

**SURVEY OF FARMING PRACTICES  
ON COCOA FARMS IN  
CÔTE D'IVOIRE  
29 October – 10 November 2001**

**PACCC/ICCO/Industry Project  
for the Improvement of Cocoa Quality in Côte d'Ivoire**

**Field Study Report  
Karine LAINÉ – CAOBISCO**

# Table of Contents

## Introduction

## Acknowledgements

## Presentation

1. *Participants*
2. *Methodology*
3. *Scope of the survey*

## Questions raised in the framework of the PACCC/ICCO/Industry Project for the Improvement of Cocoa Quality and other farming practices which could adversely affect the quality of Ivorian cocoa

1. *Frequency of harvests during the main crop*
2. *Harvest of black pods*
3. *Extraction of the placenta*
4. *Transport of wet beans to the village*
5. *Use of banana leaves in fermentation process*
6. *Fermentation*
7. *Drying*

## Pictures

## Training Materials

1. *Practicality of the sheets*
2. *Understanding of the sheets*

## Proposal for future activities

## Samples : Test results

1. *Sample description*
2. *Conclusions*
3. *Methods of analysis*
4. *Cut test and bean count results*
5. *Ochratoxin A (OTA) results*
6. *Note on samples taken*

## Annexes (separate document)

Annex 1 : French questionnaires

Annex 2 : Questionnaire results

Annex 3 : Detailed itineraries

Annex 4 : Report of the final meeting of 10/11/01 in Abidjan

## **Introduction**

Following the mission by Martin Gilmour (Mars, UK) and Tony Lass (Cadbury, UK) to Côte d'Ivoire (in early July 2001) and the discussions that ensued, a work programme was established for the 2001/2002 cocoa year. The work programme complied with the objectives drawn up for the PACCC / ICCO / Industry Project for the Improvement of Cocoa Quality in Côte d'Ivoire.

The first stage of the work programme for the 2001/2002 cocoa year involved a survey among cocoa farmers. The results of this survey were to assist in the formulation of a strategy for the improvement of cocoa quality in Côte d'Ivoire. The survey focussed on harvesting, fermentation and drying practices in the main cocoa producing regions (the East, South-East, South, Centre-west and South-west regions of Côte d'Ivoire), in order to identify any weaknesses present. Cocoa farmers were interviewed during the survey on their practices and training material was discussed with them. The training material had been produced by BCCCA/SATMACI for the Gagnoa project of the 1980's.

The objective of the survey among farmers was to get answers on a number of specific questions including the transport of the beans from the farm to the village, both before and during fermentation and the use of banana leaves as a substrate in the fermentation process. Other farming practices likely to adversely affect the quality of Ivorian cocoa were also covered.

The report gives the results of the survey conducted between 29 October and 10 November 2001. For ease of reference, the completed questionnaires are provided in the annex attached.

## **Acknowledgements**

This report is the result of excellent collaboration between the different parties involved in the Project: the Ministry of Agriculture of Côte d'Ivoire, ANADER (the National Rural Development Support Agency), PACCC, ICCO and the European Chocolate Industry. We would like to thank all those who have assisted in this stage of the project.

# Presentation

## 1. *Participants*

The survey was conducted by two teams of researchers, composed of representatives from the industry, ANADER and the Ministry of Agriculture in Côte d'Ivoire, with co-ordination assistance provided by the PACCC (Mr. Séhi Yue Bi) and ICCO (Mr. Jan Vingerhoets)

**Team 1** : A one-week survey conducted in the East, South-East and South of the country (29 October - 3 November 2001)

Mr. Patrick Leheup, Nestlé

Mr. Lanzéni Traoré, Cadbury

Mr. Thomas Blé Dali, Ministry of Agriculture Abidjan

Mrs. Clarisse Mouné, ANADER, Abidjan

A local representative of ANADER, varying from region to region.

**Team 2** : A two-week survey conducted in the South-West, Centre-West and South of the country (29 October – 10 November 2001)

Mrs. Karine Lainé, Nestlé

Mr. Djibril Yéo, Nestlé

Mr. Michel N'Dri Kouamé, Nestlé

Mr. Edmond Kodjo, Ministry of Agriculture, Abidjan

Mr. Daniel Glounaho, ANADER, Abidjan

One or two local representatives of ANADER, varying from region to region.

## 2. *Methodology*

The survey was carried out through individual and group questionnaires for farmers. The questionnaires are attached in Annex 1. The farmers were interviewed both as part of a group (average 30 farmers / group) and individually. This enabled the information obtained to be validated. At the same time some farms were observed in operation. In each case, the questions were the same, except that the group questionnaire was a shortened version of the individual questionnaire. The training material was discussed with the farmers on an *ad hoc* basis, either on a group or on an individual basis (See section on 'Training material').

Most of the farmers interviewed were affiliated to a local co-operative, and were in most cases aware of some of the issues affecting quality (e.g. humidity levels, degree of fermentation, foreign matter, etc.). The fact that a farmer was affiliated to a co-operative did not necessarily mean that he sold exclusively to the co-operative. He often also sold to *pisteurs*.

### **Team 1 :**

- **Discussions with groups of farmers** : the questions used and the corresponding answers have been recorded in a summary table to provide statistical analysis of the results (covering a total 315 farmers). See the table attached to Annex 2a.
- **Individual discussions** : a summary table was prepared, providing a statistical analysis of the results (See Annex 2b). However, the results are statistically less significant.

