Economic Incentives Necessary for Adoption of Environmentally Friendly Cocoa Production in Ghana

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INTRODUCTION

Between 1998 to 2007, 2.3 million ha of forest in Sub-Saharan Africa, where more than 70% of global cocoa is produced, was cut down due to increased cocoa area. This deforestation, specifically in Ghana and Cote d'Ivorire the global leaders in cocoa production, was attributed to cocoa's high revenue earning potential. Plant breeding progress through introduction of hybrid varieties of cocoa that thrive under no-shaded (deforested) conditions have also exacerbated deforestation.

Economically, the concern with producing cocoa with shade (canopy production) is lower potential yields. The higher yield potential of hybrid cocoa has led to its increased adoption and subsequent increased deforestation. However, the long-term benefits– agronomic, economic and ecological – of the shaded system likely outweigh the short-term benefits of increased yields of no-shade cocoa.

Given that majority of cocoa farmers in Sub-Saharan Africa live on less than $2/day and cocoa accounts for 60-90% of their income, growing cocoa under no shade is often not a choice but a necessity as it has the potential to increase profits by 67% relative to shaded cocoa. Consequently, producers may not be willing to opt for the environmentally beneficial practices inherent in cultivating cocoa under shade if appropriate short-term economic incentive in terms of a price premium does not at least offset the additional profit that farmers may have to forgo by not cultivating cocoa under no shade. In fact, the literature has argued that farmers would require financial incentives to conserve shade-grown cocoa plantations (Waldron et al., 2015).

In 2016 the Fairtrade and UTZ guaranteed their certified cocoa farmers an equivalent of 6.6 and 3.3% price premium, respectively for sustainable production. However, while the Fairtrade premium is set at either country specific, regional or global level, the UTZ premium is largely an additional payment to cover the monetary cost of certification and to reward participating farmers. Thus, price premiums paid to farmers via current third-party production certification schemes do not holistically reflect the true opportunity cost of certification; i.e. the income forgone by not producing cocoa under conventional methods such as growing cocoa under no shade. Currently the literature is sparse with regards to empirical studies that attempt to ascertain the price premium that reflects such opportunity costs. Using Ghana as a case study, this study attempts to fill this knowledge gap.

METHODOLOGY

First, a multiple regression analysis was employed using a sample of 2,076 cocoa producing households collected over five growing seasons (2001/02, 2003/04, 2005/06, 2007/08, and 2009/10), to estimate the potential yield difference among three varieties of cocoa (Amazonian hybrid (Az), Non-Amazonian hybrid (Hy), and Local/Amelonado (Lc)). These yield differentials in addition to yield curves based on field research (Afari-Sefa et al., 2010; Gockowski et al., 2011) were then used to simulate yield curves for Az, Hy, and Lc under shaded and unshaded cocoa production.

In the second step, Mahrizal et al. (2014)'s optimal-phased-replacement model was used to empirically calculate the initial year of replacement (IRY) and optimal rate of replacement (ORR), to maximize NPV by variety and shade management. Given the IRYs, ORRs, and NPVs, the final step searches for the price premium that will make farmers indifferent between switching from unshaded (low environmental services) to shaded (high environmental services) cocoa production.

Knowledge on the price premiums that reflects the opportunity cost of planting cocoa under shade could help inform policy makers, large cocoa buyers and managers of certification schemes in setting appropriate premiums to make producers indifferent between production methods while enhancing biodiversity and reducing deforestation.

RESULTS-Tables/Figures

Table 1: Simulation results of cocoa production over a 50-year period differentiated by cocoa variety and production system in an optimal replacement model

Variety	ORR (%) [a]	IRY (Years) [b]	Quantity (Kg/year) [c]	NPV ($/year) [d]	Prob. [e]
High Input, No Shade Cocoa (HINSC)					
Amazon	5.3	7.9	660	242	0.7
Hybrid	5.7	5.0	609	206	0.6
Local	5.6	8.8	479	87	0.5
Mean	5.5	7.2	583	178	0.6
High Input, Medium Shade Cocoa (HIMSC)					
Amazon	5.2	7.3	475	112	0.6
Hybrid	5.1	6.3	451	91	0.5
Local	5.6	8.5	346	1	0.4
Mean	5.3	7.4	424	68	0.5

[a] Initial Replacement rate (%) of replanting cocoa trees
[b] Optimal Initial year to start replanting cocoa trees
[c] Simulated as the cumulative quantity of cocoa produced divided by 50
[d] Simulated as the sum of the NPV of annul profits divided by 50
[e] Calculated as the number of simulations that resulted in a positive NPV, divided by 1,000.

