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IMPACT OF STRUCTURAL ADJUSTMENT AND ADOPTION OF TECHNOLOGY ON COMPETITIVENESS OF MAJOR COCOA PRODUCING COUNTRIES

by

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RÉSUMÉ

La totalité de la production mondiale de cacao est cultivée dans les pays en developpement — plus de la moitié en Afrique de l'Ouest et essentiellement pour l'exportation. A l'exception du Brésil, de la Malaisie et de l'Indonésie; le cacao est produit par de petits exploitants. Sur le marchés international, les cours du cacao ont connu une hausse brutale en 1977 mais subi une baisse constante depuis, alors que les surplus de production persistent.

Pour les producteurs, les conséquences de l'ajustement structurel et du processus de libéralisation ont été diverses. Malgré le maintien de prix bas sur le marché international, les producteurs ont généralement perçus une marge plus élevée du cours officiel. Par ailleurs, les prix des intrants ont augmenté et les subventions pour les engrais et le matériel agricole ont été réduites ou éliminées. Dans ces conditions, les exploitants les plus pauvres achètent encore moins d'intrants.

L'ajustement structurel a eu un impact négatif sur la recherche sur le cacao, notamment pour les institutions gouvernementales de recherche au Brésil et en Afrique. En Malaisie la situation est différente car la recherche dépend du secteur privé.

Contrairement à d'autres cultures vivrières — par exemple le riz — et malgré des pertes annuelles considérables dues aux maladies et aux parasites, le cacao n'a bénéficié d'aucune coordination de l'aide international pour la recherche, Des arguments de poids pèsent en faveur d'un effort internationale pour identifier de manière scientifique et préserver les ressources génétiques du cacao.

SUMMARY

All the world's cocoa is grown in developing countries — more than half in West Africa — essentially for export. Except in Brazil, Malaysia and Indonesia, it is grown by smallholders. In the international cocoa market, prices rose steeply in 1977 but have been in almost constant decline since and production surpluses have persisted.

For producers, the impact of the structural adjustment and liberalisation process has been mixed. While prices have remained low on the international market, producers have generally received a higher share of the international market price. On the other hand, input prices have increased and subsidies for fertiliser or improved planting material have either been reduced or eliminated. Under these conditions, poor producers then use even fewer purchased inputs.

Structural adjustment has had a negative impact on cocoa research, particularly in public research institutions in Brazil and in Africa. In Malaysia the situation is different as the private sector is involved in research.

In contrast to some of the food crops (for example rice), and despite substantial annual crop losses due to disease and pests, cocoa has not benefited from any coordinated, international research effort. Strong arguments are presented in favour of an international effort to characterise and conserve cocoa genetic resources.

PREFACE

This study is part of a research project on "Technological Change in Developing Country Agriculture: Implications of the Changing Public/Private Sector Balance". The project has been undertaken in the context of the Development Centre's 1990-1992 research programme on "Developing Country Agriculture and International Economic Trends", headed by Ian Goldin.

The Centre's research on agriculture incorporates several components: a conceptual component to provide analytical guidance for the broader issues; a global general equilibrium model to analyse the overall trends and policy consequences; a component to analyse the links between economic reform and technological change in agriculture; and a series of country case studies to look more closely at the economic reform options for individual representative countries.

The work on technology seeks to determine whether the structural adjustment and liberalisation process — and, by implication, changes in the public/private sector balance — is enhancing or impairing the economic and institutional conditions conducive to technological innovation and greater productivity. In order to examine this hitherto unresearched issue, an eclectic approach has been adopted and a number of different types of study commissioned. These include: a conceptual study of the interaction between changes in economic policies and agricultural productivity; two commodity studies — of rice and cocoa; a study of biotechnology research developments with respect to these two commodities; a case study of agricultural research institutions in Brazil; a study of seeds supply and diffusion in three African countries. These provide different perspectives and angles on the relation between economic reform and technological change in agriculture.

This study of cocoa has been contributed by Emily Bloomfield and A.R. Lass. It assesses the impact of structural adjustment programmes and economic liberalisation on the adoption of technological innovations in cocoa production in a cross section of key cocoa-producing countries in three continents: Cameroon, Côte d'Ivoire, Ghana and Nigeria in Africa; Brazil in Latin America; and Indonesia and Malaysia in Asia. The impact of technological change in the cocoa sector on productivity and the relative competitiveness of each of the countries is also examined.

The study highlights the equivocal impact of structural adjustment on incentives for small cocoa producers and the continuing need for strong public sector support of cocoa research.

The lessons to be drawn from the project and the policy implications will be brought together in a synthesis volume edited by Carliene Brenner, to be published in the Development Centre studies series.

Louis Emmerij
President of the Development Centre
May 1992

I. INTRODUCTION

Objective

The objective of this study is to assess the impact of the process and changes dictated by structural adjustment programmes and economic liberalisation on the adoption of technological innovations for cocoa production in a cross section of key cocoa-producing countries in three continents: Cameroon, Côte d'Ivoire, Ghana and Nigeria in Africa; Brazil in Latin America; and Indonesia and Malaysia in Asia. In turn, the impact of technological change in the cocoa sector on productivity, quality characteristics and hence the relative competitiveness of each of the countries will be examined. The relative shift in the balance between the public sector and private sector involvement in the cocoa sector as a result of undertaking structural adjustment measures will also be addressed in this context.

"Competitive" is a difficult and qualitative adjective for evaluating and describing the cocoa sectors of the various countries covered in this paper. Traditional economics has tended to concentrate on comparative advantage, articulated initially by David Ricardo (1963) and then developed more fully by Heckscher and Ohlin (Samuelson, 1948). The theory of comparative advantage assumes that all nations are endowed with identical technology, but specialise according to differences in factor endowments, such as land, labour, natural resources and capital. While comparative advantage is important in the context of cocoa production, and helps explain, for instance, the recent slight shift in emphasis away from cocoa in Malaysia despite being one of the lowest cost producer countries (to be discussed more fully later), it accounts for only part of the developments currently taking place in the world cocoa market. Furthermore, to a certain extent the discussion of comparative advantage is beyond the scope of this paper because it requires a cross-commodity and cross-industry examination of each of the producer countries. Instead, this study analyses the developments across countries but confined to cocoa production. Because competitive advantage for cocoa producers can also result from lower costs of production relative to other producers, a theory first ascribed to Adam Smith (1937), and/or to product differentiation, which allows a country to charge a premium price (Porter, 1990), it is on these areas that this study will focus.

