitability measures of certified cocoa production assuming a 25% yield gain following training on best practices.

System	*NPV*	*BCR*	*Labor IRR*	*Annual net return at t=10*
HIMSCC with 25% yield gain	373	1.09	3.88	384

3.2 Cash Flow Analysis

As the analysis is focused on the feasibility of developing an alternative production systems, the investment costs associated with such an enterprises will be required for credit applications. Cash flow projections allow the enterprise to manage the outflow of cash in order to stay solvent.

In order to assess medium and long term credit needs, we project cash flows on an annual basis over the 20 year production cycle (Table 4) for the certified production system. Outflows are split into labor and physical input (planting material, tools and equipment, agrochemicals etc.) expenditures. We also examine short term credit needs by splitting

expenditures into those occurring during the production season and those occurring during the major harvest period.

The certified production system has much lower capital requirements and because early bearing Amazon planting materials are used was assumed to begin producing in the third year. A positive cash flow is sustained from year 6 to year 18. Total expenditures per ha over the first five years of production are projected at 3,267 GHc per ha against a total income of 2,868 GHc leaving a deficit of 399 GHc per ha. In the first season a total cost of 643 GHc/ha is incurred with no revenue. More than two-thirds of this sum may be considered "sweat equity" if, rather than hiring labor to establish a new farm, the cocoa farmer chooses to do it herself. In terms of actual physical inputs, an expenditure of 223 GHc/ha would be required. Although this may not seem like a great deal of money, for the chronic poor, it potentially represents a major credit constraint. Short term borrowing needs include fertilizers and agrochemicals with projected average expenditures of roughly 300 GHc ha^{-1}. This again may represent a serious credit constraint for the poor.

Table 4. Cash flow projections for high input certified cocoa production system.

Year	Labor quantity (days)	Labor costs (GHc/ha)	Physical input costs (GHc/ha)	Total costs (GHc/ha)	Total revenues (GHc/ha)	Net annual return (GHc/ha)	Expenditures during production season (GHc/ha)	Expenditures during harvest season (GHc/ha)
1	121	420	223	643	0	-643	643	0
2	85	295	64	359	900	541	307	52
3	91	317	7	324	500	176	295	29
4	136	471	367	838	374	-464	648	190
5	241	837	267	1,104	1,094	-9	548	556
6	259	900	267	1,167	1,219	52	548	619
7	275	954	267	1,221	1,326	104	548	673
8	288	1,000	267	1,267	1,415	148	548	718
9	299	1,036	367	1,403	1,487	84	648	755
10	306	1,063	267	1,330	1,541	210	548	782
11	312	1,082	267	1,349	1,577	228	548	801
12	315	1,092	267	1,359	1,596	238	548	810
13	315	1,092	267	1,359	1,598	238	548	811
14	312	1,084	367	1,451	1,581	130	648	803
15	307	1,067	267	1,334	1,548	214	548	786
16	300	1,041	267	1,308	1,496	188	548	760
17	290	1,006	267	1,273	1,427	154	548	725
18	277	962	267	1,229	1,341	112	548	681
19	262	909	367	1,276	1,237	-39	648	628
20	244	847	267	1,114	1,115	1	548	566
21	1434	4,977	267	5,244	6,576	1,332	548	4,696

Finally we note that there is a large labor cost and a large revenue item in the final year of the system. These charges are for the harvesting of 59 *Terminalia superba* trees

which are conservatively assumed to yield 56 cubic meters of timber at a stumpage value of 25 GHc m^{-3}. Both the total volume and the stumpage price of the timber used in our calculations are believed to be conservative estimates. Increasing these values to 88.5 m^3 and a price of 93 GHc m^{-3} would change the net returns in year 21 from 1,330 to 3,670 GHc ha^{-1}. However because of the long time lag and high discount rate, the NPV is only increased by approximately 50 GHc ha^{-1}.

4. Summary, Conclusions and Recommendations

At the national level, Ghana has set an ambitious target of producing 1 million tons of cocoa by 2012. As forest lands for new cocoa plantings have all but disappeared, achieving this growth target will require a concerted effort to introduce innovations to cocoa farmers. Average yields for most regions are low and production is still extensively based on low input systems most often planted to local landraces. These are modeled in our analysis by the LILC system and assume no agrochemical application other than those supplied by the government at no producer cost. Most of the recent growth in national output is attributable to expansion in the Western Region where forest lands have been converted to full sun production systems which are represented in our analysis by the HINSC system. Yields in the northern districts of the Western Region are the highest in Ghana. This is attributable to the robustness of their tree stocks composed of recently planted Amazon hybrids developed by CRIG combined with low or no permanent shade, high levels of soil nutrients after forest conversion and higher application rates of purchased fertilizers, insecticides and fungicides.

In our analysis, certified cocoa is differentiated from standard bulk cocoa by the way in which it is produced. Perhaps the most significant production difference relates to the inclusion of shade trees at a density of 70 trees per ha. To establish the impact of shade and fertilizers on cocoa we turned to the research trials of CRIG. Shade fertilizer trials revealed 30 to 50 percent yield declines at slightly less than the RA-SAN standard for shade as compared to a no shade system. We assumed the more optimistic decline of 30%. The other significant cost implication of RA-SAN certification is the need to buy personal protective equipment for the mixing and application of pesticides. On the demand side we assumed that there was a 144 GHc per ton premium paid for RA-SAN certification which was evenly distributed to the marketing agent and the producer (i.e. a 72 GHc increase in the farmgate price).

One of the purported benefits of certification is the productivity impact of farmer training on the implementation of good agricultural practices in accordance with certification standards. A 25% increase in yield following farmer training would improved the profitability of this system ahead of the high technology HINSC system to number two on the list. However when fertilizer subsidies are removed, the certified HIMSCC system becomes a breakeven proposition while the high technology HINSC system is no longer profitable. The results for all systems were highly sensitive to the choice of the discount rate with the exception of the representative LILC system.

The main findings of the study include:

- At the current price target of 70% FOB, the representative low input LILC system has a negative NPV.
- A shift of price policy to an 85% FOB level would have significant poverty reduction impacts.
- Benefits of a 25% yield increase following certification training exceed the costs of certification.
- The RA-SAN shade standard of 70 trees per ha results in a 30% yield reduction relative to the full sun yield of the HINSC system.

Before concluding with policy suggestions we would like to call attention to the limitations of the study. First of all not all costs associated with certification were estimated. Finally, it must be pointed out that all our estimates represent just a single moment in time. In these volatile economic times it is difficult to predict how prices might move over time. Based on the above analyses we proffer the following suggestions for consideration by the relevant authorities.

1. Cocoa marketing authorities should assist those identified districts with beans of superior quality in differentiating and branding their premium quality cocoa on world markets.
2. Direct interventions and distortions in input markets can impede the development of a competitively structured private sector and should be avoided.
3. Policy reforms are needed to foster efficiency and private sector involvement in input markets.
4. Private input dealers and public extension services should inform farmers on safe and rational use of agrochemicals.

5. Rural financial institutions require outreach training of staff to develop appropriate lending arrangements in support of agricultural intensification n the cocoa belt.

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