## **Team 2 :**

- **Discussions with groups of farmers :** the questions and answers enabled a precise description of local agricultural practices and the reasons for the use of certain practices. Subsequently, the survey also covered the concerns farmers had, linked to the quality issue, so as to emphasize the importance of quality. The ‘active’ participation of farmers was placed at 26 per cent (i.e. farmers who reacted spontaneously to the questions). The results are presented in Annex 2c.
- **Individual discussions :** the results are shown in a summary table (see Annex 2d). The statistical results cover 22 farmers.

## **Samples :**

The opportunity was taken to obtain further information on OTA. In total, 28 samples of ‘ready for sale’ cocoa were bought in double quantity from farmers and co-operatives as a spot test to measure the presence of Ochratoxin A (OTA). The samples were analysed by Reading Scientific Services Ltd (UK) and the results are provided at the end of this report.

### **3. Scope of the survey**

#### **3.1. Geographical spread**

<b>Department</b>	<b>Sub-prefecture</b>	<b>Village / settlement</b>	<b>Team</b>
<b>East &amp; South-east regions</b>	(old cocoa trees)		
Abengourou	Niablé	Niablé, Broukro	1
Adzopé	Akoupé	Akoupé, Affery, Ayekia, Carla	1
Agboville	Agboville	Aboudé Kouassikro, Offompo	1
<b>Southern region</b>	(old cocoa trees)		
Tiassalé	Tiassalé	Binao	1
Divo	Divo	Divo, Didoko, Datta, Brabori/Kabalisco	1 & 2
	Hiré	Hiré, Kagbé, Petit Bouaké carrefour, Bouakakro	2
<b>Centre-west region</b>	(mature cocoa trees)		
Oumé	Oumé	Gnamien Kouadiokro	2
	Diégonéfla	Tonla	2
Gagnoa	Ouragayo	Pissékou, Biakou	2
Issia	Issia	Issia	2
	Iboguhé	Iboguhé, Nianabehi, Saliguhé	2
	Saïoua	Kouadiokro Klémagny, Oussoukro	2
Vavoua	Vavoua	Pélézi	2
	Dania	Konanbokro, Etiennekro	2
<b>South-western region</b>	(young cocoa trees)		
Soubré	Méagui	Alou Kouassikro, Petit Bondoukou	2
	Okrouyo	Okrouyo, Albertkro, Juleskro, N’Gorankro	2
San Pédro	San Pédro	Gabiadji, Bida, Amani Kouassikro	2

Detailed itineraries are provided in Annex 3.

### 3.2. Demographic spread

In total, nearly 940 farmers took part in the survey, comprising :

	Team 1	Team 2	Total
Co-operatives	10	13	23
Groups of farmers	10	19	29
Total farmers	315	591	906
Individual farmers	8	22	30

List of co-operatives contacted :

Co-operative	Area	Date formed	Members	Cocoa Tonnage 99/00	Cocoa Tonnage 00/01
<b>Abengourou</b>					
CANIA	Niablé	08-1999	700	1123	569
COOPRANIA	Niablé	09-1999	400	919	572
<b>Adzopé</b>					
COOPASS	Akoupé	1999	144*	360*	
COOPAAF	Affery	1999	220*	850*	
<b>Agboville</b>					
SCAGBO	Offompo	1999	4800*	5056*	
CEACI	Aboudé Kouassikro				
<b>Tiassalé</b>					
CAMENE	Binao				
<b>Divo</b>					
COOPADJI	Divo	1999	2500*	4700*	
AKAYARA	Datta				
COOPED	Didoko				
ZABIA	Kagbé				
Patience de Hiré	Hiré		1000	650	754
<b>Oumé</b>					
COOPAS	Diégonéfla, Tonla	09-1999		3500	4000
SCADO	Gnamien Kouadiokro	1999	3652*	4500	3000
<b>Gagnoa</b>					
COOPRADEG	Pissékou		2000*	62*	
COOPADEF	Biakou	09-1999	3742	4500	990
<b>Issia</b>					
SOUANGAKRO	Issia	08-2001	269		
COPAYO	Saïoua, Oussoukro	10-1999	1080		1715
<b>Vavoua</b>					
CODESVA	Konanbokro, Etiennekro				
<b>Soubré</b>					
ECOOPAM	Méagui, Alou Kouassikro, Petit Bondoukou	1999	3000		8273
ECASO	Soubré Okrouyo, Albertkro, N’Gorankro	08-1999	1500		5600
CAPDI	Iboguhé		823		176
<b>San Pédro</b>					
COOPAGA	Gabiadji Bida, Amani Kouassikro	1999	1832	2500	

(\*) Tonnage of cocoa and coffee, information of 15/10/00, extracted from ‘*Observatoire café – cacao*’: ‘Analytical report of accredited co-operatives, commercial campaign of 1999/2000’ by BNETD, February 2001.

# **Questions raised in the framework of the PACCC/ICCO/Industry Project for the Improvement of Cocoa Quality and other farming practices which could adversely affect the quality of Ivorian cocoa**

## ***1. Frequency of harvests during the main crop***

Among the regions visited, the number of harvests that take place during the main crop varies between three (majority) and four. We were informed that the main crop takes place over the months of October, November and December, with harvests every three or four (majority) weeks.

The frequency of the harvests depended on the following factors :

- Availability of labour.
- Quantity of pods produced : given the costs involved, a minimum quantity is required to make harvesting viable.
- Availability of drying facilities.
- Weather conditions.

