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Management of cocoa: Constraints during acquisition and application of pesticides in the humid forest zones of southern Cameroon

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ABSTRACT

Subsidies for inputs, such as pesticides, enabled about 400 000 households in southern Cameroon to grow cocoa and provide for basic needs such as food, education, bride price and house construction. Economic liberalization resulted in disengagement of the State in favor of the private sector and engendered a new behavior pattern among cocoa farmers. This study focuses on the constraints inherent in the acquisition and application of pesticides for cocoa growing on small farms in the tropical rainforest areas of southern Cameroon.

Over 50% of farmers use chemical pesticides, but the high cost and lack of availability in rural areas are cited, respectively by 65% and 55% of cocoa farmers as major constraints by users of pesticides. Only 21% of cocoa farmers buy their pesticides in the village. Fungicides are the main pesticide used to control *Phytophthora megakarya*, but farmers do not apply the recommended application rate so production is low. Some farmers form groups to circumvent production problems, while some use plant extracts. To increase production it is essential to improve safe practices in the purchase, transportation; storage, handling and application of pesticides and promote integrated pest management in southern Cameroon.

1. Introduction

Pesticides are the main inputs in the cocoa agroforest management of the humid forest zone in southern Cameroon (Gockowski and Dury, 1999; Matthews et al., 2003). By and large, cocoa farms are undergoing attacks by black pod disease and capsids. Until recently the State-run cocoa board SODECAO, ensured the purchase and application of pesticides in farmers' plantation (Matteson et al., 1995). Cocoa is the main source of income in southern Cameroon. In the 1980s, it represented between half and three quarters of the household budget in the area (Leplaideur, 1985). A cocoa farm in the Central and South provinces of Cameroon could produce, on average, 150–300 kg/ha/year (Losch et al., 1991). In the Lekie district within the Central province, revenues from cocoa amounted to 230 000 FCFA/farmer in 1983–1984 (Losch et al., 1991). This money is generally used for basic need such as health care, school fees, house construction, etc.

Fungicide control of cocoa black pod disease fell overnight from over 30 million packets of fungicide freely distributed by the Government in the mid 1980s to less than 3 million packets purchased from private suppliers in 1993 (Varlet and Berry, 1997). Hence, pest and disease outbreaks became major limiting factors to sustainable cocoa production in southern Cameroon (Sonwa et al., 2005). With an investment (labor and other costs) of 46 000 F CFA, a farmer of southern Cameroon could, in 2002/2003, earn 164 000 F CFA/ha (Gockowski et al., 2004). With the cocoa crisis, cocoa production (and indirectly cocoa income) fell dramatically precluding appropriate pesticide campaigns. Without fungicide application, black pod incidence could be more than 60% (Sonwa, 2004). In some areas capsids attack can reduce cocoa production up to 75% (PAN, 2001).

During the cocoa crisis of 1989, world cocoa prices dropped and the cocoa and pesticide sectors were liberalized without thorough preparation. Subsidies in the form of pesticides were gradually suppressed between 1991 and 1994. Farmers and the private sector were ill prepared to replace the State in the management of the pesticide sector (Matteson et al., 1995). In 1994, devaluation of the CFA doubled the price of pesticides,

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which for the most part are imported. However, it increased the cocoa farmer's income, and triggered reclamation of abandoned cocoa farms. Measures adopted by the Government resulted in new behavior patterns among farmers (Coulibaly et al., 2002; Sonwa et al., 2002). Some of these new practices are found in the daily management of pesticides and deserve further attention. In this paper, the regional use of pesticides is of central concern. The following issues will be investigated:

(1) the degree of pesticide use;
(2) the various pesticide supply sources;
(3) reasons mentioned by cocoa farmers for not using pesticides;
(4) main pesticides used by farmers; and
(5) frequency of pesticide use in the humid forest zones of southern Cameroon.

2. Zone of study and methodology

2.1. Zone of study

In Cameroon, cocoa farming is carried out in the South West, Littoral, East Provinces and the forest provinces of the Central and South. This study will be limited to the secondary forests in the center around Mbalmayo and Yaounde and to the primary forest in the South around Ebolowa. Forest degradation increases from South to North (Yaounde region). The Mbalmayo region has intermediate characteristics between the Yaounde and Ebolowa zones (ASB, 2000). The climate is equatorial with four seasons (two rainy seasons and two dry seasons). Rainfall is 1654 mm in Yaounde, 1624 mm in Mbalmayo and 1876 mm in Ebolowa (EPHTA, 1996). The soils are ferric, poor in nutrients, acidic and fragile (Muller and Gavaud, 1979). Average fallow period is 3.9 years in Yaounde, 5.4 in Mbalmayo and 7.5 in Ebolowa.

