

## **Integrated pest management in cocoa agroforests in southern Cameroon: Constraints and overview**

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*Keywords:* cocoa agroforest, humid forest zone, indigenous knowledge, integrated pest management, pesticides, southern Cameroon

### **Abstract**

Imports of pesticides have long been subsidised for use in the cocoa agroforests of the humid forest zone of southern Cameroon. With the liberalisation of the cocoa and pesticides sectors and the devaluation of the local currency (CFA franc), farmers are facing fluctuations in the price paid for cocoa and the high cost of farm inputs. Without the support of the extension services, they themselves have developed traditional integrated control methods based on the use of plant extracts mixed with conventional pesticides. From a survey of 300 cocoa farmers, the study assesses the farmers' command of these methods, the pests controlled, the problems encountered and the institutional constraints in the definition and dissemination of integrated control methods. The study concludes with recommendations for research and development towards the better definition and dissemination of integrated control methods.

*Mots Clés:* lutte intégrée, savoir local, pesticides, agroforêt-cacaos, sud-Cameroun, zone de forêt humide

### **Résumé**

Les pesticides ont été longtemps subventionnés de l'importation aux applications dans les agroforêts cacao de la zone de forêt humide du Sud-Cameroun. Avec la libéralisation des filières cacao et pesticides et la dévaluation du franc CFA, les paysans font face aux fluctuations des prix d'achat du cacao et du coût élevé des intrants agricoles. Sans l'appui des services d'encadrements, ils ont développé eux mêmes des méthodes traditionnelles de lutte intégrée basée sur l'utilisation des extraits de plantes mélangés aux pesticides conventionnelles. Partie d'une enquête auprès de 300 cacaoculteurs, l'étude évalue le degré de maîtrise des ces méthodes, les pestes contrôlées, les difficultés rencontrées et les contraintes institutionnelles dans la définition et la diffusion des méthodes de lutte intégrée. L'étude se termine par des recommandations en matière de recherche-développement pour une bonne définition et diffusion des méthodes de lutte intégrée.

### **Introduction**

Subsidies on pesticides and other inputs for many years allowed cocoa farmers in the humid forest

zone of southern Cameroon to maintain production at a reasonable level. Cocoa production 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. At that time, the Cocoa Development Company (SODECAO) provided training for the farmers and supervised the general development of cocoa production. It opened up roads in the cocoa plantations, provided the necessary inputs, trained officers to treat the plantations with chemicals, etc. In 1984, subsidies on pesticides represented 96% of the total market volume (Matteson *et al.* 1995). The subsidies included the free acquisition and application of pesticides. These pesticides were paid for partially from funds taken from the sale of cocoa by the National Commodities Marketing Board (ONCPB) which stabilised prices and/or subsidies provided by the bilateral and multilateral donors. With the cocoa crisis, the price paid to the farmers fell from CFA 420 in 1988/1989 to CFA 250 in 1989/1990. The ONCPB was unable to stabilise prices. In the meantime, the international financial community had, since the mid-1980s, been demanding that Cameroon implement adjustment policies intended to restore the economic and financial balance. Internal trade liberalisation required State withdrawal from many sectors, including agriculture. The ONCPB was dissolved in 1989. The pesticide sector was liberalised. Subsidies in the form of pesticides were gradually done away with between 1991 and 1994 (Matteson *et al.* 1995). There was a recovery in export crops after the 1994 devaluation of the CFA franc, but this quickly disappeared as imported farm inputs doubled in price.

The private sector is not yet ready to take over from the State in supplying pesticides to farmers. The SODECAO officers who were responsible for training farmers and spraying plantations no longer do this work. State withdrawal has thus resulted in fewer plants being sprayed, and hence an increase in cocoa pests. Per hectare yield will decline. Without the support of the extension services, farmers are trying by themselves to find ways of increasing their income, firstly, by intensifying and diversifying the crops in cocoa plantations and, secondly, by using traditional control methods based on indigenous knowledge (Coulibaly *et al.* 2002). These new methods, developed to include pesticides and plant extracts, may be a starting point towards finding integrated control methods for cocoa pests. Very few studies have as yet been conducted on these farmer initiatives, which could help to achieve significant results in

both ecological and economic terms. A survey of the problems encountered by this farmer initiative in controlling cocoa pests could help to build up and disseminate new integrated control methods. The objectives of this paper are: (1) to assess how well the farmers of the Humid Forest Zone apply these new forms of traditional control methods; (2) to identify current constraints on the definition, dissemination and use of integrated control methods in cocoa plantations; and (3) to assess the farmers' perceptions of the future development of integrated control methods.