### ***Effect on the final quality of the cocoa :***

When there is a large production of pods, more frequent harvests (for example every two to three weeks) prevent the appearance of black pods on the trees. However, a minimal quantity of pods has to be harvested to enable the beans to ferment properly (the BCCCA/SATMACI recommendation is a minimum 100 kg of fresh beans per fermentation pile, i.e. four baskets).

## ***2. Harvest of black pods***

Across the range of regions visited, many farmers referred to the picking of black pods during harvests. A common practice is the separation of 'good' beans of 'good' black pods from 'bad' beans of 'bad' black pods.

The 'good' beans (often dark, without pulp, but ungerminated) are fermented with normal beans. The treatment of 'bad' beans (black and/or germinated and/or mouldy) varied from farmer to farmer.

- The 'bad' beans are extracted and dried directly (without fermentation) before being sold at a reduced price to traders.
- The 'bad' black pods are discarded, without removal of the beans.
- The 'bad' beans are integrated into the fermentation pile with other beans.

The separation between 'good' and 'bad' pods occurs at varying stages depending on the farmer.

- At the time of harvesting ; the farmer usually knows how to recognize 'good' black pods from 'bad' black pods (which are soft and lighter).
- At the time of opening the pods.

### ***Effect on the final quality of the cocoa :***

The black beans invariably turn up in the hands of the exporter, in varying forms : germinated, unfermented, mouldy and – according to studies made by CIRAD – containing high proportions of free fatty acids (FFA).

### **3. *Extraction of the placenta***

Throughout the regions visited, the placenta is usually extracted during the drying process.

Sometimes, the procedure takes place when the pods are opened, providing there are enough female workers. If the beans are to be transported to the village before fermentation, extraction of the placenta in the field only occurs if the transport vehicle does not arrive too soon after the pods are opened.

### ***Effect on the final quality of the cocoa :***

If the placenta is not removed and the beans are not separated, the bean fermentation is highly likely to be uneven.

### **4. *Transport of the wet beans to the village***

#### **4.1 *Results***

Our discussions revealed that the transportation of the beans from the farm to the village, either before or during fermentation, occurs throughout most of the departments visited. The exceptions are Agboville, Tiassalé and San Pédro.

#### **East, South-east and South of the country :**

- The results obtained from the groups of farmers showed that only 15 per cent of farmers transport their beans to the village before or during fermentation. However, out of the 12 groups interviewed, seven mentioned this practice.
- The results obtained from individual farmers showed that 30 per cent of farmers transport their beans to the village during fermentation (out of a total of 10 farmers). It should be noted that the fermentation process of wet beans starts immediately after opening of the pods.

#### **South-west and Centre-west of the Country :**

- Out of the 17 groups interviewed, 10 referred to the transport of beans from the farm to the village before or during fermentation as a current practice.
- The results obtained from individual farmers showed that 22.5 per cent transport their beans to the village before or during fermentation (out of a total of 20 farmers).

#### **4.2 *Analysis***

The reason commonly given is the risk of the beans being stolen if they are left unwatched on the farm. However, other reasons were given as follows :

- When there is a large cocoa harvest (this can be anything up to one tonne in a single harvest), it is difficult to transport the fermented beans manually to the village for the drying process to begin. (Drying usually takes place in the village). It is hard to find the

labour needed to transport such a quantity of beans, so the use of some form of transport is a practical solution to the problem. However, vehicles are not readily available in villages, which means that farmers take advantage of any vehicle travelling to the village to carry their beans, fermented or not.

- On the other hand, when there is a low yield of cocoa beans and/or the farm is very close to the village, the transport of the beans is less of a problem and the farmer prefers to transport his beans ‘manually’ to keep a closer eye on them.

When the cocoa beans are at risk of being stolen from the farm, the only alternative for the farmer, apart from having them transported to the village, is to have an (armed) night watch. This practice was referred to several times. Only those farmers whose farms are in areas less favoured by thieves or those whose house is in the middle of the farm are free of that worry.

The beans are transported from the farm to the village at varying stages :

- Immediately after opening the pods.
- At any time during fermentation.
- At the end of fermentation.
- There are no cases of transport of pods.

When the beans are transported before or during fermentation, final fermentation in the village takes place in a cemented area (also used for drying), under black plastic sheeting. As mentioned above, the time of transportation depends mainly on the availability of a vehicle.

The following forms of transport are used :

- The back of a pick-up truck, lined with black plastic sheeting : very often.
- In a tractor trailer, lined with black plastic : often.
- In sacks and baskets : seldom.

When a vehicle is used to transport the beans, the following arrangements are made between the farmer and transporter:

- A delivery contract. In this case, the farmer does not pay the transporter immediately for the transport of the beans. However, the farmer undertakes to sell the beans to the transporter as soon as they are ‘ready’. In most regions, both co-operatives and *pisteurs* act as transporters of ‘*poto-poto*’ beans (i.e. wet beans).
- Hire of the vehicle (10,000 CFA was the minimum price at the time of the survey).
- Sale of fresh beans (either unfermented or fermented) to the *pisteur*.

The choice of these options depended on the farmer’s financial means.

#### 4.3 *Effect on the final quality of the cocoa*

- When the beans are transported during fermentation, this has the advantage of mixing them when they are loaded and unloaded. Otherwise, the farmer does not systematically mix the beans (see below), so having the beans transported is a benefit.
- However, given that transportation can occur at any time during fermentation, the mixing process described above can occur at any time during fermentation. When transportation occurs immediately after opening the pods, the beans are not mixed unless the farmer explicitly decides on mixing them.
- The environment of the village is totally different to that of the farm (in the village, the beans are placed directly into an unshaded, cemented area, etc). This can have a negative effect on the fermentation process.