Settlement in the humid forest zone is either linear or arranged along fragmented circles. Population density decreases from Yaounde to Ebolowa. In some districts around Yaounde, the population density is 85/km^2, while in the most densely districts around Ebolowa the density is only 15/km^2. The pressure on resources is therefore very high around Yaounde (Endamana and Sonwa, 1998). The population depends on hunting, small livestock farming, gathering and agriculture. In each village, 2/3 of the income is from agriculture. The population of the Ebolowa region depends on cocoa growing more than anything else (Gockowski, 1996).

2.2. Methodology

The study, through surveys, was organized in two stages. The first stage consisted of group interviews in 45 villages (that is 15 in each region: Ebolowa, Mbalmayo and Yaounde) across the humid forest zone of southern Cameroon. In each village, a group interview of at least 10 farmers per village was conducted by a multidisciplinary team made up of ecologists, sociologists and economists. At the end of this phase 21 villages, that is 7 per zone, were retained for a second round of questioning, related to farm and household practices. Among other questions, the cocoa farmers were asked:

- if they use chemical products to control pests;
- to give the name of the pesticide(s) they use; where they purchase each pesticide (the answer required being "bought in the village market, bought in the nearest town, bought from the village co-operative, bought from other farmers, took on credit from a local company, other…");
- the frequency of pesticide use and the constraints linked to pesticide use; and
- those who did not use pesticides were asked to give the reasons they did not do so (the answer required being, "not available, too costly, very dangerous, do not know how to use, do not know anything about pesticides, other…").

Number of respondents per village was recorded as well as the response for each of the questions. Results were integrated for each of the three zones (blocks). The average values for each of the three zones (blocks) and for the entire study region were calculated. Variables were subjected to an ANOVA for the comparison between zones (blocks). In case of significance of the ANOVA at $P = 0.05$, means were separated using least significant difference (LSD) tests.

3. Results and discussions

3.1. Degree of pesticide use

3.1.1. Use of pesticides

More than 60% of cocoa farmers of the humid forest use pesticides to treat their cocoa farms (Table 1). This percentage is 59% in Yaounde, 66% in Mbalmayo and 59% in Ebolowa. A study carried out by the Ministry of Agriculture reveals that more than 42% of farmers use pesticides (PAN, 2003). According to Gockowski and Doumbe (1999) 51% of horticultural plots around Yaounde are sprayed with pesticides although these farmers are not adequately informed about the proper use of pesticides.

The two main constraints faced by those who use pesticides are the high cost and unavailability (Table 2). These two reasons are mentioned, respectively by, 65% and 55% of cocoa farmers using pesticides. These two constraints are even more acute in the Mbalmayo and Ebolowa blocs of villages, which are more distant from the Yaounde, the capital and main internal pesticide redistribution center. The other reasons (dangerous to health, expired products, handling of pesticides, etc.) are rarely mentioned, if at all, by those cocoa farmers using pesticides. Thus, the latter minor constraints are overshadowed by the cost and supply difficulties, which in turn are compounded by the liberalization of the sector and the devaluation of the CFA franc.

3.1.2. Justification for the non-use of pesticides

The high cost of pesticides is one of the major constraints alleged by cocoa farmers who do not use these products (26%; Fig. 1), particularly in Mbalmayo (33%) and in Ebolowa (30%). Nearly all non-users in Mbalmayo and Ebolowa invoke the high cost, against only 40% in the Yaounde bloc. Here, pesticide use is the rule among horticulture farmers (Gockowski and Doumbe, 1999).

The unavailability of pesticides is regretted by 39% of cocoa farmers in Mbalmayo and 60% in Ebolowa. Again, distance and isolation from the main urban centers explain these supply constraints (Thenkabail, 1999). In contrast, the Yaounde zone has a denser road network than that of the other blocks. Last but not least, the private sector was inadequately prepared relaying the State in the distribution of pesticides throughout the humid forest of southern Cameroon. Eventually, most farmers were left unaccounted for.

The real problem for farmers wishing to purchase pesticides is their unavailability, particularly in Ebolowa, irrespective of other constraints (Fig. 1).