### Study site

In Cameroon, cocoa is grown in South-West, Littoral, East, Centre and South provinces. This study concerns only Centre and South provinces. The vegetation in this zone is primary forest in the South (around Ebolowa), and secondary forest around Mbalmayo and Yaoundé. The forest degradation gradient increases from the south (Ebolowa region) towards the north (Yaoundé region). The Mbalmayo region has characteristics intermediate between those of Yaoundé and Ebolowa. The climate is equatorial, with four seasons (two rainy and two dry). Rainfall is 1654 mm in Yaoundé, 1624 in Mbalmayo, and 1876 in Ebolowa. The soils are ferralitic, nutrient-poor, acid and fragile. The fallow period is 3.9 years in Yaoundé, 5.4 in Mbalmayo, and 7.5 in Ebolowa.

Settlements in the humid forest zone are linear and fragmented into hamlets. The human density gradient declines between Yaoundé and Ebolowa. In some districts around Yaoundé, population density is 85 inhabitants per Km<sup>2</sup>, while the most densely populated districts around Ebolowa have only 15 inhabitants per Km<sup>2</sup>. Pressure on resources is thus very high around Yaoundé. The populations of the Humid Forest Zone of southern Cameroon live from hunting, gathering and farming. In each village, 2/3 of total income comes from farming. The population of the Ebolowa region depends more on cocoa production than do the others.

### Materials and methods

The investigations consisted of a survey of 300 cocoa producers in the Humid Forest Zone of

southern Cameroon in 21 villages around Ebolowa, Mbalmayo and Yaoundé. The survey was conducted by a multi-disciplinary team of ecologists, sociologists and economists.

The questionnaire asked, amongst others, whether the farmer was aware of new integrated control methods for cocoa pests (Coulibaly *et al.* 2002); whether s/he could name the traditional methods; whether s/he knew of any constraints on the use of these methods; the effectiveness of the methods which resulted from indigenous knowledge, compared to that of the modern methods recommended by the extension services when pesticides were still subsidised; and the farmers' future preference between traditional and modern methods. This was the information of interest to this study. The data were entered and analysed using Excel. The analysis looked for frequencies in the types of response to each question.

## Results

### *Degree of knowledge and mastery of traditional methods*

More than half of the cocoa producers of the humid forest zone of southern Cameroon know of

traditional control methods for cocoa pests (Table 1). The figure for the whole zone is 62%, with 71% at Ebolowa, 51% at Mbalmayo, and 64% in the villages around Yaoundé. Several farmers stated that they had learned of the existence of these methods from another local person. The system for the dissemination of this indigenous knowledge so far is from person to person.

More than half of those who know of the existence of traditional methods know or use one of these methods with precision (Table 2). The figure is 54% for the whole zone; 61% around Yaoundé, 49% around Mbalmayo, and 51% around Ebolowa.

The traditional products mentioned by the farmers are based on Indian hemp (*Cannabis sativa*), the production and use of which is banned by the law. This no doubt leads to a certain level of suspicion on the part of the farmers. During the survey, some cocoa producers probably feared that the scientists would later denounce them to the State services. This probably had an influence on the information obtained regarding other control methods (even those not based on the use of *Cannabis*) and even the number of those saying that they knew or used traditional control methods. The results given are probably lower than the real figures. *Cannabis* is already used by farmers

Table 1. Knowledge of traditional control methods in phytosanitary control of cocoa pests

|   | Yaoundé<br>(n = 96) | Mbalmayo<br>(n = 104) | Ebolowa<br>(n = 100) | HFZ<br>(n = 300) | p-Value |
|---|---------------------|-----------------------|----------------------|------------------|---------|
| 1: Have heard of or used a traditional method | 64                  | 51                    | 71                   | 62               | 0.0116  |
| 2: Have never heard of traditional methods    | 36                  | 49                    | 29                   | 38               | 0.0116  |
| 3: Total                                      | 100.00              | 100.00                | 100.00               | 100.00           |         |

NB: Percentage calculated from survey total.