- The delivery contract between the farmer and transporter means that the farmer undertakes to let the transporter have his ‘ready’ beans on his next trip, which can vary in time. This means that humidity levels at the time of sale can vary considerably, with the risk of mould developing. In an extreme case, it means that the transporter can buy beans that are either underfermented and/or not completely dried.

## **5. Use of banana leaves in fermentation process**

### **5.1 Results**

The use of banana tree leaves as a substrate in the fermentation process varies from region to region.

#### **East, South-east and South of the country :**

- The results obtained from the groups of farmers showed that 77 per cent of farmers ferment their beans in a pile and under banana tree leaves compared with 22.5 per cent who ferment their beans under black plastic sheeting.
- The results obtained from individual farmers showed that 50 per cent of farmers ferment their beans in a pile and under banana tree leaves compared with 50 per cent who ferment their beans under black plastic sheeting (out of a total of 10 farmers).

#### **South-west and Centre-west of the country :**

- Out of 17 groups interviewed, all referred to fermentation under black plastic sheeting as a common custom. Three groups (San Pédro and Vavoua) commented that only black plastic sheeting was used in fermentation. Fermentation using banana tree leaves had ceased to be used.
- The results obtained from individual farmers showed that only 20 per cent ferment their beans in a pile and under banana tree leaves, compared with 70 per cent who use black plastic sheeting (out of a total of 20 farmers).

### **5.2 Analysis**

The reasons given for not using banana tree leaves varied according to the region:

- A lack of banana trees, this could be due to :
  - The type of soil being unfavourable to banana trees.
  - Weather changes (decrease in rain).
  - Ageing of cocoa farms (banana trees are not used for the shade protection of adult cocoa trees, because of the dense canopy and lack of space).
- Practical reasons :
  - When there is a large quantity of beans to ferment, the use of black plastic sheeting is more practical. The labour and time required to prepare for fermentation are less.
  - Black plastic sheeting does not deteriorate during fermentation. Banana tree leaves have to be replaced during fermentation as the covering leaves dry out, thereby not providing protection.
  - Black plastic sheeting can be recycled for future fermentation.
  - Black plastic sheeting is better at protecting the beans from ants and impurities.
  - Transport of wet beans to the village. Once the beans have been placed in the cemented area, those beans undergoing fermentation are piled up and covered with black plastic sheeting as banana tree leaves are not available.

Even when banana trees are present and in sufficient quantity, some farmers are reluctant to cut too many leaves as it exhausts the trees. In many cases, banana tree leaves are only used in fermentation when there is a low volume of beans to ferment.

Some farmers indicated that they use a combination of black plastic sheeting and banana tree leaves. Fermentation takes place as follows:

- black plastic sheeting on the ground
- banana tree leaves on the black plastic sheeting
- pile of beans on the banana tree leaves,
- banana tree leaves placed on the pile of beans,
- black plastic sheeting placed on top.

This both prevents the banana tree leaves from drying out and protects the beans from impurities and ants.

Whatever the method used in fermentation, the fermentation pile is often positioned on a slope so that the fermentation juices can disperse easily (these can be drunk on the first day of fermentation and are indeed enjoyed by farmers).

Palm tree leaves are sometimes used in order to keep the cover of the fermentation pile in place. The use of fermentation boxes was mentioned. However, we believe this method is seldom used.

### ***5.3 Effect on the final quality of the cocoa***

- Farmers noted that fermentation on and under banana tree leaves is better ; the dispersal of fermentation juices is more effective and the drying time is quicker. They noted that fermenting beans under black plastic sheeting results in a ‘burnt’ appearance to the beans after fermentation. Nevertheless, the final appearance of the beans after drying was the same whatever method is used.
- The reaction that takes place during fermentation is oxidation ; oxygen content is therefore a significant factor in successful fermentation. Banana tree leaves enable aerobic (beneficial) reactions to occur as they are more permeable than black plastic sheeting.

## ***6. Fermentation***

### ***6.1 Duration of fermentation***

The vast majority of farmers who ferment their cocoa have an excellent understanding of this procedure. They have practical criteria to assist them in recognizing a well fermented bean : the internal and external colour of the bean, its smell and shape, temperature inside the pile, etc.

Throughout the regions surveyed, we noted a wide variation in the duration of fermentation, which varies from zero to eight days and averages at five to six days.

The duration of fermentation depends on the following criteria :

- Climatic conditions : in the dry season, fermentation takes longer than in the rainy season (average six to seven days in the dry season compared with four to five days in the rainy

season). In the rainy season, some farmers believe that the beans continue to ferment under forced conditions of storage under black plastic sheeting in the drying area.

- Length of storage time of pods between harvest and opening ; the length of storage time varies considerably and can be anything from zero to 18 days ! The average length is seven days. The farmer reduces the fermentation time when storage time is prolonged.
- The risk of theft of the beans from the farm : when the beans are not transported before or during fermentation, the farmer shortens the length of fermentation time to ensure that the beans are brought to safety near his house as quickly as possible.
- The availability of labour and means of transport : at the end of fermentation, the farmer has to gather as much labour as possible in order to open the fermentation pile and transport the beans to the drying area.
- Variety of cocoa : some farmers assure us that they ferment their hybrid cocoa one to two days longer than their Amelonado cocoa.