Pesticides are generally imported through Douala from where they are taken to towns such as Yaounde, from where other

Table 1
Degree of use of pesticides in each of 3 humid forest zones of southern Cameroon (in % households per zone)

	Yaounde ($n = 96$)	Mbalmayo ($n = 104$)	Ebolowa ($n = 100$)	HFZ ($n = 300$)	P
Use pesticides	59	66	58	61	0.7845
Do not use pesticides	39a	13b	38ab	30	0.0703
Undefined	2b	21a	5ab	9	0.0809

Zones not sharing a common letter in a row are significantly different at $P = 0.05$.

Table 2
Main constraints faced by those who use pesticides in each of 3 humid forest zones of southern Cameroon (in % households using pesticides per zone)

	Yaounde ($n = 58$)	Mbalmayo ($n = 68$)	Ebolowa ($n = 58$)	HFZ ($n = 184$)	P
Pesticides are not available	46	60	60	55	0.4746
Pesticides are too expensive	59	62	74	65	0.4604
Pesticides are very dangerous	3	4	13	7	0.1006
Pesticides are always expired	1	3	2	2	0.8847
Handling pesticides is difficult	2	0	2	1	0.4117
Other constraints	0	5	5	3	0.4006

Zones not sharing a common letter in a row are significantly different at $P = 0.05$.

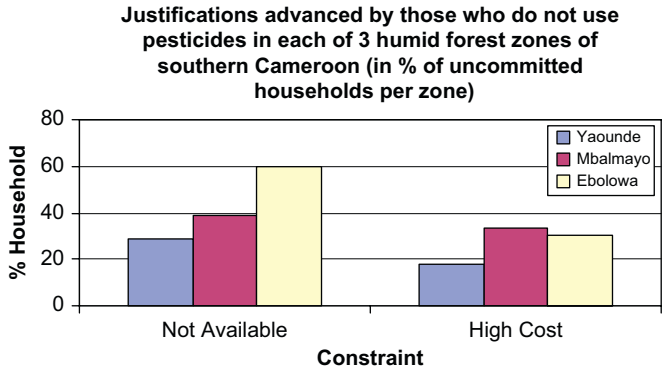

Fig. 1. Justifications advanced by those who do not use pesticides in each of 3 humid forest zones of southern Cameroon (in % of uncommitted households per zone).

smaller towns like Ebolowa and Mbalmayo and their surrounding villages are supplied. Distribution pre-supposes a good organization of the sector, from importers to retailers. The role of the Ministry of Agriculture is still preponderant as it grants the import authorization and approves the distribution and sales. The Ministry has already approved 213 retailers (Pan-Afrique, 2003). Retailers should act like relays to semi-wholesalers up to the furthest points in villages. Some of these villages are accessible only during part of the year. Consequently, transportation costs render sales prices out of reach for many farmers, added to the fact that devaluation doubled the prices of imported products. Following the liberalization of the pesticide sector at the beginning of the 1990s, imports of pesticides were less than half of those of the 1980s (Matteson et al., 1995). These authors also state that presently no enterprise has the required infrastructure for large-scale distribution.

3.2. Main pesticide supply points

Buying pesticides in the village is common practice for 21% of cocoa farmers in the humid forest zone of southern Cameroon (Table 3). The percentage of those who buy in the poorly accessible zone of Ebolowa is half of those who buy in Yaounde.

Twenty percent of cocoa farmers in the humid forest zone of southern Cameroon purchase their pesticides in town and 21% on the village market. As expected, Yaounde has larger percentages of pesticides buyers both in town as on the village market. Unexpectedly, village markets (29%) are preferred supply sites in the Mbalmayo zones (Table 4).

Other supply sources (14%) are only used by cocoa farmers in the more remote zones of Mbalmayo and Ebolowa. Some farmers use outdated stocks from the former SODECAO cocoa board. Faced with the uncertainty of having pesticides, they store these products carefully and use them sparingly. Some buy their products from traveling salesmen who move from village to village to sell pesticides. Some farmers state that they get their pesticides from local religious authorities. Some come together in Common Initiative Groups (CIGs) to buy their products, stock them and then distribute them to members. One of the farmers stated that he got his products from an abandoned warehouse. These miscellaneous supply sources are likely to be unaware of the storage and handling hazards inherent to pesticides. Matthews et al. (2003) reported that in Cameroon, only a quarter of farmers claimed to have a special building, with secured stores. Nine percent of farmers stored pesticides in their bedroom, and 12% stored them with other items. Special measures ought to be taken during spraying rounds on the farm. Poor monitoring of pesticide use increases risks arising from pesticide use in the south of the country (Matthews et al., 2003).