Table 2. Level of command of traditional methods amongst those aware of their existence

|  | Yaoundé<br>(n = 61) | Mbalmayo<br>(n = 53) | Ebolowa<br>(n = 71) | Total<br>(n = 185) | p-Value |
|--|---------------------|----------------------|---------------------|--------------------|---------|
| 1: Know or use a traditional method with precision                                 | 61                  | 49                   | 51                  | 54                 | 0.3910  |
| 2: Know that traditional methods exist, but do not know any of them with precision | 39                  | 51                   | 49                  | 46                 | 0.3910  |
| 3: Total   | 100.00              | 100.00               | 100.00              | 100.00             |         |

NB: Percentage calculated from those who know of the existence of traditional methods.

against food crop pests. Other plants commonly mentioned by farmers during the survey were *Guibourtia tessmannii* (local name: Essingang) and *Erythrophleum ivorense* (local name: Elon). These plants are regularly used in the villages to deal with witches (Essingang) and as poison (Elon). The farmers are thus testing the effectiveness of local products against cocoa pests. Tree extracts are used either alone or mixed with the pesticides previously used to control cocoa pests (Coulilaby *et al.* 2002).

#### *Pest controlled by traditional methods*

Capsids are the pest which the farmers say are best controlled by traditional methods. These are followed by *Phytophthora* Black pod disease. Traditional methods are rarely used in weed control in cocoa plantations (Table 3). Throughout the zone, 42% of those who know or use the traditional methods well put capsids in first place. This figure is 49% around Yaoundé, 54% around Mbalmayo, and 28% around Ebolowa. Throughout the zone, 18% of those who know or use the traditional methods with precision aim to control Black pod disease. These figures are 5% around Yaoundé, 27% around Mbalmayo, and 18% around Ebolowa. Some farmers did not clearly state the problem they were targeting in their use of traditional control methods. In these cases, the methods seem to have a broader control spectrum and, particularly, be effective against capsids and Black pod disease at the same time.

Black pod disease is one of the major constraints on cocoa production in the humid forest zone of southern Cameroon. Before SODECAO was restructured, it distributed fungicides and helped the farmers to apply them. Faced with the lack of these products, the cocoa producers have tried to develop methods, many of which involve mixing

fungicides with plant extracts. The farmers believe that this mixing increases the effectiveness of the fungicide. Capsid control is by mass fumigation. In contrast to the fungicides, which are easy to acquire and apply individually in the field, capsid control with synthetic pesticides is more difficult, as it has to be applied over a wider area (generally several plantations). Since the cocoa crisis, capsid treatment is no longer carried out, apart from in the case of a few farmers in the Lekié region, who join together to apply the product. This explains the significant development of control methods for this pest. The farmers also often burn vehicle tyres in the cocoa plantations in an attempt to control the capsids. There was a similar reaction from Indonesian farmers in 1992, where they covered and burned coconut husks to get rid of the cocoa pests (pod borers) (Ruf 1993). Weeds are generally eliminated by hand and are not as much of a problem as brown rot and capsids. Herbicides are not often used in cocoa plantations. This explains the fact that very few traditional weed control methods (other than slashing) have been developed. According to the farmers, the advantage of traditional methods is that they are effective against several problems at the same time. They also say that these methods allow them to reduce the number of treatments. Bark extracts, amongst other things, apparently help the pesticides to stick to the plants better, and thus remain active for longer.

#### *Constraints encountered in the use of traditional methods*

The ban on the production of some plants used in traditional control methods is one of the main constraints for those farmers who know or use traditional control methods (Table 4). Throughout the region, 24% quote this as a problem. More

Table 3. Percentage who know or use traditional methods, by problem

|                                 | Yaoundé<br>(n = 37) | Mbalmayo<br>(n = 26) | Ebolowa<br>(n = 36) | HFZ<br>(n = 99) | p-Value |
|---------------------------------|---------------------|----------------------|---------------------|-----------------|---------|
| 1. Problem 1: capsids           | 49                  | 54                   | 28                  | 42              | 0.0775  |
| 2. Problem 2: Black pod disease | 5                   | 27                   | 25                  | 18              | 0.0380  |
| 3. Problem 3: weeds             | 3                   | 4                    | 0                   | 2               | 0.0538  |

NB: Percentage calculated from those who know or use a traditional method with precision.