### ***Effect on the final quality of the cocoa :***

The variation in fermentation time inevitably means variation in the fermentation of the beans, as well as the appearance of slaty beans when fermentation does not take place, or is insufficient.

#### *6.2 Mixing of beans during fermentation*

Throughout the regions surveyed, this operation is never systematic. The number of mixings during fermentation varies between zero and two, depending on the following parameters :

#### **No mixing :**

- When there are a large number of beans : it is impossible to mix the pile.
- The acid vapours present can burn people's arms.

#### **One mixing :**

- This usually occurs during the third day.
- This occurs naturally when the beans are loaded onto a vehicle if they are being transported from the farm to the village during fermentation.

#### **Two mixings :**

This is unusual, but it occurs when the length of fermentation exceeds five days, mainly in the dry season.

### ***Effect on the final quality of the cocoa:***

Without mixing, the fermentation of the beans is usually uneven.

## **7. Drying**

### *7.1 Methods of drying*

Four methods are used in drying :

- A drying table 'séco' equipped with mats made of bamboo, raffia bambo or thin strips of the inner veins of palm leaves.
- A cemented area, usually in the front of the house.

- Plastic sheeting (black or thicker).
- On tarmac road.

The method used for drying the beans varies from region to region : in the departments of Divo, Oumé and Gagnoa, the 'séco' table was never mentioned, although this is a frequent practice in the South-west, and indeed very widespread in the East of the country. The following is noted:

**Drying tables ('séco') :**

- The preparation of a drying table is a day's work ; the mats can be reused for up to three years before having to be replaced.
- In the rainy season, the 'séco' method is quicker than any other.
- The 'séco' method allows an initial sorting of the beans to take place, as the debris, flat and broken beans can easily fall through the strips of bamboo or palm.

**Cemented area/plastic sheeting :**

- In some regions, bamboo and raffia are hard to find.
- In the dry season, drying in a cemented area or under plastic sheeting is quicker than the 'séco' method.
- A cemented area can last a very long time.

**Drying on tarmac road :** This method was mentioned to us by several farmers. The advantages to them are as follows :

- Drying is quicker.
- This method is cheaper and involves less work : the farmer does not need to construct or buy a drying area.

This method is used by farmers unfamiliar with quality issues, whose villages are situated alongside tarmac roads and whose production is small.

***Effect on the final quality of the cocoa :***

Apart from drying of cocoa on a tarmac road – which is already being outlawed in some regions through awareness campaigns – it is difficult to assess the real impact of a given drying method (i.e. 'séco', cemented area, plastic sheeting) on the final quality of the cocoa. However, best known practice is drying on a raised drying table.

**7.2 *Length of drying time***

Farmers have practical criteria which enable them to recognize a bean that has been sufficiently dried (i.e. humidity rate at around 8 per cent) : The beans are crumbly when touched or bitten, they come away easily from their shell, they have a distinctive internal and external colour, a certain taste, a certain noise when they are shaken during drying etc. Drying time is variable and can be insufficient. The average length of drying time is seven days, but it can vary between three and 15 days, according to the following parameters :

- Climatic conditions : drying takes longer during the rainy season. The average time during the rainy season is 10 days, compared with six days in the dry season.
- The choice of drying method (see the section above on 'Methods of Drying'.)
- The financial needs of the farmer.

- The practice of some *pisteurs*, involving purchasing cocoa whatever its humidity rate, at prices often better than those offered by the co-operatives. This practice has become more marked since the beginning of the 2001/2002 cocoa year.

***Effect on the final quality of the cocoa :***

Insufficient drying leads to beans becoming mouldy, both inside and out, high FFA and off-flavours.

## Pictures



*Collection of black beans after opening the pods.*



*Transportation of the ('poto-poto') beans from the farm to the village during fermentation.*



*In the foreground : fermentation of the cocoa in the village, on a cemented area under black plastic sheeting.*

*In the background : drying of fermented cocoa.*



*Fermentation of the beans on the farm under black plastic sheeting. Note the pile has been arranged on a slope so that the fermentation juices can easily disperse.*



*Cocoa beans at the start of drying. Note:*

- *The presence of clusters of beans which indicates that the placenta was not extracted when the pods were split.*
- *The presence of black beans.*



*Extraction of the placenta during the drying of the beans.*

# Training Materials

In the course of the survey, two training sheets were discussed with the farmers in order to gauge their opinions on the usefulness of these materials and also to see how well they understood them. The responses to the two sheets are summarized below :

## 1. *Practicality of the sheets*

All farmers, from whatever region, showed a high level of interest in the sheets, both in terms of their layout and content. (Sometimes it was difficult to retrieve them!)

The farmers found the sheets to be an invaluable source of information, both for their personal purposes as well as for the training of labourers and/or new employees. The existence of such sheets (in enlarged form) in the co-operatives and their divisions appears to be an idea worthy of further consideration. One of the co-operatives visited in the eastern region, CAMENE in Tiassalé, has indeed already utilised this form of training by drawings.

In some regions, however, the techniques illustrated in the sheets are not those in current use, so that the farmers concerned found them irrelevant. Furthermore, some illustrations were barely understood (see below for further details).

## 2. *Understanding of the sheets*

### 2.1 *Sheet: 'Preparation of good quality cocoa in a pile'*



Picture No.2 :

- Clubs are seldom used to open cocoa pods in the country. Hence, the picture does not correspond to current custom on farms. In reality, farmers use knives or machetes (also used for harvesting), which are turned into knives by shortening the blade. It would be more appropriate to show the type of knife used in opening the pods.
- There was difficulty in recognizing the germinated beans.
- There was difficulty in understanding the separation stages.
- The composite picture contains a lot of information. It would have been easier to follow if the drawings were split into single pictures. The process of opening the pods could be broken down into simple stages, including the splitting of the pods (emphasizing the need to leave the beans unbroken), extracting and dividing the beans.

