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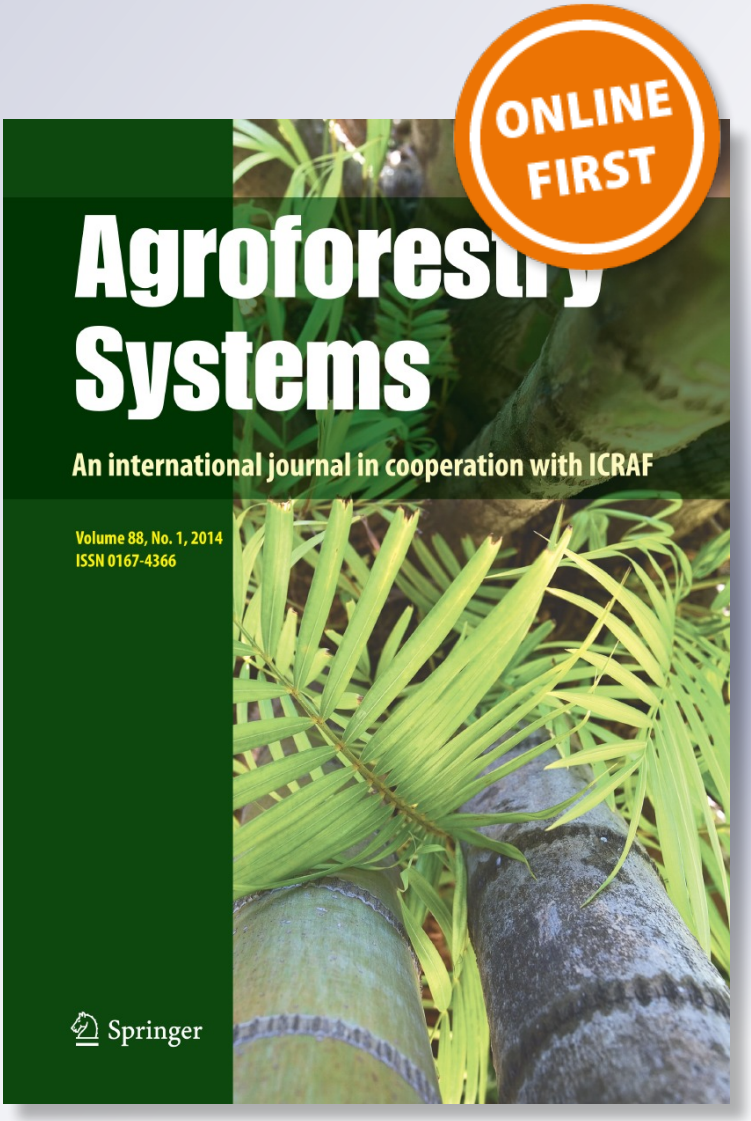

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Farmer attitudes and intentions towards trees in cocoa (*Theobroma cacao* L.) farms in Côte d'Ivoire

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Abstract Cocoa yields in Côte d'Ivoire are low and falling each year, partly as a result of full-sun cropping systems. Thus, interest is now high in establishing sustainable cocoa agroforestry systems through the re-introduction of shade trees. This article uses data collected from a sample of 400 cocoa farmers in the Soubré region of Côte d'Ivoire to analyze farmers' current and intention to plant trees in their cocoa farms in the future and the motivation for their decision. Logit regressions are used to assess the various determinants of current tree planting behaviour and future adoption intention. Results show that both current and likelihood of deliberately planting trees with cocoa in the future is significantly affected by extension and certification programs, severity of diseases affecting cocoa, and geographic zone. Future intentions to associate trees with cocoa are further influenced by the age of the farmers, household size and the average age of the cocoa farm. To increase the adoption of tree planting in cocoa fields there is the need to intensify extension messages on the benefit of shade trees in cocoa farms especially in areas where adoption intention is still low. Where awareness is high, adoption can be increased through the supply of seedlings and provision of specific trainings on planting density and management techniques to ensure that agroforestry has the maximum positive effect.