Table 4. Constraints on the use of traditional methods of phytosanitary control in cocoa plantations in southern Cameroon

|   | Yaoundé<br>(n = 37) | Mbalmayo<br>(n = 26) | Ebolowa<br>(n = 36) | HFZ<br>(n = 99) | p-Value |
|---|---------------------|----------------------|---------------------|-----------------|---------|
| 1: Some plants used in control methods are banned | 42                  | 23                   | 28                  | 24              | 0.8223  |
| 2: The methods are too time consuming             | 8                   | 4                    | 0                   | 4               | 0.2175  |
| 3: The methods are too labour intensive           | 3                   | 0                    | 6                   | 3               | 0.4558  |
| 4: The methods are too expensive                  | 0                   | 0                    | 3                   | 1               | 0.4211  |
| 5: Some ingredients are hard to find              | 3                   | 15                   | 11                  | 9               | 0.2014  |
| 6: They are dangerous to health                   | 3                   | 8                    | 6                   | 5               | 0.6699  |
| 7: They cause other problems                      | 5                   | 0                    | 3                   | 3               | 0.4734  |
| 8: Others   | 0                   | 4                    | 14                  | 6               | 0.0387  |

NB: Percentage calculated from those who know or use a traditional method with precision.

specifically, the figures are 22% for Yaoundé, 23% for Mbalmayo, and 28% for Ebolowa. *Cannabis sativa* is one of a number of plants used in many of the farmers' methods, despite the legal ban on its use. Farmers therefore prefer running the risk of breaking the law by using the plant in treating their cocoa plantations, rather than leaving their plantation vulnerable to pests. The discovery of other plants with the same chemical properties as *Cannabis* should overcome the farmers' dependence on the illegal cropdrug.

The shortage of some ingredients is mentioned as a constraint by 9% of respondents who know or use traditional methods. The figure is 3% around Yaoundé, 15% around Mbalmayo, and 11% around Ebolowa. *Guibourtia tessmanni* and *Erythrophleum ivorense*, the barks of which are used in traditional products, are high value timber species, which are logged for their wood and as sources of products needed for integrated control methods. Reforestation with these species, particularly in cocoa plantations, would provide shade trees, as well as financial income for the farmers from the sale of the wood and the ingredients which can be used in traditional control methods. This reforestation would also allow them to work towards increasingly complex multi-strata systems, necessary to meet their households' social and economic needs without secondary effects on the environment.

Some farmers say that the traditional methods are harmful to health. Of those who know or use traditional methods, 5% say this. *Guibourtia* and *Erythrophleum* are sometimes used as poisons, and *Cannabis* is banned by the law because it is a drug. Of those who know or use traditional methods, 4%

think they require too much time, and 3% think they require too much work. The farmers have developed methods of extracting and fermenting the barks which take an average of 7 days (Coulbaly *et al.* 2002). Usually, after 7 days, the resulting liquid is mixed with the 'modern' pesticides. The final preparation of the modern pesticides, before spraying, takes less than an hour. If it were possible to reduce the time needed for extraction and fermentation, this would improve the use of the traditional methods. There might also be some hope in farmer research. *La Voix du Paysan* (a local rural newspaper) recently (issue 91 of August 1999) published a traditional method based on mixing extracts of Bubinga (Essingan) and Padouk (*Pterocarpus soyauxii*) bark. This mixture is relatively quick to prepare, includes no banned plants, and is effective against cocoa *Phytophthora* and tomato rot.

Of those questioned, 45% cited no constraints on the use of traditional methods. The fact that use of these methods is still quite recent may explain the lack of awareness of the constraints on the part of some farmers. Traditional methods are still in their experimental phase. The current mastery of traditional methods is probably lower than it would have been if institutional factors had not hindered its development.

#### *Institutional constraints to the definition and dissemination of integrated control methods*

The pesticide sector in Cameroon was long subsidised by the State, with the support of bilateral and multilateral bodies. The State bodies purchased, distributed and applied the pesticides. The

price paid for treatment was lower than its real economic value. In these conditions of dependence, it was difficult for the farmers to develop alternative practices for the treatment of their cocoa plantations. Indigenous knowledge needed for integrated control has thus long been inhibited by the paternalism of the public services. Rosset and Moore (1997) note that, unable to import agricultural inputs, including pesticides, the Cuban Government established a low-import agriculture policy in 1990. Biological control and integrated control methods were given an important place in this. In 1994, Cuba already had 222 small decentralised laboratories producing insects, nematodes and entomopathogens (bacteria, fungi and viruses which cause insect diseases) in 15 provinces of the country. The use of these biopesticides helped Cuba increase its food production. In order to do this, scientists in the ministries, universities and research centres were mobilised to overcome the crisis.