- The pictures with lines across them were not well understood. A cross, rather than a line across an image would have been more effective in illustrating what should not be done.

*Picture No.3 :*

In general terms, the farmers knew how to define the size of the fermentation pile (height and surface area), but could not equate it in terms of kg or tonne or number of baskets.

*Picture No.4 :*

In regions where banana leaves have been replaced by black plastic sheeting under which the beans are fermented, the farmers could not see the relevance of the picture to themselves. It would have been better to show the different fermentation practices as a triple image:

- Fermentation under banana leaves.
- Fermentation under black plastic sheeting on a sloping surface allowing the dispersal of fermentation juices, provided that it was shown beforehand that this method did not harm the quality of the cocoa.
- Fermentation in a pierced chest covered with old sacks.

*Picture No.5 :*

The picture was not recognized as depicting the mixing of beans during fermentation. The farmers understood this picture to be about the opening of the pile after fermentation (i.e. removing the beans for drying). The farmers did not react to the red arrows. The picture needs to be made more explicit.

*Pictures No. 6, 7 & 8 :*

In regions where the drying tables have been replaced by a cemented area or plastic sheeting, on top of which the fermented beans are placed for drying, the farmers could not identify themselves with the scene being described. It would have been better to show the different drying techniques as a triple image :

- Drying on a drying table.
- Drying on a cemented area.
- Drying on plastic sheeting.

*Picture No.7 :*

The depiction of debris being discarded from the beans needs to be made more explicit.

*Picture No.8 :*

The depiction of rain and night needs to be enlarged and made into two pictures, drying on a cemented area could be shown in one of the two pictures.

*Picture No.9 :*

The picture of black cocoa beans in the right hand of the farmer led to confusion. Some farmers interpreted the picture as representing the separation stage. Picture no. 10 of the 'Preparation of good quality cocoa' sheet, depicting the criteria for recognizing cocoa that has been well dried, appears to have been better understood. Pictures depicting the breaking and cutting of well dried beans would be useful.



Difficulty in understanding that this scene was about someone rolling out a bamboo mat. Generally, at night and in the rain, farmers who use drying tables roll out the bamboo mat or 'boudin' which they then cover with black plastic sheeting. Picture no. 8 in the 'Preparation of good quality cocoa in a pile' sheet seems to have been better understood. See the notes to this picture.

*Picture No.12 :*

See the notes to Picture No.11 in : 'The Preparation of good quality cocoa in a pile'.

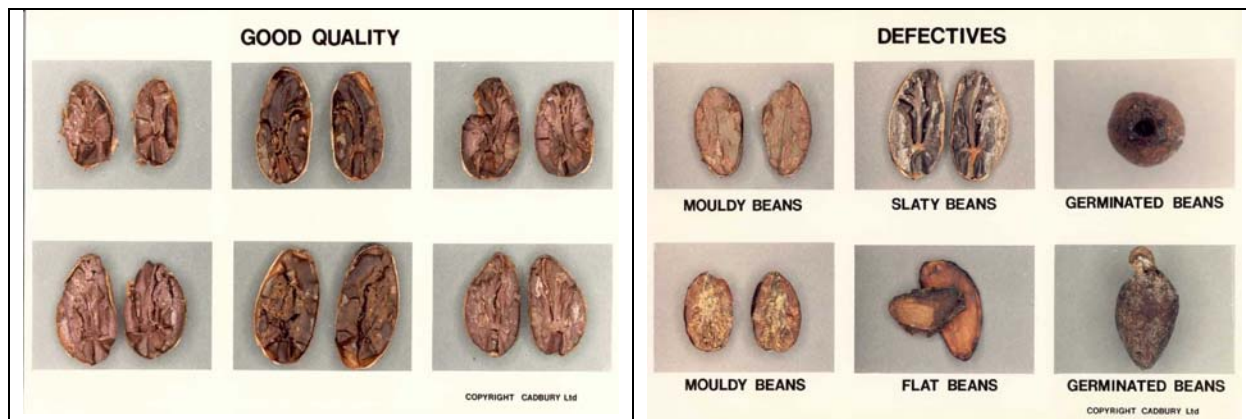
### 2.3 *Other comments*

- The numbers at the bottom left hand side of each picture led to confusion. Some farmers took them to mean the number of days required for the procedures being depicted. For example, in picture no. 4, some farmers thought it was being suggested that fermentation should take place over four days, etc. We suggest that these numbers be removed.
- The composite pictures were seldom well understood. For example, it was not clear to the farmer that sorting the beans, as depicted in picture no. 2 of the two documents, should occur during the opening of the pods. Single pictures would have been easier to understand.
- Farmers do not read or speak French fluently, although heads of co-operatives generally do, so information has to be conveyed through them. Hence, the French language can continue to be used in training materials to describe procedures.