Keywords Côte d'Ivoire · Agroforestry · Cocoa · Diversification · Technology adoption

A. Gyau (✉) · D. Ofori
World Agroforestry Centre, United Nations Avenue, Box 30677, Gigiri, Nairobi 01000, Kenya
e-mail: a.gyau@cgiar.org

K. Smoot
Department of Agricultural and Resource Economics, University of California Davis, One Shields Avenue, Davis, CA 95616, USA

C. Kouame · L. Diby · J. Kahia
World Agroforestry Centre, Cocody Mermoz, Avenue 908, BP 2823, Abidjan, Ivory Coast

Introduction

Sustainable agricultural production in many developing countries is increasingly been recognized as a means to address the long-term production constraints. This notwithstanding, agricultural practices in these countries still adhere to unsustainable practices such as intensive farming systems which may result in short term increase in productivity but may experience considerable decline in the long term (Smoot et al. 2013). This trend seems to be happening in the cocoa industry in Côte d'Ivoire where productivity per land area is among the lowest in the world though it still remains the largest producer in the world. One reason for this is the fact that the dominant full-sun, mono-cropped cocoa systems in the country, which increase yields in the short-term, has led to severe long-term

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nutrient degradation of the soils and has promoted rapid deforestation (Ruf 2001). Cocoa grown in this way requires rotation to new land after a period of 20–30 years, but deforestation and increasing land pressure in Côte d'Ivoire means that this type of farming is no longer sustainable (Ruf 2001; Asare 2005) necessitating a new model for cocoa.

Recent research has shown that cocoa systems which incorporate other tree species for shade, moisture retention, restoration of soil fertility, goods for family consumption used in the farm or sold are more sustainable in the long-term and only experience a small decrease in yields over time under ideal conditions (Asare 2005; Ofori-Frimpong 2007; Cloug et al. 2009; Jagoret et al. 2011). Another element of sustainability is economic diversification. Currently the majority of cocoa farmers in Côte d'Ivoire depend solely on cocoa farming revenues, meaning that in times of crop failure (during pest, disease or environmental catastrophes), increased input prices, or low prices of cocoa can be disastrous for them. If farmers develop a more diversified income base then they would have alternate sources of income and hence face less risk from price fluctuations and crop failure (Gibson 2007).

Cocoa agroforestry systems in Côte d'Ivoire are being promoted with the hope to bring about the twin objective of increasing productivity in the long run whilst at the same time enhancing environmental sustainability. This article seeks to investigate current farmer knowledge and attitudes toward cocoa agroforestry, determine whether farmers have interest and intention to plant more trees with their cocoa in the future, and identify the factors which significantly affect these attitudes and intentions.

Materials and methods

Model development

To understand farmers intentions and attitudes towards adoption of agroforestry practices, we relied on variables which have been used in past agroforestry adoption studies. Most studies of technology adoption use ex post data, looking only at whether a farmer actually adopted an agricultural technology or not (Prokopy et al. 2008). However, other studies such as Adrian et al. (2005), Verhees et al. (2005), Garforth et al. (2006) and Rezaei-Moghaddam and Salehi (2010) have looked at intention to adopt as the dependent variable. To provide a comprehensive understanding of adoption we used the two variables namely; current adoption behaviour and future intention to adopt as dependent variables.

Variables which have been commonly included in past studies as influencing factors of agroforestry adoption were also used as independent variables. A review of 32 different agroforestry adoption studies by Pattanayak et al. (2003) found that the common groupings of factors used are; household preferences (determined by characteristics like age, education, household size, etc.), resource endowments (total land, available labor, and wealth, proxied by bank accounts and non-agricultural revenue); market incentives (perception of expected profitability, distance to the market); biophysical factors (rainfall and soil quality); and risk and uncertainty (based on land tenure, migration status, and information access proxied by extension services and association membership). Several other empirical studies also found these factors to be significant (Current et al. 1995; Peterson et al. 1999; Adesina et al. 2000; Casey and Caviglia 2000; Neupane et al. 2002; Degrande et al. 2006; Pawarda et al. 2010).

Other factors influencing adoption of new production technologies include: farmers' perception on the efficacy of a given technique or technology (yield increase, greater drought resistance, etc.) (Adesina and Baidu-Forson 1995; Garforth et al. 2006; Zubair and Garforth 2006; Rezaei-Moghaddam and Salehi 2010), and awareness relevant environmental problems on their land (D'Souza et al. 1993; Franzel 1999; Sood and Mitchell 2006). Thus, in summary it can be observed that farmers' adoption behavior can be influenced by three main factors namely (1) the characteristics of the adopter and its environment (2) the attributes of the technology (3) communications mechanism.