3.3. Main pesticides used

In the cocoa area of southern Cameroon most pesticides are fungicides. The ever present prevalence of black pod disease (mildew) forces farmers to use fungicides periodically, among them *Nordox*, *Kocide*, *Cacaobre* and *Ridomil* (Table 4). These fungicides are generally copper based. In only very few instances use of insecticides was mentioned such as Azinphos methyl (Table 4), or *Cypercal*, *Dursban* and *Aldrin*. The latter insecticide is classified "1b" by the World Health Organization (WHO) and qualified as "highly dangerous" (PAN, 1999) and is no longer recommended.

The low use of insecticides is explained by the fact that the greater part of the Cameroonese cocoa plantations is under shade, and hence less exposed to capsid damage. Moreover, mass fogging

Table 3
Shopping preferences of farmers according to pesticide supply points in each of 3 humid forest zone of southern Cameroon (in % households per zone)

	Yaounde ($n = 96$)	Mbalmayo ($n = 104$)	Ebolowa ($n = 100$)	HFZ ($n = 300$)	P
Buy their pesticides in the village market	23ab	29a	10b	21	0.1206
Buy their pesticides in the nearest town	34a	10b	16b	20	0.0066
Buy their pesticides in a local cooperative	0b	0b	3a	1	0.0277
Buy from other farmers	0	1	4	2	0.2017
Take on credit from a local company	0	1	0	0	0.3874
Others	0b	20a	21a	14	0.0505

Zones not sharing a common letter in a row are significantly different at $P = 0.05$.

Table 4
Main pesticides used in the cocoa agroforests in the humid forest zones of southern Cameroon

Nature of pesticide	Percentage of farmers who use given pesticide	Occurrence (%) of given product among farmers who use pesticides	Active ingredient (AI or ~ substance)
Nordox			
Contact fungicide	47	75	Copper oxide
Kocide			
Contact fungicide	25	41	Copper hydroxide
Caocobre			
Contact fungicide	23	37	Copper oxide
Ridomil			
Penetrating fungicide	18	29	Metalaxyl+ copper
Methyl			
Insecticide	8	13	Azinphos methyl
Fydrox			
Contact fungicide	6	10	Copper oxide
Maneb			
Contact fungicide	3	5	Maneb

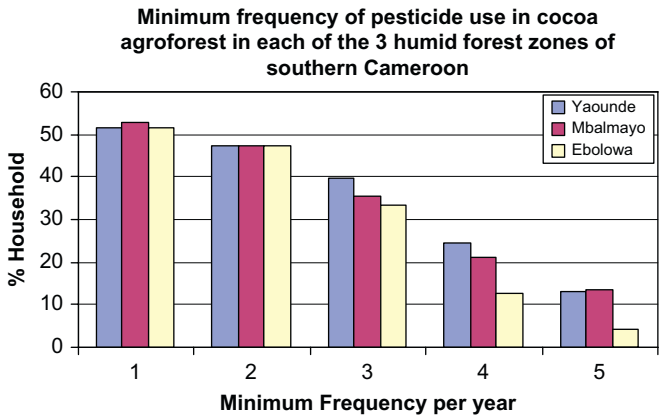

Fig. 2. Minimum frequency of pesticide use in cocoa agroforests in each of 3 humid forest zones of southern Cameroon (in % of households per zone).

has been generally discontinued after the collapse of SODECAO. Ideally, individual farmers should group their efforts together to carry out large-scale anti-capsids treatments as isolated applications are ineffective since insects from untreated farms can re-infest previously treated neighboring farms.

3.4. Application of pesticides

Fifty-two percent of cocoa farmers evenly distributed in the whole zone, state having used pesticides at least once (Fig. 2). However, at the higher application frequencies of 4 and 5 times, Yaounde and Mbalmayo farmers are outperforming Ebolowa farmers twice, if not thrice.

Out of the 10 sprays required for anti-fungal treatment (see the Memento de l'Agronome, by Ministère de la Coopération et du Développement, 1993), very few farms carry out 5, consequently leading to significant yield losses with poor seed quality, in the humid forest zone of southern Cameroon. According to Matteson et al. (1995) this poor use should stimulate the development of integrated pest management. Knowledgeable farmers themselves have developed other methods to control cocoa pests (Coulibaly et al., 2002; Sonwa et al., 2002) (see Section 4).