## Proposal for future activities

The field study in Côte d'Ivoire was concluded by a meeting in Abidjan, attended by participants and organizers. The report of this meeting is attached in Annex 4. A summary of the activities proposed during the meeting is contained below :

- Prepare a revised version of the training material.
- Establish recommendations in the light of the problems arising from current farming practices as described in this report. These recommendations can take various forms :
  - A manual on good post-harvest farming practices.
  - Film on cocoa quality.
- In the light of these recommendations, amend the advice given by ANADER to farmers.
- The equipment used by co-operatives and their divisions in quality control :
  - Scales.
  - Knife for cutting the beans.
  - Measuring instrument.
  - Humidimetre KPM AquaBoy.
  - Analysis table (to be prepared locally).
  - A manual on good post-harvest farming practices, as mentioned above.
  - Training material including : revised and enlarged picture strips (see above under the section on 'Training Materials') et pictures (enlarged) of broken beans :



- When they receive the items described above, the representatives of the co-operatives and their divisions need appropriate training in their use and upkeep. The training can be provided by the agricultural counsellors of ANADER who have been trained themselves ('training of trainers').

# Samples : Test results

## 1. *Sample description*

- 19 samples purchased from farmers, for which the preparation history is known with adequate accuracy (results in table 1).
- 9 samples purchased from co-operatives, for which the preparation history is unknown (results in table 2).

The conditions of preparation of the 19 samples are very diverse (see table 1 attached).

*Fermentation :*

- Heap wrapped in banana leaves ('banana')
- Heap wrapped in plastic sheets ('plastic')
- Heap wrapped in a combination of plastic sheets and banana leaves ('plastic + banana')
- Heap directly on concrete area covered with plastic sheets ('plastic village')

*Drying :*

- Bamboo mats on table ('table')
- Concrete area ('concrete')
- Tarpaulin or plastic sheets ('plastic')

*Storage :*

Either in sacks ('sacks') or heaps (heap') inside or outside. Most samples had only been stored for 1 or 2 days, with the exception of 2 samples kept for 1 and 2 weeks.

*Moisture content :*

Min. 6.0%, max. 10.5%.

## 2. *Conclusions*

From the limited number of results presented in tables 1 and 2 (28 samples):

- Overall, the levels of Ochratoxin A (OTA) are low :
  - Average 0.2 ppb, median 0.0 ppb.
  - Range : 0.0 to 2.0 ppb, the maximum value was found in one sample purchased from a co-operative, 2 samples purchased from farmers had OTA levels slightly above 1.0 ppb, all other results were below 0.3 ppb.
- We did not find any correlation between OTA levels and fermentation method, OTA levels and drying method or drying duration, OTA levels and storage method or storage duration. Correlation between OTA levels and fermentation duration may need to be further explored.
- We did not find any correlation between OTA levels and moisture content, OTA and mouldy levels, OTA and slaty levels, OTA and defectives levels.

## 3. *Methods of analysis*

All samples were analysed by RSSL (UK) for bean count, cut test and OTA analyses.

• *Moisture content :*

Samples 1 - 10 and 15 - 19: a KPM AquaBoy was used, measurement made at the time of sample collection.

Samples 11 - 14 and 20 - 28: a Dickey Jones was used, measurement made after the samples were further sun-dried at Nestlé Côte d'Ivoire.

• *Bean count :*

300 representative beans excluding broken beans and debris were weighed to calculate the number of beans in 100g.

- *Cut test :*

100 representative beans excluding broken beans and debris were cut with a Magra bean cutter. The results on the following parameters are reported:

- Mouldy : beans that show mould that is visible to the naked eye. The cotyledons of the bean usually have a powdery surface.
- Slaty : all beans that show more than 50% slate. Slate presents itself as dark pigment spots in the bean giving a silver/grey tinge to the surface. The beans also have a soft/cheesy cut. Slaty beans are unfermented.
- Infested : beans that show signs of insect attack (usually as tunnelling or excreta).
- Flat : beans that cannot be cut to give a cut surface of cotyledon.
- Germinated : includes beans from which the germ is missing or protruding.

- *Ochratoxin A (OTA) analysis :*

Extraction with solvent, clean up by use of an immuno-affinity column and final determination with HPLC with fluorescence detector.

In interpreting these results, one should not forget the limitations linked to the sampling technique, to the number of samples collected and to the method of analysis used.

#### **4. *Cut test and bean count results***

Note: Standard Côte d'Ivoire (based on international cocoa standards)

Grade I : mouldy = 3%, slaty = 3%, flat & germinated & infested = 3%

Grade II : mouldy = 4%, slaty = 8%, flat & germinated & infested = 6%

All the samples purchased during the survey are within grade I or grade II.

- The average bean count is 88 beans / 100 g, range : 76 (sample No. 13) to 101 (sample No. 20) beans / 100 g.
- Apart from 2 samples (samples No.5 and 11) which have higher levels of mouldy beans (6 and 7% respectively), all other samples are at or below 3% mouldy beans.
- Apart from sample No. 9 that contains 6% of slaty beans, all other samples are well fermented, i.e. at or below 3% slaty beans.
- One sample has a significant level of germinated beans (sample No. 26: 6%), all other samples are at or below 4% germinated beans.
- All samples have low level of infested beans (max. 2% for sample No. 6).
- No flat beans were detected in the cut test.

#### **5. *Ochratoxin A (OTA) results***

##### **5.1 *Samples of known history (table 1 attached)***

The results show that all samples of known history have a low level of OTA. Only 2 samples (No. 7 and 10) have levels slightly above 1.0 ppb (i.e. 1.1 and 1.15 ppb respectively). OTA levels in all other samples are below 0.1 ppb. The 2 samples slightly above 1.0 ppb were purchased in the Centre West region of Côte d'Ivoire, however other samples from this region have very low levels of OTA. In terms of preparation history, the only difference between these 2 samples and the others is the shorter fermentation described by the farmers: only 3 and 4 days, against an average of 6 days for all other samples (min. 5 days, max. 7 days).