Technology, which is assumed away in comparative advantage theory, and which is the main emphasis of this paper, can shift comparative advantage and cost advantage as well as lead to product differentiation. The aim in this study is to tie economic policies implemented by governments as the result of structural adjustment or liberalisation to the development and adoption of technological innovation by the main producing countries. This sequence of events is depicted in Diagram 1. *Part II* of this study will describe the nature and impact of technological developments in cocoa, both generally and for different regions. It examines the assumption of comparative advantage theory that all nations are endowed with identical technology. It details the advances in cocoa research and development in the public and private sectors, including cocoa bean fermentation and drying.

Part III analyses the changing roles of the private and public sectors in the development and dissemination of technology in the countries included in this study. In *Part IV*, the elements of structural adjustment programmes which impinge directly upon technology in the cocoa sector will be described and analysed. This includes the impact on exchange rates, taxes and tariffs, producer prices, supply and demand of inputs, research and extension services, infrastructure and other support and incentive systems for introducing new technologies, as well as cocoa processing. The underlying assumption is that the economic policies pursued by a country can contribute to laying the foundation (or not, as the case may be) for technological advancement and hence competitiveness of the cocoa sector. The final section, *Part V*, draws Parts II to IV together and evaluates the impact of structural adjustment/liberalisation on the dissemination and adoption of technology and on the costs of production and competitiveness of the different cocoa-producing countries, and how like situations can be expected to evolve in the future. It includes a discussion of the policy implications with respect to the roles of the public and private sectors in technology and diffusion. It also touches on and negates in this context the "fallacy of composition" argument that adoption of technology could lead to lower prices.

II. TECHNOLOGICAL DEVELOPMENTS IN COCOA

This part of the study provides an historical overview of the research and development efforts in the cocoa sector since the turn of the century. It examines the progress made to date in the development of high yielding varieties of cocoa, and of cocoa varieties which are resistant to various diseases and pests. It also reviews other technological advances which have affected cocoa production. Throughout this part of the study, the question of public versus private sector involvement in research is addressed, but one of the key conclusions is that an international coordinated effort in the development of cocoa research and technology is the most urgent priority.

An overview of global technological developments and advances affecting cocoa production

1. Earliest Research

The first Government sponsored research station specifically for cocoa was established with the help of a group of cocoa growers in 1923 at Urucuca in the centre of the cocoa zone of the State of Bahia, Brazil. It was established to produce better planting material and improve agronomy. Prior to this, there had been a number of independent studies by individual scientists in other countries on specific diseases (Petch on canker in Sri Lanka in 1910, Stockdale on pink disease in Trinidad in 1909, Stahel on witches' broom in Surinam in 1915 and Rorer on monilia in Ecuador in 1918), the funds for that work usually being provided by the Colonial Administrations concerned.

The first privately funded cocoa research initiative was the establishment of the 'Cacao Proefstation te Salatiga' by estate owners in Central Java, Indonesia in 1900. It was started with the initial intention of producing an economic control method for two devastating pests, but quickly moved on to work on other aspects of cocoa cultivation as well.

Probably the earliest recorded attempt at developing cocoa hybrids was another private initiative at the turn of the century in Java, Indonesia, when a plantation manager introduced some seedlings from Venezuela. The first systematic selection programme was started by the privately owned United Fruit Company in Costa Rica in 1920 and continued for a number of years.

Funding for cocoa research has therefore been provided by a mixture of the public and the private sectors almost since the time that cocoa became an important economic crop. The public/private sector balance has clearly changed over time and the relative importance has varied between the various cocoa-producing areas, but they have both had an important role in the development of new technologies.

2. International Efforts

a. Technology Transfer

All extension efforts must be location specific and thus there are no international extension efforts. Most national extension programmes for cocoa have been characterised by an almost permanent shortage of resources, which over the years has varied from severe to chronic, depending on the prices in the international cocoa market at the time.

b. Research

The first truly international cocoa research effort started in Trinidad in 1930 after the so-called "Cocoa Research Scheme" was initiated in 1927 with funds from the Colonial Administrations of a number of cocoa growing countries and a few UK chocolate manufacturers. In the 1930s, this programme produced the 100 ICS clones which have been very widely planted throughout the cocoa world in the ensuing 60 years. The successor to the "Cocoa Research Scheme" is the present-day Cocoa Research Unit (CRU) of the University of the West Indies. Due to these longstanding international links, the island of Trinidad has conserved a very broad range of cocoa germplasm since earliest times and so has been, and continues to be, a major source of primary germplasm for incorporation by cocoa breeders in other countries into their improvement programmes. This primary cocoa germplasm material is all internationally available and so is still being dispatched from Trinidad to quarantine stations around the world in response to specific requests by plant breeders. Thus, the work on genetic conservation and evaluation at the Cocoa Research Unit in Trinidad has continued for 60 years (Posnetto, 1986), albeit with a number of funding crises which have at times put the future of the broadly-based germplasm collection in jeopardy. The Government of Trinidad and Tobago and the trade association of the UK Chocolate and Confectionery Industry have been major long-term donors to this critical work of genetic conservation and evaluation. A number of other donors have contributed on a shorter term basis. In recent years two substantial grants from the European Development Fund have enabled CRU to re-establish all the accessions in Trinidad onto one site (now known as the International Cocoa Genebank, Trinidad (or ICG,T), where evaluation will be much more straightforward and can be done under more uniform conditions. This collection has been acknowledged by International Board of Plant Genetic Resources (IBPGR) as one of two "primary genebanks for cocoa" — the other being located at CATIE (the Agricultural Research and Training Institute) in Costa Rica. These two germplasm collections are being enlarged continuously to ensure the broadest possible range of material is available for evaluation.