A logit model was used to explore the effect of the selected independent variables on current and intended use of shade trees in cocoa farms. The model is shown below: Currently have associated trees/ Intention to plant more trees in cocoa = ln(total land areas) + extension + education + coop member + premium from certification in 2012 + has bank account + farmer age + (farmer age)^2 + average cocoa age + (average cocoa age)^2 + ln (distance to

paved road) + market in village + ln(% revenue from cocoa) + non-agriculture revenue + ln(cocoa labor) + ln(cocoa yield 2012) + Cocoa Swollen Shoot Virus (CSSV) + other severe diseases + sell agroforestry products + ln(number advantages of trees cited) + currently practicing agroforestry on any land + origin + zone. The regression on the intention/likelihood and current tree association are almost identical, except that the current agroforestry variable is omitted from the independent variables.

Study area

The area covered in this study was the department of Soubré (land area covering 8,306 km^2), located in the southwest of Côte d'Ivoire. This area is an important cocoa producing area, contributing about 20 % of national cocoa production, or 250,000 tons/year, in 2010 (World Agroforestry Center (ICRAF) 2011). The total population of Soubré in 2012 was approximately 940,000 people (World Agroforestry Center (ICRAF) 2011) with a population density of 76 people per m^2. This is much higher than the national average due to the high levels of migration to the area spurred by the cocoa economy. Cocoa cocoa is the most important source of income in addition to others like coffee, food crops, rubber, livestock and oil palm (Kouadjo et al. 2002). According to Assiri and Kacou (2012) the average yield for cocoa in Soubré was 560 kg/ha/year, which is higher than the national average but still far lower than potential yields. Soubré has a typical equatorial climate, with two rainy seasons and two dry seasons per year. The average total annual rainfall across the 1999–2008 period was 1,363 mm. There are essentially three types of soil found in the department: brown tropical soils, highly unsaturated iron soils, and water-logged soils near rivers and marshes that are ideal for flooded cultivation of crops like rice (World Agroforestry Center (ICRAF) 2011).

Sampling procedure and data collection

The data for this analysis come from a survey of a random sample of 400 cocoa farmers conducted in January and February 2013. The study area was divided into five approximately equal zones based on size and a different surveyor was assigned to cover each zone. Within each zone, ten villages were selected so as to capture diversity within the sample along several different variables: geographic location, level of isolation, dominant ethnic group, and exposure to extension services. Eight producer households were interviewed within each village. Surveyors were trained in sampling methods and survey implementation, which included an on-the-ground supervised test, before being sent to their assigned zones.

The survey covered demographic data, village geographic and market data, the current presence of trees on the land and the reasons for their presence or absence, and general attitudes toward cocoa agroforestry. Other questions covered include farmers' reasons for not having certain tree species on their farms as well as their level of awareness of the benefits associated with planting trees in cocoa farms. The survey focused on a limited number of five target tree species namely: akpi (*Ricinodendron heudelotii*), oil palm (*Elaeis guineensis*), iroko (*Milicia excelsa*), frake (*Terminalia superba*) and framire (*Terminalia ivorensis*) which were elicited in a previous study by Smoot et al. (2013). Both the head of household (in most cases a male) and the head female member of the household were interviewed for the same survey in order to get the most accurate information, since women tend to be in charge of all crops other than cocoa and may thus know more about alternative trees on the land.

Results

Summary statistics on adoption and attitudes toward agroforestry

The results showed that 50 % of sampled farmers had akpi on their land, 92 % had oil palm, 42 % had iroko, 32 % had frake, and 19 % had framire. Farmers who said that they did not have a given species on their land gave reasons why they do not. The percentages of the sampled farmers who provided each of six primary reasons are shown in Table 1.