However, this shorter fermentation described by the farmers is not reflected by a higher level of slaty beans in the results of the cut test.

#### 5.2 *Samples of unknown history (table 2 attached)*

Additional results were obtained on samples purchased at village co-operatives, the conditions of preparation in that case are unknown. Again, generally low levels of OTA are observed. Only one sample (No. 20) has a slightly higher OTA level (i.e. 2.0 ppb). OTA levels in all other samples are below 0.3 ppb.

#### 6. *Note on samples taken*

The samples analysed above were provided by the farmers as 'ready for sale'. These are not representative of the beans purchased by the *pisteurs*.

Table 1 : Moisture, bean count, cut test and OTA results for samples of known preparation techniques

Centre West										
Sample No.	1	2	3	4	5	6	7	8	9	10
'Département'	Issia	Issia	Issia	Vavoua	Vavoua	Gagnoa	Gagnoa	Gagnoa	Oumé	Oumé
Village	Saliguhé	Kouadiokro Klémagny	Oussoukro	Konanbokro	Etiennékro	Biakou	Biakou	Pissékou	Gnamien Kouadiokro	Tonla
Fermentation duration (day)	5	6	6	6	7	5	4	5	5	3
Fermentation method	Banana	Plastic	Plastic village	Plastic	Plastic	Plastic + banana	Plastic + banana	Plastic	Plastic	Plastic
Drying duration (day)	7	6	5	6	6	4	5	4	6	3
Drying method	Plastic	Concrete	Concrete	Concrete	Concrete	Plastic	Plastic	Plastic	Concrete	Plastic
Storage duration (day)	1	1	1	?	?	7	4	1	1	1
Storage method	Sacks	Sacks	Sacks	Heap	Sacks	Sacks	Sacks	Sacks	Sacks	Sacks
Moisture (%)	8.5	7.0	7.5	8.5	7.5	7.5	7.0	9.5	6.0	10.5
Bean count (beans / 100g)	87	95	98	93	84	97	96	83	93	92
Mouldy (%)	0	1	3	0	6	0	0	0	0	0
Slaty (%)	0	0	0	0	1	0	2	2	6	0
Defectives (%)	1	1	4	2	1	4	1	0	4	1
OTA (ppb)	0.0	0.0	0.0	0.1	0.0	0.0	1.1	0.0	0.0	1.15

Notes: Samples were purchased from individual farmers.  
Defectives include infested, flat and germinated beans.

Table 1 Continued: Moisture, bean count, cut test and OTA results for samples of known preparation techniques

Region	East & South East			South			South West		
Sample No.	11	12	13	14	15	16	17	18	19
'Département'	Abengourou	Adzopé	Adzopé	Divo	Divo	Divo	San Pédro	Soubré	Soubré
Village	Broukro	Carla	Ayekia	Datta	Petit Bouaké carrefour	Bouakakro	Bida	Amani Kouassikro	Petit Bondoukou
Fermentation duration (day)	6-7	5	6	7	5	7	5-6	6	6-7
Fermentation method	Plastic	Banana	Banana	Plastic village	Banana	Plastic village	Plastic	Plastic	Plastic
Drying duration (day)	6-7	7	7	7	6	5	6-7	7	7
Drying method	Table	Table	Bamboo mats	Concrete	Concrete	Concrete	Table	Concrete + Plastic	Table
Storage duration (day)	1-2	0	?	?	2	14	?	2	0
Storage method	Sacks	-	Sacks	Sacks	Sacks	Heap	Sacks	Heap	Table
Moisture (%)	7.3	7.5	7.2	7.6	7.0	6.5	9.0	6.0	8.0
Bean count (beans / 100g)	88	82	76	91	86	86	85	87	83
Mouldy (%)	7	0	0	2	1	3	0	1	1
Slaty (%)	0	0	0	0	1	0	0	0	0
Defectives (%)	5	1	1	4	2	1	1	1	4
OTA (ppb)	0.0	0.0	0.0	0.0	0.0	0.05	0.1	0.0	0.0

Notes: Samples were purchased from individual farmers.  
Defectives include infested, flat and germinated beans.

**Table 2 :** Moisture, bean count, cut test and OTA results for samples of unknown preparation techniques

Region	East & South East					South			
Sample No.	20	21	22	23	24	25	26	27	28
'Département'	Abengourou	Abengourou	Adzopé	Agboville	Agboville	Tiassalé	Divo	Divo	Divo
Village	Niablé	Niablé	Affery	Offompo	Aboudé Kouassiko	Binao	Divo	Didoko	Datta
Co-operative	CANIA	COOPRANIA	COOPAAF	SCAGBO	CEACI	CAMENE	COOPADJI	COOPED	AKAYARA
Moisture (%)	7.7	7.6	7.1	7.0	7.8	7.2	7.2	7.6	7.8
Bean count (beans / 100g)	101	85	87	82	87	82	85	80	84
Mouldy (%)	2	1	0	3	0	0	0	2	1
Slaty (%)	0	0	0	3	0	0	0	0	1
Defectives (%)	4	0	1	2	0	0	6	1	0
OTA (ppb)	2.0	0.0	0.0	0.15	0.1	0.05	0.1	0.0	0.3

Notes: Samples were purchased from co-operatives.  
Defectives include infested, flat and germinated beans