The primary genebank at CATIE has been intermittently funded by the trade association of the US Chocolate and Confectionery Industry. It contains a narrower range of primary germplasm than ICG,T, but more selection and breeding has been carried out with this material. This is because CATIE supplied Central American and Spanish speaking cocoa-producing countries in the Caribbean with increasing numbers of cocoa seeds from 1976 until recently. A mixture of seed of 35 hybrids was produced, the parentage being Upper Amazon and local selections. This material has

been planted in a number of locations, but with varying success. This programme is unusual as it is rare for selected hybrids of any species to be freely transferred from one country to another in that way.

In the mid 1970s, efforts were made to create an International Cocoa Research Centre to utilize the primary germplasm in Trinidad. It was planned that this Centre would be based at the Cocoa Research Unit at the University of the West Indies with the hope that this could become part of, or associated with, the Consultative Group on International Agricultural Research (CGIAR) system.

Current work on cocoa genetic resources around the world is still inadequate, and so the need for a coherent international effort remains. A high percentage of the world's cocoa production is grown by farmers with holdings of less than 1 hectare in countries with very inadequate resources and poor facilities for the conduct of any agricultural research at all, let alone for the long-term conservation and evaluation of primary genetic material. The absence of suitable research infrastructures means that many such countries actually need to import pre-bred material or proven selected hybrids of cocoa that have been shown to be successful elsewhere. Unfortunately, very few research organisations are working towards this goal, and in some cases the institutes are not permitted to co-operate with other cocoa-producing countries in that way. In other cases, such as the Côte d'Ivoire, Malaysia and Indonesia, planting material can be sold to selected cocoa-producing countries provided specific approval has been given by their respective governments. This is clearly unsatisfactory, as the future prosperity of the world cocoa industry lies in the widespread planting of high yielding, disease resistant planting material across a reduced area of land to release land for other productive purposes such as planting with other crops. This goal is most likely to be achieved by international co-operative efforts aimed at the production of sufficient quantity of planting material with the requisite characteristics.

At present, and in recent decades, the international cocoa research initiatives (both on genetic resources and on other topics) have not been coherent; consequently, they have been insufficient to produce the advances in yield, disease resistance etc which have been seen in so many other tropical and temperate crops. These advances are needed to maintain the competitiveness of cocoa with other crops — both tropical and temperate. For example, dramatic productivity improvements have been seen in rice in both the tropics and in temperate zones and completely new cultivation systems have been developed for orchard crops (such as apples and pears) in Europe and in North America. In the past, a more consistent well-funded programme of characterisation and evaluation of cocoa genetic resources to provide breeders with reliable information on heritable characters would have been of enormous value. This would have put current cocoa breeders in a good position to select useful parents for the production of new high yielding and disease resistant planting material for distribution to farmers. This work could have been carried out anywhere, though ICG,T and CATIE would have been favoured sites. Unfortunately, consistent, long-term and reliable funding was not forthcoming and so neither institution was able to embark on the necessary programme of evaluation of the primary cocoa germplasm which it holds. Many of the present problems of the world cocoa industry stem from this failure. The evidence available suggests that Structural Adjustment Programmes (SAP) have had no impact, either positive or negative, on the

conservation of cocoa genetic resources, or on cocoa breeding programmes or on the international availability of improved planting material of the type indicated above, because structural adjustment efforts have been concentrated on individual countries rather than on international research institutions.

In the text which follows, it has not been possible to give much of the technical background to cocoa cultivation in the various countries involved due to shortage of space. The reader requiring more detail is recommended to consult Wood and Lass (1985).

Recent Technological Advances

1. Collection and Conservation of Cocoa Genetic Resources

Collecting of wild germplasm is continuing slowly, but steadily, with the accessions being established in the country of collection and in ICG,T in Trinidad or CATIE in Costa Rica. It is planned that the wild accessions should always be in two locations for security in case of natural disasters or political upheaval.

There remains a need for more cost effective techniques of conservation of primary cocoa germplasm to replace the present system of planting in a field genebank, which is done at considerable cost for both genebank establishment and for its maintenance in perpetuity. Cryopreservation (i.e., preservation by storing at very low temperatures) might be an appropriate technique for conservation in the future, but so far success with cocoa has not been reported, though some preliminary studies have been undertaken. For success, cryopreservation would require the parallel development of a system for the regeneration of embryos.

At the moment, the transport of primary germplasm can only be made using budwood, which is very susceptible to low temperatures and pathogen attack and will probably only remain viable for about 10 days. The development of a reliable alternative means of transporting of cocoa plant material other than as budwood would be desirable. The successful regeneration of axillary buds of cocoa from orthotropic shoots has recently been reported. This could give a collecting method in which the material could remain in a viable condition in a test tube and avoid damage from pathogens or external environmental conditions. Unfortunately, most scientists who have worked on the regeneration of cocoa have not worked on the development of a simpler method of germplasm movement.

There is no evidence to suggest that structural adjustment has had or could have any positive or negative effect on current efforts to collect and conserve wild cocoa germplasm, which requires a cross-country effort. There is an urgent need for the international community to allocate significant sums of money to assure the continuity of adequate funding of the two "primary genebanks for cocoa" in the indefinite future.

2. Characterisation and Documentation of Cocoa Germplasm

There are a total of over 3,000 accessions of different primary (wild) germplasm in ICG,T and CATIE, but nothing is known about the great majority of these individual accessions. A little is known about the small number which have been extensively used in breeding programmes throughout the cocoa world. This lack of information on the great majority of the world's primary cocoa germplasm is unfortunate, but largely reflects the difficulty of devising an internationally useful methodology for characterisation, as well as the time consuming nature (and perhaps unreliability) of making measurements of morphological characters — the best technique which has been at our disposal until quite recently.