Despite the efforts of the colonial administration in Cameroon, with the creation of Nkoevonne research station (18 km from Ebolowa) in 1949, and IRA-Nkolbisson (the Institute for Agricultural Research) in 1953, both of which were continued by the various governments after independence, little work has been done to research and improve indigenous knowledge of cocoa plantation protection. In Cameroon, as in many other African countries, few researchers work in cocoa production. According to a personal communication from Joseph Bakala, quoted by Gockowski and Dury (1999), cocoa research in Cameroon is currently conducted by 9.5 scientist years. The scientists are distributed as follows: 4.3 in pathology, 2 in genetics, 1.5 in agronomy, 1.3 in entomology, and 0.5 in post-harvest technology. These scientists must listen to the farmers in order to work on the participatory development of integrated control methods which could be broadly disseminated. In the developing countries in general, agricultural research often puts emphasis on chemical control methods, whilst biological and cultural methods are given less attention (Waibel & Fleischer 1995). Very little of the agricultural research budget is devoted to non-chemical plant protection methods.

One of the problems with disseminating the traditional methods may result from the inefficiency of the agricultural extension services.

SODECAO officers have long provided far more training and advice for the farmers than have the departments of the Ministry of Agriculture. When the latter do provide training or advice, they think first and foremost of chemical methods. Waibel and Fleischer (1995) found that, in most developing countries, the information, training and extension services encourage the use of chemical products for plant protection. Matteson *et al.* (1995) noted that the extension services in countries such as Cameroon had not yet extended the existing integrated control methods. Eighty-five percent of cocoa producers say that they have never had any contact with agricultural extension agents.

The huge subsidies on the pesticide sector have inhibited the development of indigenous knowledge in the control of cocoa pests. Research has dealt very little with indigenous knowledge. Priority should be put, both by research and the extension services, on mastering this knowledge. This interest would help to develop new, low cost, integrated control methods, compatible with environmental protection.

#### *Towards integrated control methods based on farmer knowledge*

Most farmers (73%) who know or use traditional methods are not yet able to compare them to modern methods (Table 5). Of those who know or use traditional methods, 13% think that they are less effective than the modern methods. Twelve per cent say that both types of methods are equally effective. Some farmers are reluctant to pronounce on the effectiveness of the traditional methods, perhaps because they are new to control methods for cocoa plantations.

With the emergence of traditional methods, 45% of farmers in the humid forest zone of southern Cameroon cannot yet decide between these and the use of modern pesticides (Table 6). This figure is 60% around Yaoundé, 38% around Mbalmayo, and 29% around Ebolowa. The use of the two methods (modern and traditional) together could represent a hope in the establishment of new integrated control methods for use in cocoa plantations.

Integrated methods are combinations of several techniques aimed at reducing the pest level and maintaining it below the economic threshold,

Table 5. Comparison between traditional and modern methods

|   | Yaoundé<br>(n = 37) | Mbalmayo<br>(n = 26) | Ebolowa<br>(n = 36) | HFZ<br>(n = 99) | p-Value |
|---|---------------------|----------------------|---------------------|-----------------|---------|
| 1: Traditional methods are more effective | 3                   | 0                    | 3                   | 2               | 0.7018  |
| 2: Modern methods are more effective      | 19                  | 15                   | 5                   | 13              | 0.2268  |
| 3: Both methods are effective             | 16                  | 8                    | 11                  | 12              | 0.5861  |
| 4. Do not know                            | 62                  | 77                   | 81                  | 73              | 0.1845  |
| Total                                     | 100.00              | 100.00               | 100.00              | 100.00          |         |

NB: Percentage calculated from those who know or use a traditional method with precision.

Table 6. Preference for the future use of control methods

|                                 | Yaoundé<br>(n = 96) | Mbalmayo<br>(n = 104) | Ebolowa<br>(n = 100) | HFZ<br>(n = 300) | p-Value |
|---------------------------------|---------------------|-----------------------|----------------------|------------------|---------|
| 1: Prefer only 'modern' methods | 14                  | 22                    | 26                   | 21               | 0.0893  |
| 2: Prefer traditional methods   | 5                   | 2                     | 6                    | 4                | 0.3181  |
| 3: Prefer both methods          | 21                  | 38                    | 29                   | 30               | 0.0237  |
| 4: No opinion as yet            | 60                  | 38                    | 39                   | 45               | 0.0014  |
| 5: Total                        | 100.00              | 100.00                | 100                  | 100              |         |

NB: Percentage calculated for whole survey.