Equipment for spraying pesticides and protective clothing are inadequate resulting in potential health and environmental risks. Matthews et al. (2003) reveals some hazardous examples of pesticide use in Cameroon: sprayers belonging to small-scale farmers are in a poor condition; high proportion of farmers mentioned that sprayer leaked during its use (lever-operated knapsack sprayers being the dominant type of sprayer in the cocoa zone); 85% of small-scale farmers did not use protective clothing (because it was either not available or too expensive); 25% washed their sprayers "in river", etc. Hence, availability of pesticides and related products needs to be improved. Finally, farmers should be trained to overcome risks associated with pesticide use.

4. Outlook: IPM strategies could off-set acquisition issues of pesticides in Cameroon

Black pod and capsids are the main diseases of cocoa in this region (Vos and Neuenschwander, 2002; Sonwa et al. 2005). Cocoa yield provided a livelihood as long as pesticides were provided at subsidized rates by SODECAO. In 1989, the cocoa sector was affected by an overall economic crisis. World market prices declined and the government had to undergo tough structural

adjustment programs advocating removal of input subsidies, and the liberalization of cocoa products market (Coulibaly et al., 2002).

Farmers of southern Cameroon embarked on developing some cheap, indigenous pest control practices based on their knowledge of pesticide plants such as to enhance the effect of low application levels of whatever synthetic pesticides still available to them. These strategies included either pure plant extracts or plant extracts mixed with pesticides at different proportions (Coulibaly et al., 2002). Coulibaly et al. (2002) noticed that the methods developed by farmers were based on the use of *Cannabis sativa* (locally called "Banga") or the extract of other plant such as *Erythrophleum ivorense*, *Guibourtia tessmannii* and *Nicotiana tabacum*. For the Banga, the plant leaves are boiled, dried or pounded to extract the active ingredients. Extracts are combined with synthetic products or with other indigenous plants. For plants other than Cannabis, extracts are collected from barks, roots and any other part of the plant. According to farmers, the more species are mixed together, the more effective will be the mixture. Despite the fact that, they acknowledge the effectiveness of some of the plant extracts they use, they prefer a commercial product if it is affordable. (More details on IPM developed by farmers can be found in Coulibaly et al. (2002) and Sonwa et al. (2002).) These farmers' initiatives are seen as an insight into a future integrated pest management (IPM) policy in southern Cameroon (Sonwa et al., 2002).

Since 2000, the sustainable tree crops program (STCP) was initiated to support sustainable cocoa production systems in Cameroon, Nigeria, Ghana and Côte d'Ivoire (Shapiro and Rosenquist, 2004). As pest and diseases are known to be among the main constraints of cocoa production in West and Central Africa (Sonwa et al., 2005), one of the first initiatives of this program was an IPM workshop (Vos and Neuenschwander, 2002), after which pilot farmers field schools were developed to train farmers in solving pest and disease problems. In 2005, a partial budget analysis of Cameroonian farmers who attended STCP-supported cocoa FFS showed that IPM practices lowered overall costs of production by 11% (Nyemeck and Gockowski, 2006, cited by David, 2007). In 2005, David (2007) noticed for Cameroon that: the majority of farmers mentioned practices related to black pod management, spraying and post-harvest operations as the main lessons from FFS; farmers to change their management practices; and eighty six percent of FFS alumni shared some aspect of what they learnt with other farmers. Thus, the IPM could help in "solving" non-affordability and non-availability of pesticides in the cocoa area in Cameroon. Development of IPM strategies are likely to lower production costs of cocoa beans (Neuenschwander, 2004).

5. Conclusion

Sixty percent of cocoa farmers use pesticides after the cocoa crisis and the devaluation of the CFA franc. Those who do not use them mention supply difficulties (43% of farmers) and the high cost of the pesticide inputs (26%). Fungicides are the most used pesticides.

The purchase of pesticides in the village is done by 21% of cocoa farmers and is done more in the Yaoundé zone where the road network is denser. Equally, 20% buy in the towns. In the other areas, farmers buy from traveling salesmen or use old stocks kept since the SODECAO era, which raises serious problems of storing and handling pesticides by less expert hands. This risky handling of obsolete pesticides represents a threat to health and environment. The application of pesticides is more intensive in zones where pressure on natural resources is higher. The number of applications is lower than recommended. Hence, yield is below expectation and farmers are forced to diversify their sources of income. There is a need to further develop locally acceptable IPM strategies against cocoa pests and diseases.

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