Measurements of a substantial number of morphological characters over a number of years on a range of primary germplasm in ICG,T have recently been analysed. These data suggest that eight descriptors from amongst the 64 proposed by IBPGR will represent all the leaf and flower parameters on the genotypes tested. These eight descriptors are easy to measure and it is now proposed to measure them for all the germplasm in ICG,T. Unfortunately, morphological measurements alone will not give breeders an adequate understanding of the genetic make-up of cocoa and so other techniques will be required for this and thereby give essential information to permit the rapid attainment of the breeding objectives.

In the mid 1980s, a system of starch gel electrophoresis (or isozyme) analysis was developed for cocoa, but recent studies have shown that there is probably an environmental influence on some of these enzyme markers. This potential influence, combined with the cost and complexity of running these isozyme gels concurrently on a number of enzyme systems, means that it is not likely to be a viable option for characterisation of all cocoa germplasm. It may though have a role on a small-scale to confirm the identity of a specific germplasm acquisition in a collection.

Recent research to "fingerprint" cocoa clones using DNA-based markers shows promise, but still requires considerable development work before it can be used on a wide range of germplasm in the field. This is a very significant advance which could be most useful for characterisation of germplasm collections and would help cocoa breeders decide on promising parents. This work is currently being carried out in cocoa consuming countries and is being funded by both the UK and the US trade associations for the Chocolate and Confectionery Industries (called BCCCA and ACRI respectively). As soon as possible the technology will then be transferred to the primary germplasm collections in order that all their material might be quickly characterised. However, it would still not give a "genetic map" of cocoa for which much more sophisticated techniques will be required.

The need for a system of correct and uniform identification of germplasm material is well illustrated by the following example: The well known clone ICS 95 from Trinidad was given accession number P1234539 by the USDA Quarantine Station at Miami; it is listed as M-031352 at the Subtropical Research Station in Mayaguez, Puerto Rico and is known as EET-11 in Ecuador.

A framework of an International Cocoa Germplasm Database (ICGD) is also nearing completion, building on the existing and widely disseminated ‘Primitive Cocoa Germplasm Database.’ Isozyme and other biochemical data can be accommodated in it, together with data on location of accessions, synonyms, morphological data etc. This Database is available free of charge in computer diskette form or as hard copy to all enquirers.

Because the current efforts to characterise or document the world’s cocoa genetic resources involve, and even require, international cooperative research efforts, little has been done on an individual country basis, particularly in cocoa producer research institutions. Consequently these efforts have been unaffected by economic adjustment programmes in cocoa-producing countries.

Selection and Breeding of Cocoa

The most successful breeding programme on cocoa is almost certainly that of W E Freeman in Trinidad. He started his work in the 1940s with a few clones (IMC 67, SCA 6, ICS 1, PA 30, 44, 46, 56, 118 and 121) and carried out a series of carefully conducted field trials over almost 50 years. Clones (the TSH series) have been identified which have a potential yield under Trinidad conditions of 2 tonnes per ha per annum, with a very substantial bean size, good flavour and some resistance to witches’ broom disease. Unfortunately, it is very unlikely that any one person will ever again have the opportunity to work on a cocoa selection programme with field trials at one location for that number of generations. A tree must be at least 5 years old before the number of pods available is adequate to permit any yield assessment. This means that varietal trials of cocoa are both expensive and unattractive to breeders. This is in marked contrast to wheat, rice or maize where two generations can be produced in a year.

In order to overcome this constraint, a number of cocoa breeders have made a vast number of crosses, identified superior trees from the F1 populations produced and used the superior individuals from these trials to classify that complete population without doing the necessary field-trials to prove the yield potential of the whole population. This unreliable and unsatisfactory procedure has been followed in a number of the countries included in this study, and was adopted because the breeders were required to show results "quickly". If this had merely remained an experimental technique to be used only on the research stations then no real harm would have been done. Unfortunately that has not been the case and the "Hybrids" produced as a result of these experiments have often been made rapidly available to farmers.

The use of only the superior trees to classify the whole hybrid population (which would have been expected to have a normal distribution) often quite substantially overestimated the yield to be expected by a farmer who would always have to plant a mixture of the superior, the average and the poor crosses. This situation arose because the plant breeders and their colleagues in the plant production departments had to produce the enormous quantity of "hybrid seeds" in order to achieve the planting targets set by governments and donor agencies. Therefore, effectively many farmers have been provided with so-called "superior hybrid seed," which was actually seed of unproven merit and may well be lower yielding and/or less

disease resistant than the traditional types that they would have been accustomed to planting. Not surprisingly, a number of farmers have expressed dissatisfaction at the poor performance of these supposedly "superior hybrid seeds". In one documented example, from an actual field planting in Costa Rica, about 20 per cent of these "superior hybrids produced 80 per cent of the crop" or, more dramatically, "80 per cent of the trees produced only 20 per cent of the crop."

Anecdotal evidence also exists for the poor long-term performance of the hybrids based on white-seeded Catongo material in the traditional Brazilian cocoa growing area in the State of Bahia. This material appears to have performed even worse when transported (as pods in lorries) to the Brazilian Amazon for planting under different environmental conditions with different pests and diseases.

The urgency of the cocoa breeding programmes in Brazil and Côte d'Ivoire during the late 1970's and early 1980's was undoubtedly stimulated by the excessively high world market prices of the late 1970's. For Malaysia and Indonesia it was the high prices of the late 1970s which in turn encouraged their breeding programmes. As a cocoa tree can easily live for 50 years, the effects of this will be long-lasting. For the most part, there is little evidence to suggest that recent structural adjustment efforts have had any direct effect, either beneficial or contrary, on current programmes to breed new cocoa varieties. Indirectly, policies which enable farmers to realise a greater proportion of the world cocoa price, such as in Malaysia and Indonesia, have stimulated breeding and planting programmes. Furthermore, in Ghana, progress with the SAP (Economic Recovery Programmes — ERP I and ERP II) has meant that a major cocoa research programme has been initiated, funded by ODA in coordination with the World Bank through ERP II. This programme has brought incremental new funds to the cocoa research effort in Ghana. However, it is only indirectly helping the cocoa breeding effort as it is not concentrating specifically on breeding new varieties, but rather on understanding the farming systems, on devising better diagnostic tools for the control of Cocoa Swollen Shoot Virus (CSSV) and on improved methods of control of Phytophthora Pod Rot. It is clear that ODA would not have funded this programme in the absence of the ERP.