The most common reason stated for the absence of all tree species except for oil palm was that they did not grow there naturally, indicating that most cocoa farmers have a very passive attitude toward associating these particular trees. The majority of farmers (65.7 %) who did not have oil palm said that the tree was present on the land naturally but they had clear-cut it when they planted their cocoa. A sizeable number of farmers also gave same reason for the absence of other

Table 1 Reasons given by farmers (in percentages) for not having the target tree species in their cocoa fields

	It doesn't grow there naturally	I cut it when I planted my cocoa	I am not aware of any advantages	Not good for cocoa	To avoid cutting by companies	Existed previously but died
Akpi (*R. heudelotii*)	60	22.8	7.9	3.3	–	4.7
Oilpalm (*E. guineensis*)	5.7	65.7	–	25.7	–	2.9
Iroko (*M. excelsa*)	53.2	27	3.6	4.0	6.0	2.8
Frake (*T. superba*)	58	26.1	5.3	2.1	3.9	1.8
Framire (*T. ivorensis*)	63.5	20.1	5.7	2.7	3.3	1.8

Table 2 Identified benefits of selected tree species as expressed by farmers

	Portion of the sample (%)						
	Shade for cocoa	Soil fertility	Soil humidity	Good for timber	Good for fuel wood	Supplies other products	No advantages
Akpi (*R. heudelotii*)	10.9	12.3	5.4	–	–	58.3	11.7
Oilpalm (*E. guineensis*)	–	–	–	–	–	91	5.4
Iroko (*M. excelsa*)	11.4	7.6	7	48.1	2.8	6	15
Frake (*T. superba*)	11.3	5.9	3.8	46.6	6.8	4.1	21.2
Framire (*T. ivorensis*)	9.7	5	3.6	43.6	6.4	3.8	27.3

Table 3 Reported agroforestry practices by zone according to interviewed farmers in percentages

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Pooled
Parcels with associated tree crops	86.3	73.8	88.8	98.8	50	79.5
Parcels w/associated food crops	87.5	52.5	73.8	95	35	68.8
Intention to plant trees in future	70	61.3	30	60	35.4	51.4

trees on the list. The second most common reason for the lack of oil palm was that the farmer believed that it damaged cocoa and thus actively removed it. Interestingly, only very few farmers were unaware of any economic or environmental benefits of the species listed, and an even smaller number believed that any of the target species had negative effects on cocoa, and yet the trees were still absent from their fields.

Farmers' awareness of benefits of selected species

Akpi and oil palm were highly ranked for their fruits, which are harvested for home consumption and sold for revenue. A significant minority of farmers (10.9 %) was aware that akpi can provide beneficial shade to cocoa and improve soil. Iroko, frake and framire were cited by the largest number (more than 43 % in all cases) of farmers as providing good timber. Over 11 % of the sample recognized that iroko and frake provide beneficial shade to cocoa, though only 9.7 % said the same of framire probably due to the fact that fewer farmers were familiar with framire which also had the highest number of respondents (27.3) who were not aware of any of its advantages (Table 2).

Current agroforestry practices

Overall 79.5 and 68.8 % of the farmers have trees and food crops respectively in association with their cocoa (Table 3). 51 % intend to plant tree in the future.

Adoption of agroforestry varies widely by zone, with the lowest current and intended tree association in zones 5 and 3, respectively.

The results also indicate that over half the sample practiced intercropping of food crops and were intending to plant more trees in the future. Interestingly, more farmers (79.5 %) currently have associated trees than those who stated a future intention to plant more trees (51.4 %); however, the difference is not statistically significant (Table 3).

Motivation to plant trees

The top motivation for intending to plant trees was the expected benefits of shade trees to cocoa, closely followed by a desire to supplement one's income. A much smaller number (<40 farmers) said they wanted the products of trees for household consumption and only 20 farmers said that they would plant more trees because it is a requirement for certification (Fig. 1).

Reasons for not wanting to plant trees

The top reason cited among farmers who said they did not plan to plant trees in their cocoa plots in the future was that they were unaware of any advantages to associating trees with cocoa (30 %). A lack of adequate space was the primary barrier for 25 % of these farmers, a fear that associating trees would decrease cocoa yield was cited by about 21 %, and a lack of means (money, access to seedlings, labor) was cited by about 18 % as shown in Fig. 2.

Results of the regression model

Summary statistics for the independent variables used in the logit regression model is presented in Table 4. Average land size is 9.4 ha with a minimum and maximum being 1 and 57.5 ha respectively. Average age of farmers is 49 years and cocoa yield per hectare averages 0.35 tons/ha. Whereas some farmers can obtain a high yield of 2.3 ha/ton others can obtain as low as 0.3 tons/ha. Cocoa income forms 88 % of average household income in the Soubre area. Most cocoa trees in the study area are quite old averaging about 23 years.