Table 2: Proposed premiums to incentivize cocoa farmers to switch from High Input, No Shade Cocoa (HINSC) to High Input, Medium Shade Cocoa (HIMSC) by cocoa variety

Switching		Production Change (%) [a]	Prob. [b]	Price premium/ discount (%) [c]
From HINSC	To HIMSC			
Amazon	**Amazon**	-28.0	1.0	31.3
Amazon	**Hybrid**	-31.7	0.9	38.5
Hybrid	**Amazon**	-21.9	0.9	22.6
Hybrid	**Hybrid**	-26.0	1.0	29.3
Local	**Amazon**	-0.8	0.5	-6.1
Local	**Hybrid**	-6.0	0.6	-1.0
Local	**Local**	-27.8	1.0	28.7
Mean		-20.3	1.0	20.5

[a] Calculated as the difference in the production (kg) between the pair presented on table 1
[b] Calculated as the number of simulations that resulted in a positive NPV, divided by 1,000.
[c] Calculated as the price change the will make HIMSC as profitable as HINSC

RESULTS-Key Finding

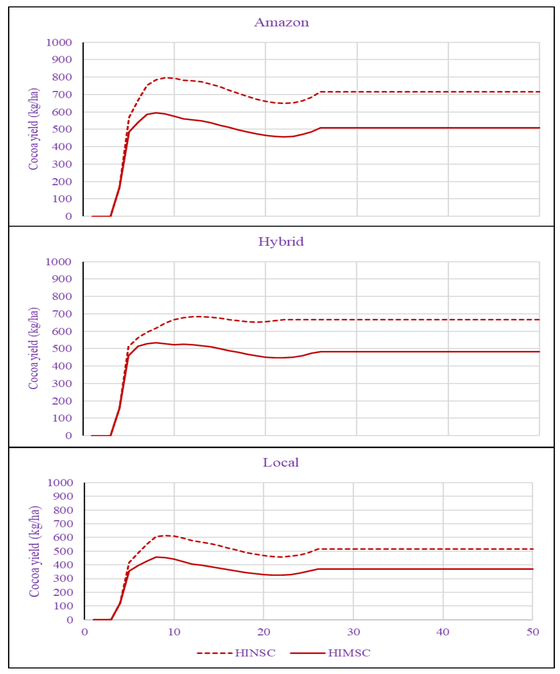
The null hypothesis of no effect of cocoa variety type on yield was rejected at the P<0.01 level. The results indicated that, when a hectare of land initially planted to the Az cocoa variety was replaced with Hy or Lc, cocoa yields decline by 5.1% or 26.9%, respectively; albeit not statistically significant (P<0.10) in the case of the former. When a hectare of land initially planted to the Hy was replaced with Lc, cocoa yield statistically (P<0.05) declined by 21.9%.

Because HINSC was on average 20% more productive than the more environmentally friendly HIMSC, switching to the later resulted in yield losses which necessitated a mean price premium of 20%.

When the price premium is disaggregated by cocoa variety and production system, the results indicated that, those farmers switching from the most productive cocoa variety under HINSC (the least environmental services) had the highest yield lose as such required the largest price premium to switch to low shade

Given the mean price premium of 20%, and range of 22.6 to 38.5%, the price premium of approximately 4.95% offered by third-party production certification schemes for cocoa sustainability do not fully reflect the true opportunity cost of sustainable cocoa production.

Figure 1: Monte Carlo simulation of annual cocoa yield curves by variety over two production cycle (50 years) in optimal baseline models for High Input No Shade Cocoa (HINSC), and High Input Medium Shade Cocoa (HIMSC) production systems in Ghana



CONCLUSIONS

Information on the opportunity cost of providing environmental services in the form of shaded cocoa production is important to cocoa producers to determine whether sustainability production is sufficiently profitable to be adopted. For manufacturers, such an information indicates the cost needed to secure a reliable supply of sustainably produced cocoa.

This study has shown that a larger price premium will be needed if the supply of sustainably produced cocoa is to be met through current production hectares. Additionally, given that about 24% of world cocoa is produced in Ghana, a 20.3% decrease in production due to producing cocoa under shade could shift Ghana's cocoa supply curve that could place upward pressure on global cocoa price, thereby reducing the needed price premium to incentivize farmers.

Thus, there is a need for future research to focus on how such a shift could minimize the necessary price premiums to incentivize profit maximizing producers to switch to sustainably cocoa production.

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