1. Propagation and Tissue Culture of Cocoa

Despite the failure of *in vitro* techniques, rapid propagation of cocoa plants by vegetative means at modest cost is routinely achieved on a substantial scale by plantation companies for field planting in both Malaysia and Indonesia. The necessary steps (described by Shephard *et al*, 1981) have been continually refined to improve production efficiency and reduce the cost of the operation, such that the rapid propagation of selected planting material for field establishment cannot now be considered to be a limiting factor. However, the absence of regeneration of cocoa *in vitro* means that a very wide range of so-called modern biotechnology techniques cannot even be tried on the crop at present, which is unfortunate.

To date no adult cocoa plant has been recovered from an *in vitro* system. Somatic embryogenesis has been reported from immature sexual embryos, and one or two survivors are reportedly available. This situation prevails despite a very substantial amount of research effort at a large number of centres in both cocoa-

producing and cocoa consuming countries over the last decade or so. Furthermore, there is no reliable axillary bud culture system, neither have successful anther, or protoplast, culture systems yet been reported in the literature for cocoa.

It would be especially helpful if *in vitro* techniques were available to reduce the generation time for cocoa. Regeneration of a complete plant from a single cell would have major experimental advantages, including a very much shorter generation time and in due course would permit the introduction of genes from other cocoa plants or eventually from other species.

2. Control of Phytophthora Pod Rot and Canker

These pathogens are ubiquitous and so cause economic loss to a greater or lesser extent in all cocoa-producing countries, but most especially in those with prolonged periods of high relative humidity at, or near to, saturation levels. Until 1979, it was believed that all losses from Phytophthora spp. were due only to Phytophthora palmivora, but it was then shown that in fact four species of Phytophthora were involved. This group of pathogens, which causes cankers and attacks pods of all sizes, is harboured in the roots of cocoa during the dry season and is thus very hard to control. Traditionally, expensive copper based fungicides (or systemics) have been applied frequently (sometimes every 10 days) in areas of high infection. Without prophylaxis, the losses could reach 100 per cent in areas of continuous high humidity and high disease incidence, although the disease has a normal range of 5-90 per cent.

The SAP in Cameroon, which is being supported by the World Bank, has meant that the number of cocoa farms treated for Phytophthora pod rot in the country has been substantially reduced, because the abundant government subsidies which existed until 1990 are being eliminated in a step-wise fashion over a three year period. These government subsidies were on the price of the fungicides throughout the country, but in some administrative areas the farms were also sprayed (in theory as often as five times per annum) by a government agency (SODECAO) on behalf of the farmer. These fungicide treatments were applied with reasonable reliability and effectiveness by SODECAO and probably had the effect of keeping old and uneconomic cocoa farms in production long after they logically should have been abandoned or replanted by their owners. The subsidies on the fungicides probably had a rather similar, though less dramatic effect in the remaining areas of the country. Phytophthora pod rot thrives in conditions of high rainfall and humidity such as exist in many of the cocoa areas of Cameroon, where pod infections with this pathogen can reach 100 per cent on a routine basis when farms receive no copper fungicide treatments. This pathogen has, therefore, already rendered some areas of Cameroon uneconomic for the cultivation of cocoa despite the favourability of soil and the other climatic conditions in those locations. These recent dramatic changes in the cost of copper fungicide application to the farmer can be expected to substantially reduce the area of land in Cameroon under cocoa cultivation and the effect of this can already be seen in the figures for total cocoa production of Cameroon.

Over the years, considerable quantities of copper based fungicides have been applied in all cocoa growing areas and at substantial cost to farmers, but this has often not given economically effective control. The single application technique was

therefore proposed in Brazil. This uses cuprous oxide applied in one (or two) massive doses at the beginning of the season, with the copper being re-distributed through the canopy by rain during the season. This technique could be adopted widely in other cocoa areas when the disease epidemiology at a given location is well understood, but unfortunately the necessary fundamental research to confirm this has not always been completed.

Programmes of integrated pest management with precise fungicide application combined with field sanitation should be encouraged in all areas where Phytophthora causes significant losses on cocoa. Meaningful cost savings on the fungicides, spraying machines and labour for application might well be made with such techniques, but unfortunately they have not yet been well researched and therefore have been little utilised to date.

An interesting new technique has recently been proposed following experimental work in Trinidad (Sreenivasen *et al*, 1990) This technique involves tying a number of bands of absorbent material previously impregnated with copper fungicide around the trunk and the main branches of each cocoa tree. The technique uses only very small doses of the chemical and thus has very clear cost and environmental advantages over the traditional methods of control. The precise design of these so-called "collars" needs further refinement, but it is hoped that in due course it will be possible to make them from cheap locally available materials.