The results of the logit regression on both current shade tree presence in cocoa and intent to plant more trees in cocoa parcels in the future are shown in Table 5. The odds ratio indicates the probability of a farmer desiring to plant trees relative to not desiring to plant. Results show that only few of the tested variables have a significant effect on current tree planting behaviour. Farmers with non-agricultural revenue were significantly more likely to have trees by a factor of 3.4. Having higher cocoa yield, having severe problems with diseases other than CSSV, and living in zone 4 also significantly increased the likelihood of current agroforestry practices: a 10 % increase in yield increased the odds by 1.5 times, having other diseases increased the odds by 1.8 times, and living in zone 4 increased the odds by 9 times when compared to those living in zone 1. On the other hand, farmers who used more labor in the cocoa fields (man-hours per week) were less likely to have trees: a 10 % increase in labor decreased the odds by 1.3. Those living in zone 2 were four times less likely and those living in zone 5 were 8.6 times less likely to have trees in their cocoa farms when compared to those living in zone 1.

The logit regression on farmers' stated intention to plant more trees in their cocoa parcels yielded more significant results. As expected, those who received extension services or training had a higher intention to adopt, by a factor of 3.8. Also as expected, those farmers who received a certification premium in 2012 also had a higher stated intention to adopt, by a factor of 2.5. Farmer age had a U-shaped relationship with likelihood to adopt, decreasing with age, but increasing with the square of age, suggesting that farmers at the two extremes of the age range had the highest interest in cocoa agroforestry. A 10 % increase in household size led to a decrease in the intention to adopt by a factor of 2. The presence of both CSSV and other severe diseases increased the likelihood of being willing to plant more trees, by factors of 1.7 and 1.8, respectively. Farmers in all other zones had a lower likelihood of planting trees when compared with zone 1: by a factor of 3 for zone 2, a factor of 12.7 for zone 3, 4.5 for zone 4 and 4.7 for zone 5.

Discussion

Both current tree association with cocoa and intention to adopt agroforestry in the future differ significantly across geographic zones. This may be the result of differences in biophysical factors in the various zones

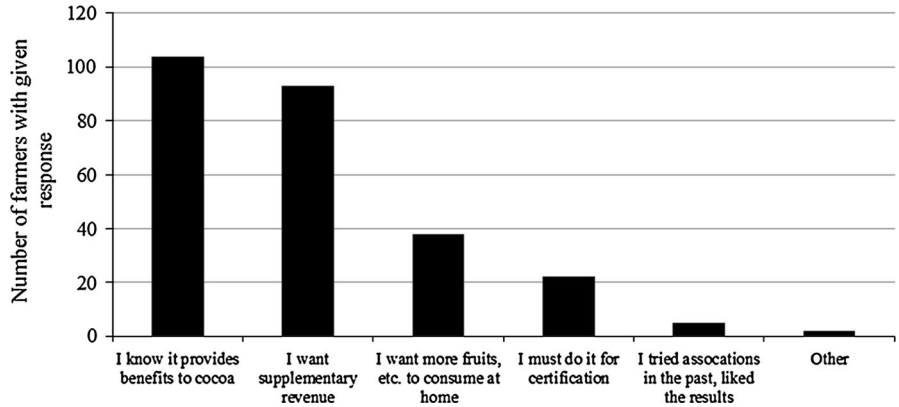

Fig. 1 Reasons for farmers' intention to associate other trees with cocoa in the future