avoiding any undesirable secondary effects (Waage and Greathead, 1992). Integrated control tries to link breeding, cropping methods, chemical control and biological control. In the case of southern Cameroon, efforts must be made to produce improved varieties (Gockowski and Dury 1999). The application of good cropping practices could help save a large part of production, but the farmers do not master these techniques. In the ecological conditions of Cameroon, cutting and eliminating mummified husks at the beginning of the season, followed by weekly sanitation harvesting, would reduce the level of Black pod disease attack by 25% and produce around 700 kg/ha (Tondje *et al.* 1993). The farmers say that some tree species repel or attract cocoa pests. The Sterculiaceae and the Bombacaceae are generally host plants of cocoa pests. According to a 1988 report by the IRA (Institut de Recherche Agricole), Achae caterpillars, which defoliate cocoa trees, survive on species such as *Piptadeniastrum africanum*, *Margaritaria discoidea*, *Petersianthus macrocarpus*, *Chlorophora excelsa*, *Terminalia superba*, *Entandrophragma utile*, and *Pycnanthus angolensis*. Despite this, the farmers still keep these species in their plantations.

They probably produce benefits which outweigh the losses due to defoliation, or the farmers are not yet aware of the harmful effects of these species. However, they have already developed indigenous pesticides against cocoa pests (Coulibaly *et al.* 2002), but they still use synthetic pesticides. Applied on a mass scale, synthetic pesticides often eliminate the natural enemies of crop pests. Waage and Greathead (1988) note that, in Malaysia, the targeted application of pesticide on the resting sites (lower part of branches) of the cocoa pod borer, *Conopomorpha cramerella*, maintains the natural enemies, which are found on the leaves and fruits. The search for natural enemies would help introduce biological control processes. Farmer knowledge should be investigated closely, even if it sometimes seems to diverge from current recommendations. In a study on the prospects for integrated control, Kenmore (1997) illustrates the relevance of indigenous knowledge with the cases of Indonesian, Kenyan and Malian farmers who have themselves developed integrated control practices, beginning by opposing what is taught by the official extension services. In rice production, integrated control practices are now well devel-

oped, and farmers themselves are sometimes involved in the lessons, which now reach beyond the scale of continents (Kenmore *et al.* 1995; Waibel & Fleischer 1995; Kenmore 1997). The farmers' field schools are today reputed as places where the farmers can gain greater mastery of integrated control methods. The combination of scientific information and indigenous knowledge can help define new integrated control methods for cocoa production in the humid forest zone of southern Cameroon.

Research to improve farmer knowledge would help to convince the half of the population who have not yet decided to use traditional methods in a general integrated control programme. Research is needed to: (1) develop resistant cocoa varieties; (2) find natural enemies of cocoa pests; (3) look for the cropping combinations which minimise the expression of the agents responsible for cocoa pests. Indigenous knowledge could be useful in this work. It has already produced indigenous pesticides.

## Conclusion

After the cocoa crisis and the liberalisation of the pesticide sector, farmers developed their own control methods for cocoa plantations. 62% of farmers know that traditional methods exist which can protect cocoa plantations. More than half of those who are aware of the existence of these methods know one of them with precision. Capsids are the pest most targeted by integrated control methods, followed by Black pod disease. Of the cocoa producers, 12% of those who know or use the traditional methods think that they are as effective as the modern methods. However, 30% of farmers say they are prepared to use the two methods. This wish is a hope in defining and disseminating new integrated control methods. Some farmers are still somewhat reticent in choosing one or the other of the methods as a control strategy for cocoa plantations. Some minor difficulties (scarcity of some ingredients, time and labour needs) are given as constraints by some farmers. One of the main problems encountered is the legal ban on some ingredients used in making local pesticides. However, traditional knowledge has mainly been inhibited by the high level of State subsidies (sometimes with the support of bilateral and multilateral bodies) for the pesticide sector

(from purchase to field application). Research has taken little interest in this indigenous knowledge, as have the extension services, which have done little to disseminate existing integrated control methods. The wish expressed by some farmers to use the two methods represents a hope for the definition and dissemination of new integrated control methods based on the use of indigenous and modern knowledge in protecting cocoa plantations. Participatory efforts are needed to: (1) develop resistant cocoa varieties; (2) find natural enemies of cocoa pests; (3) seek crop combinations which minimise the expression of the agents responsible for cocoa pests; and (4) disseminate widely cropping practices which minimise the use of synthetic pesticides.

## Acknowledgements

The authors of this paper would like to thank Messrs D. Mbila, D. Endamana, A. Nnama and J. Mve Mve for their help in collecting the information. They also thank Mr Louis Defo for his comments during the drafting of the paper.

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