3. Control of Witches' Broom Disease

This pathogen causes the hypertrophic growth of buds to give the characteristic witches' brooms from which the name is derived, but it also causes pod infections which can lead to a very high percentage of pod loss. For instance, a seriously infected tree in certain parts of Ecuador can have as many as 4-500 brooms on it at any one time and would probably have no healthy pods. The presence of brooms greatly reduces the vegetative vigour of the trees and thus their yield potential. The disease is a factor which has limited cocoa production in a number of Latin American countries (Ecuador in the 1910s, Trinidad in the 1930s, Surinam and parts of Peru and Bolivia currently). Many of the recent plantings in the Brazilian Amazon are now seriously infected and a large number of farms have been virtually abandoned. In May 1989, the disease was discovered across a wide geographic area of the State of Bahia, the traditional cocoa growing region of Brazil. Two and a half years later, new infections are still being identified as a Comissao Executiva de Plano da Lavoura de Cacau (CEPLAC) (the government run research and extension agency) sponsored survey of all cocoa farms continues. It is now becoming clear that the disease had already been present in Bahia for some years before its chance discovery. The latest estimate suggests that so far some 2 per cent of the cocoa trees in Bahia are infected, but that until now pod infections remain at an insignificant level. The spread seems likely to continue until, in a few years, all the trees in Bahia are infected. We do not yet know whether pod infection will cause significant loss of pods (and thus a direct loss of yield) in Bahia. In some parts of the Amazon Basin of Brazil, pod infections with witches broom as high as 85 per cent have been recorded.

Recent work, as part of a major international research project, has shown that removal of brooms by sanitation pruning provided a useful measure of control in some areas (such as the Brazilian Amazon), but it was unlikely to be successful in areas with very high broom numbers, such as the central coastal region of Ecuador. Falling cocoa prices and rising costs of labour have adversely affected the economics of witches' broom control in all producing areas, so that now very little pruning is actually done, even in the Brazilian Amazon where potential yields are quite high.

Though significant activity in controlling witches' broom on shoots or pods with some chemicals has been shown, the high costs and rapid loss of activity means that there are as yet no products which give an economic method of control. There is no doubt that the only long-term sustainable solution will be the use of tolerant or resistant planting material. However, it seems unlikely that durable resistance will be found quickly, because at the moment, there is no really reliable screening method to identify resistance to the pathogen.

4. Control of Cocoa Swollen Shoot Virus

Cocoa swollen shoot virus (CSSV) is caused by a mealy bug-transmitted virus that occurs in all the main cocoa-growing areas of West Africa. Swollen shoot disease has caused very serious losses in Ghana, where infection is now more prevalent than ever before, despite enormous expenditure for more than 40 years on control programmes. A number of strains of the virus have been identified with a range of virulence. The most virulent forms are present in Ghana, while those in Côte d'Ivoire and Nigeria can be almost ignored. The only recommended method of control is the removal and burning of any diseased trees and their contacts.

CSSV does not spread quickly or far and it is therefore amenable to control by tree eradication, but, for success, such a programme would have to be both thorough and timely. Eradication has been the principal means of control adopted in Ghana since 1936, but in that time serious problems have been encountered, due in part to the expense and difficulty of operating routine survey and treatment operations with the required efficiency on such a massive scale. There have also been major disruptions and discontinuities due initially to opposition from farmers to the removal of infected trees and later, between 1962 and 1965, to a withdrawal of official support. An additional limitation of the approach adopted until recently has been that only trees with symptoms have been removed, together with a relatively small proportion of symptomless 'contact' trees, while other trees located at a slightly greater distance from the infected tree which may potentially be infected are left in place.

Once again, the only long-term solution will be the planting of resistant planting material, but efforts towards breeding such material have only had limited success. The development of suitable biochemical techniques to identify resistance would be of considerable value, but as yet the substantial amount of work already completed has not given encouraging results. A suitable diagnostic system for use in the field to decide whether an individual tree is infected or not would be most helpful.

As part of the Structural Adjustment Programme in Ghana supported by the World Bank, the Ghana Cocoa Board (GCB) has recently been restructured. During

this, the number of GCB staff was dramatically reduced and all their activities reviewed. This included allocation of greater operational resources to the extension services as well as positive steps to re-organise their methods of working, with the expectation that this would deliver better extension advice to the farmer and would improve the control of CSSV by a more effective programme of cutting-out cocoa trees infected with CSSV. The large number of current infections indicate that, despite this support, the programme has yet not achieved an improvement.

5. Control of Vascular Streak Dieback

Vascular Streak Dieback (VSD) caused by the fungal pathogen Oncobasidium theobromae was first reported in Malaysia and Papua New Guinea (PNG) in the mid 1960s, but the causal organism was only demonstrated in 1971. It has since become the most destructive cocoa disease in Malaysia and is spreading widely in Indonesia. Unfortunately no fungicide is effective on a commercial scale.

In Papua New Guinea (PNG) VSD is now no longer such a serious threat to mature trees, as new plantings have a degree of resistance. The cocoa population in PNG is very heterogeneous and from the earliest stages of the epidemic, a number of resistant genotypes were identified and these appear to have durable resistance. The presence of further variation in field resistance amongst these hybrid progeny gives encouragement to the continuation of the selection programme. Similarly, breeding programmes in Malaysia have produced material with a high degree of resistance, and this is now being widely planted.

The presence of VSD was first reported from Indonesia in 1982, but during surveys conducted between 1984 and 1986 it was found to be widespread, thus indicating that it had been present for some considerable time. Some of the material now being planted in Indonesia is probably quite susceptible to VSD. For instance, many smallholders in Sulawesi, Indonesia are planting Amelonado material which is known to be highly susceptible to VSD. This is clearly a major risk to the future success of these substantial areas of new plantings. Furthermore, there is the possibility that there are different races of the pathogen in Indonesia, Malaysia and PNG, which would require separate breeding programmes. It is possible that an, as yet unidentified, indigenous alternate host for the pathogen exists in Indonesia and this needs further study.

The research work on VSD in PNG has been carried out at the Cocoa and Coconut Research Institute (CCRI), which is at least partially funded by the private sector through a cess on all exports of cocoa, with the balance of funds coming from the Government of PNG and various aid programmes. Most of the progress on the breeding of planting material resistant to VSD in Malaysia has been achieved at private sector research stations owned by the major plantation companies. These stations provide planting material of cocoa (as well as rubber and oil-palm) for their owners to establish new plantings, but also for sale to third parties. In Indonesia, a similar situation to that in Malaysia exists except considerable research into new varieties is also carried out on some of the many government-owned plantations, and they also regularly sell planting material to third parties.