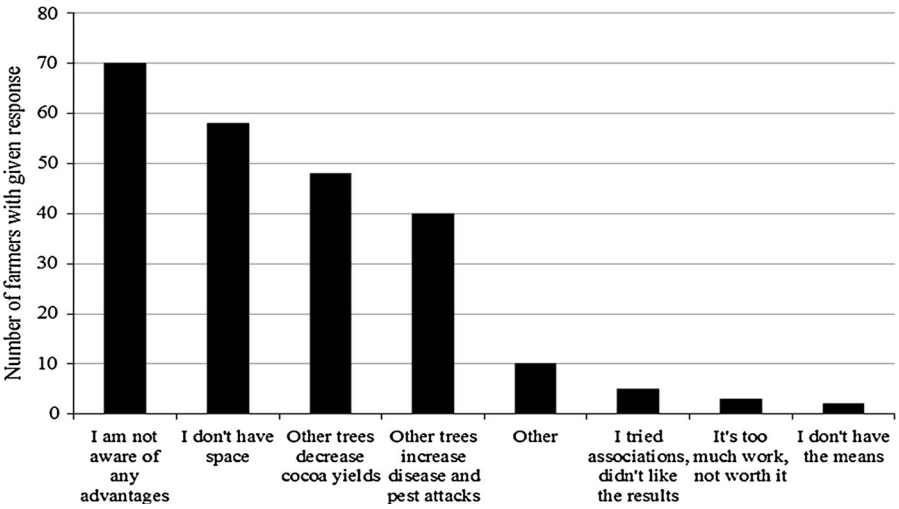

Fig. 2 Reasons for farmers' intention not to associate other trees with cocoa in the future

in Soubre. Although to the best of our knowledge, there have not been any study to compare the biophysical factors in Soubre, anecdotal evidence from field observations indicate that farmers in areas with relatively more favourable biophysical factors such as soil, climate and rainfall were seen to be less likely to practice cocoa agroforestry because those farmers regard the natural conditions as good enough for the success of their cocoa farms. This is consistent with Pattanayak et al. (2003), who found that biophysical factors had a significant impact on agroforestry adoption in 64 % of studies reviewed.

Contrary to our expectations, marketing related variables (distance to the nearest paved road and existence of market in the village) did not have a significant relationship on current or future intention to adopt. This is contradiction to the review by Pattanayak et al. (2003) who found that marketing factors like level of isolation may also play a role in the differences across region and these variables were found to be significant in 73 % of cases. This is the case because there is adequate market for most of the products which were considered in this analysis.

It was also found that existence of extension and certification programs have a significant, positive effect on intention to associate trees with cocoa. This is consistent with a number of past studies which found a highly significant and positive effect of training programs on agroforestry adoption (Adesina et al. 2000; Casey and Caviglia 2000). The fact that extension and certification variables do not significantly influence current cocoa agroforestry practices is not very surprising, considering that most trees present in cocoa plots were not planted, and thus the presence of trees except few fruit trees often does not indicate an active decision to adopt agroforestry. Furthermore,

Table 4 Summary statistics of variables influencing current and intention to plant trees in future

Continuous variables	Mean	SD	Median	Min	Max
Total land (ha)	9.4	8.2	7	1	57.5
Farmer age	49	12.6	50	21	88
Household size	12.3	7	11	1	40
Annual yield 2012 (tons)	0.35	0.29	0.29	0.02	2.3
Avg. cocoa age (years)	22.9	10.2	24.3	0.3	75.6
Revenue earned from cocoa (%)	88.4	20	100	0	100
Cocoa labor (man hours/week)	98.3	70.4	84	0	432
No. advantages cited of other trees	8.17	2.56	10	0	10

Dummy variables	No. farmers for which true	Proportion of farmers for which true (%)
Farmers w/associated trees currently	318	79.5
Other severe disease problems in field	272	68
Intention to plant trees in future	205	51.4
Domestic migrant	204	51
Foreign migrants	130	47
Sell alternative tree products	182	45.5
Educated (1+ years of schooling)	152	38
Coop member	172	43
Received extension	172	43
CSSV present in field	128	32
Bank account	96	24
Premium 2012	85	21.2
Native ethnic group	66	16.5
Earn non-agricultural revenue	60	15

certification recently started in the Soubre area and therefore most farmers have not been informed of the benefits associated with cocoa tree agroforestry. The intention to adopt the use of trees as shade in cocoa plots variable is the variable which is most affected by extension and training. Furthermore, the fact that farmers who earn a certification premium are more interested in planting trees in the future is not just as a result of the certification training, but also because they expect to earn higher profits (via continued access to premium) if they plant more trees to meet the standards.

The significant impact of farmer age on intention to associate trees, and the fact that the two variables have a "U-shaped" relationship, is surprising. The results of the current study suggest that younger farmers and very old farmers are most interested in cocoa agroforestry, while middle-aged farmers have the lowest willingness to adopt. This may be due to the fact that younger farmers are more open to new techniques and have also been more consistently exposed to the new message of the extension service, that partially-shaded cocoa is preferable to full sun. On the other hand, the oldest farmers have the most experience and, despite being taught early on that full-sun cocoa was the ideal, they have likely observed over time that shaded cocoa is more sustainable and the biggest yield problems arising now are occurring in full-sun parcels. The results support Pattanayak et al. (2003) who found that although age is included in most adoption regressions, it is significant in only 29 % of surveyed studies, and all those found positive relationships. This might indicate a difference in the dynamics of age and adoption for cocoa agroforestry when compared to other cropping systems.

The findings that an increase in household size causes a decrease in the willingness to adopt cocoa agroforestry implies larger households may be more

Table 5 Determinants of current tree planting and intention to plant trees

	Currently have associated trees		Intention to plant trees in future	
	Coefficient	Odds ratio	Coefficient	Odds ratio
Ln (total land area)	0.158	1.17	0.308	1.36
	(0.243)	(0.243)	(0.193)	(0.193)
Extension	0.512	1.67	1.323	3.75
	(0.371)	(0.371)	(0.306)***	(0.306)***
Educated	0.404	1.50	−0.026	0.97
	(0.418)	(0.418)	(0.298)	(0.298)
Coop member	0.169	1.18	0.057	1.06
	(0.343)	(0.343)	(0.292)	(0.292)
Certification premium 2012	−0.095	0.91	0.934	2.54
	(0.564)	(0.564)	(0.389)**	(0.389)**
Bank account	0.158	1.17	0.264	1.30
	(0.484)	(0.484)	(0.345)	(0.345)
Farmer age	−0.027	0.97	−0.200	0.82
	(0.083)	(0.083)	(0.065)***	(0.065)***
Farmer age^2	0.000	1.00	0.002	1.00
	(0.001)	(0.001)	(0.001)***	(0.001)***
Average cocoa age	−0.009	0.99	−0.024	0.98
	(0.042)	(0.042)	(0.040)	(0.040)
(Average cocoa age)^2	0.000	1.00	0.000	1.00
	(0.001)	(0.001)	(0.001)	(0.001)
Ln (household size)	−0.074	0.93	−0.723	0.49
	(0.293)	(0.293)	(0.256)***	(0.256)***
Ln (distance to paved road)	0.001	1.00	−0.040	0.96
	(0.044)	(0.044)	(0.037)	(0.037)
Market in village	0.211	1.23	0.065	1.07
	(0.345)	(0.345)	(0.269)	(0.269)
Ln (% revenue from cocoa)	0.075	1.08	0.232	1.26
	(0.590)	(0.590)	(0.428)	(0.428)
Non-agricultural revenue	1.213	3.36	0.505	1.66
	(0.591)**	(0.591)**	(0.351)	(0.351)
Ln (cocoa labor)	−0.293	0.75	0.090	1.09
	(0.168)*	(0.168)*	(0.112)	(0.112)
Ln (cocoa yield 2012)	0.381	1.46	0.199	1.22
	(0.188)**	(0.188)**	(0.176)	(0.176)
CSSV	0.240	1.27	0.553	1.74
	(0.423)	(0.423)	(0.312)*	(0.312)*
Other severe diseases	0.583	1.79	0.610	1.84
	(0.340)*	(0.340)*	(0.279)**	(0.279)**
Sell alternative AF products	0.333	1.40	−0.094	0.91
	(0.346)	(0.346)	(0.257)	(0.257)
Ln (no. advantages listed trees)	0.500	1.65	0.134	1.14
	(0.350)	(0.350)	(0.156)	(0.156)
Currently have associated trees	–	1.00	0.335	1.40