6. Control of Capsids

A number of species of sap sucking bugs, capsids (or mirids) cause substantial devastation to cocoa farms in all growing areas, but most especially in West Africa. There the species involved feed on stem tissues rather than on pods, as is seen elsewhere. In West Africa, if allowed to get out of hand, these insects can completely defoliate large areas of cocoa thereby encouraging very lush growth of competitive weeds as the soil is suddenly exposed to full sunlight. Heavy attacks like this are likely to totally stop the production of pods and can sometimes kill the cocoa trees. This group of insects have been an economic pest to cocoa in West Africa for almost 70 years. The successful control campaign with insecticides in Ghana led to a sudden surge in production from 1958/59 and 1960/61. Insecticide control also remains necessary on a regular basis in Cameroon, Côte d'Ivoire, Ghana, Nigeria and Togo.

In Ghana, an agrochemical with fumigant action and low human toxicity which leaves no residue in the cocoa beans, or in the soil, is applied in August, September, October and November by means of a mistblower. This should give effective control, but the mistblower is a large, heavy, expensive and highly complex piece of machinery which is hardly suited to a small farmer with limited capital. Breakdowns are frequent and so the applications are not always made at the correct time or at the correct dosage. Similar insecticides are used elsewhere in West Africa, but resistance to the most widely used ones has been noted on a number of occasions in most of the important growing areas and it is believed that this has come about because the farmers have been applying the chemicals incorrectly. There is thus an urgent need for alternative and more appropriate technology which should ideally be based on the concept of Integrated Pest Management (IPM). Unfortunately, there is currently no research in progress directed to that goal. The chemical companies perceive capsid control on cocoa in West Africa as only a small potential market and are therefore unwilling to allocate their scarce research resources to develop a novel insecticide to solve the problem.

It seems highly unlikely that it would be possible to breed capsid resistant planting material. The most useful procedures will be to ensure the canopy of a cocoa farm is kept complete and that nests of predatory ants are protected. These recommendations have existed for a number of years, but have not been promoted by the extension services in the areas affected. It will become increasingly unacceptable to use regular, large doses of pesticides in this way and so alternatives must be found.

World Bank financing in support of the SAP in Ghana has provided funding for research and has reorganised the extension services, which in turn have increased the advice on, and availability of, the traditional pesticides to control capsids, albeit at higher cost due to the removal of the subsidies. However, CRIG has not yet started research to produce an alternative system based on the concept of Integrated Pest Management to reduce the need for pesticides. It is to be hoped that adequate funds could now be allocated to this.

The SAPs in Ghana, Nigeria and Cameroon have all resulted in liberalising input prices, including those for capsid pesticides. Consequently, spraying for capsid has recently declined and the pest attacks have multiplied. Furthermore, because cocoa is grown by smallholders in West Africa, most individual farmers cannot afford the knapsack sprayers required to apply the pesticide. Where SAPs have meant cutbacks on extension efforts, notably Nigeria and Cameroon, insufficient (Nigeria) or inappropriate (Cameroon) effort has been devoted to developing informal cooperative arrangements for hiring or purchasing these sprayers on a cost-sharing basis. More seriously, it has now resulted in the neglect of the more practical and environmentally sound advice that farmers protect the canopy of their cocoa farms and the nests of predatory ants in order to avert capsid attacks. It would be very helpful if financial and organisational support could be provided to encourage the formation of these informal farmers' groups which could own a spraying machine for loan to members. It may well be that a formal co-operative structure (either imposed or officially encouraged by governments) would not be the best way to achieve such co-operation, informal farmers' groups may well produce better results as so many cocoa farmers have had such unsatisfactory experiences with co-operatives.

7. Control of Cocoa Pod Borers

The cocoa pod borer (also known as the cocoa moth) has become the most significant insect pest of cocoa in many parts of South East Asia over the past 15 years, though it has been an important limiting factor in cocoa production in Indonesia and the Philippines throughout this century. There was some intense research on control prior to the First World War by Dutch entomologists and planters in Java, but this declined in the 1920s along with the Java cocoa industry. Interest in the cocoa pod borer increased again in the late 1970s due to the revival of interest in cocoa in the region. The moth appeared in Sabah, East Malaysia in 1980, but its more recent discovery in Melaka, West Malaysia in 1986 has now made cocoa pod borer control a major concern to cocoa growers in the region. This pest causes losses by boring into the placental tissues of the pod, thereby disrupting the development of the beans. Moths lay their eggs on the surface of unripe pods, larvae emerge and tunnel to the centre of the pod where they feed for about 14-18 days before chewing their way out of the pod to pupate. This feeding damage results in pods that may ripen prematurely, with small, flat beans often stuck together in a mass of dried mucilage. The beans from seriously infested pods are completely unusable, and in heavy attacks over half the potential crop can be lost.

Cocoa growers can choose from a range of potential pod borer control measures, any of which can be used in combination for even greater effect. To get good results from insecticide spraying, growers need to get a high rate of kill over more than one generation of moths, without excessive cost or undesirable secondary effects. This requires an appropriate choice of chemical, correct timing and good targeting. The larvae and pupae are protected within the pod or beneath a waterproof membrane, and are difficult to kill even with systemic and vapour acting insecticides. Eggs would require a direct hit by a spray droplet. Adult moths do not feed, and so only contact insecticides aimed at that stage in the life cycle would be effective. A new method of control involves spraying only the daytime resting sites of the moths on the underside of relatively horizontal, lower canopy branches. Also, because many

caterpillars emerge from ripe pods both before and after harvest, while relatively few emerge from unripe pods, frequent harvesting of newly ripened pods, with rapid breaking, and subsequent eradication of husks by bagging, burying, drying and destruction will reduce the emergence of caterpillars in the field.