Table 5 continued

	Currently have associated trees		Intention to plant trees in future	
	Coefficient	Odds ratio	Coefficient	Odds ratio
			(0.324)	(0.324)
Origin 2—internal migrant	0.192	1.21	0.112	1.12
	(0.496)	(0.496)	(0.416)	(0.416)
Origin 3—foreign migrant	−0.091	0.91	0.297	1.35
	(0.580)	(0.580)	(0.439)	(0.439)
Zone 2—Grand Zattry	−1.385	0.25	−1.135	0.32
	(0.502)***	(0.502)***	(0.429)***	(0.429)***
Zone 3—Soubre	−0.059	0.94	−2.540	0.08
	(0.535)	(0.535)	(0.495)***	(0.495)***
Zone 4—Meagui	2.200	9.03	−1.502	0.22
	(1.114)**	(1.114)**	(0.533)***	(0.533)***
Zone 5—Gueyo et Okrouyo	–2.152	0.12	−1.546	0.21
	(0.599)***	(0.599)***	(0.506)***	(0.506)***
Constant	1.746	5.73	3.645	38.28
	(3.763)	(3.763)	(2.549)	(2.549)
Observations	385	385	385	385
Pseudo R^2	0.258	0.258	0.22	0.22
Wald χ^2	68.59	68.59	89.32	89.32
Log pseudo likelihood	−140.86	−140.86	−207.97	−207.97

Robust standard errors are shown in parenthesis

* Indicates significance at 10 %, ** indicates significance at 5 %, and *** indicates significance at 1 %

risk averse because they have more mouths to feed, which would be consistent with the negative relationship to adoption.

Furthermore, the significance effect of experience with CSSV or other severe disease problems present in cocoa parcels on both actual adoption and decision to adopt cocoa agroforestry in the future is consistent with the theory and past empirical finding that having a problem on one's own land increases interest in adopting a new technology to address that problem (D'Souza et al. 1993; Sood and Mitchell 2006). Agroforestry with the proper tree species has been found to slow the spread of CSSV (Asare 2005), and when cocoa is protected from sun damage and soils are more fertile then it is hardier and less vulnerable to diseases.

There was no significant impact of formal education (measured by number of years of formal education) on agroforestry adoption, but this is in fact consistent with a number of past studies such as (Matata et al. 2008; Gyau et al. 2012) which did not find any significant effect of education on adoption. Cooperative membership was also not significant, in contrast to a number of past studies (Adesina et al. 2000; Casey and Caviglia 2000; Neupane et al. 2002). The effect of ethnic origin did not significantly affect current or intended adoption, despite the fact that tenure status (for which this is a proxy) was found to be a highly significant factor in many past adoption studies (Mercer 2004). Ruf (2001) expressly stated that native groups in Côte d'Ivoire had more shade trees than migrant groups because migrants were much more likely to clear-cut prior to planting in the 1960s and 1970s. The results of this study did not reflect this trend.

Conclusions and recommendations

Overall, the results suggest that most current association of cocoa with other tree species (except few fruit trees) in cocoa farms in Côte d'Ivoire is from natural regeneration which is done either intentionally or

happens by chance. Where natural regeneration of indigenous trees or actual planting was done, it was mostly for household subsistence or to earn alternative income. We that farmers' interest in actively planting tree species to create deliberate cocoa agroforestry systems in the country is rising. Most of the sampled farmers view the integration of trees with cocoa as positive, and an increasing number are actually aware of the benefit of agroforestry practices, especially of large shade trees, to cocoa sustainability. Furthermore, extension and certification programs seem to have influence on farmers' interest and willingness to plant shade trees in their cocoa farms. This is an encouraging result which shows that the extension efforts should continue, particularly in the zones where adoption intention is still low and where farmers report lack of awareness of the benefits of agroforestry. However, there are several zones in which farmers already report a high awareness of the benefits of agroforestry and stated intention to adopt was very high due to efforts by different certification bodies that are rewarding sustainable cocoa production practices such as agroforestry. In these regions the proponents of agroforestry should go beyond ensuring farmers' awareness of the benefits of trees and agroforestry to both cocoa and the household economy, and should focus more on supplying seedlings and providing specific trainings on planting density and management techniques like pruning to ensure that agroforestry has the maximum positive effect.

Finally, organizations interested in promoting cocoa agroforestry should use different strategies to increase adoption. For instance in areas where cocoa is devastated by diseases such as the cocoa swollen shoot, farmers are more interested in agroforestry. Where disease is widespread, the best solution will be to undertake a complete replanting of cocoa, and hence farmers could at the same time interplant other tree species in a regular way throughout the field, which is not possible when trees are introduced piecemeal into an already established field.

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