Apart from reducing the survival of pod borers, frequent harvesting and husk destruction increases the proportion of the crop that is collected, reduces Phytophthora pod rot in the field and leaves fewer ripe pods to be damaged by rodents. Natural enemies contribute greatly to mortality of pod borers, and a number of attempts have been made over the years to increase their number by rearing them or introducing exotic parasites and predators. Entomologists have been looking for mechanisms of resistance to cocoa pod borer attack since the pest was identified in the 1900s, but so far with little success.

If it is allowed to spread unchecked or if no effective economic control method is devised, there is a risk that this pest could render large areas of Malaysia and additional areas of Indonesia uneconomic for cocoa cultivation. The potential economic damage which can be caused by this pest should not be underestimated. Because the governments of Malaysia and Indonesia have never been directly involved in the cocoa sector, they have not undertaken any specific measures to encourage farmers to eradicate this pest. While the newly established cocoa board in Malaysia may address this problem, it is not obvious that the public sector will intervene in the problem. Rather, it will be up to estates and smallholders to undertake preventative measures.

8. Cocoa Fermentation, Drying and Quality Control

There have been no recent changes to the recommendations for correct fermentation which should be practised by small farmers everywhere, which will produce cocoa of the good flavour sought after by chocolate manufacturers and for which they often pay higher prices. While processors of beans into intermediate cocoa products (cocoa butter/cake) tend not to be very conscious of flavour quality, those who process beans into liquor or who manufacture chocolate are highly flavour conscious, and hence will pay more for well fermented cocoa. The usual buyers of beans of irregular or unpleasant flavour are those companies who press beans to extract butter/cake. They buy the majority of cocoa from Malaysia/Indonesia (with the characteristic acidic off-flavours), the variable cocoa produced in substantial quantity in Côte d'Ivoire, or the very poor quality cocoa produced under the newly privatised cocoa marketing system in Nigeria. This privatisation and the elimination of the Nigerian Cocoa Board was as a direct result of structural adjustment.

There seems little immediate prospect of improved quality or even increased consistency in flavour quality from the newly privatised cocoa marketing system in Nigeria or from the existing marketing system in Côte d'Ivoire because they lack the necessary infrastructure for quality control. There is a danger that careless privatisation of the marketing system in Ghana will destroy that country's reputation for quality, which attracts a significant premium (currently averaging from £30-75 per tonne) for Ghana cocoa over the world price because it could result in the eradication of the careful network of quality checks which exist from farmgate to port, as

happened in Nigeria to the great detriment of its cocoa quality and reputation. The pressure to "privatise" the Ghana cocoa marketing system arises from the World Bank/IMF backed Structural Adjustment Programme currently in progress in Ghana.

Recent work in Malaysia has shown that it is perfectly possible to produce cocoa beans of West African flavour from Malaysian/Indonesian plantations and/or smallholders, provided a number of specific recommendations are all systematically and carefully adopted. In order to produce cocoa of good flavour on large automated plantations in Malaysia and Indonesia it is necessary to:

(i) harvest only ripe pods;

(ii) store pods for a few (9-12) days after harvest;

(iii) ferment in shallow boxes for 5 days at a maximum depth of 40cm;

(iv) turn beans only once during fermentation after 48 hours;

(v) dry slowly with ambient air down to 20 per cent moisture followed by air at an absolute maximum temperature of 60 degrees C to reduce the moisture content of the bean to 8 per cent.

Work is now in progress on a number of plantations to design industrial systems to permit the cost effective implementation of these proposals on a routine basis. This is likely to result in increasing availability of Malaysian and Indonesian cocoa beans with flavours appropriate to the manufacture of chocolate rather than, as at present, beans suitable solely for the production of cocoa butter.

The smallholders in Malaysia and Indonesia are almost always in a position to adopt the procedures which currently produce good flavour on the West African smallholdings (i.e., heap fermentations covered with banana leaves followed by sun-drying for about 10 days to about 8 per cent moisture content). These procedures are, however, not usually adopted by them. This is either because the extension services have not explained the techniques to these growers, many of whom have only just started to plant cocoa, or because the existing marketing structures do not discriminate between well-prepared cocoa beans of good flavour quality and beans poorly prepared. The latter would include mouldy beans or beans contaminated by smoke, or other off-flavours which originate from careless fermentation and drying. The inadequacy of the extension services for smallholders in Malaysia and Indonesia are at least partly to blame for this situation.

Prior to the elimination of NCB and the privatisation of cocoa marketing, Nigerian cocoa had a very good reputation for quality. This meant that under the regime of NCB, the world market price for Nigerian cocoa was on a par to that achieved by Ghanaian cocoa. Unfortunately, with privatisation there were no provisions were put in place to maintain the reliable quality control services which had until then been provided by NCB, and so the quality reputation of Nigerian cocoa was destroyed in a matter of days from the implementation of the privatisation. Until then nearly all

the cocoa from Nigeria had been used for chocolate manufacture rather than for fat extraction. All Nigerian cocoa is now used for the production of cocoa butter.

Implications of these Technological Developments on Cocoa Production

1. Planting Material

There are a number of technological influences on cocoa output, of which the most important is the quality of the planting material. It has been suggested earlier that a major effort is required to produce cocoa planting material of high yield, good bean quality and with pest and disease resistance. Unfortunately, the planting of so-called "hybrid seeds" in many cocoa-producing countries has not been successful. For example, under experimental conditions, yields of this hybrid material in Ghana could be 2,000 kilos/hectare, but on a smallholder's cocoa farm they might only achieve 600 kilos/hectare under good conditions, with a country-wide average yield of some 100 kilos/hectare lower. Specific difficulties which have been encountered in Costa Rica and in Brazil were mentioned earlier.

2. Pest and Disease Control

A substantial number of important pests and diseases have been mentioned already and these might well cause a total reduction of over 30 per cent below the potential of world cocoa production in a year of average losses. The control of these pests and diseases is nearly always a major cost factor for cocoa growers — for small-holders and plantations alike. The usual method of control is pesticide application, which gives a slight risk of residues on, or in, the cocoa beans. As food regulations become increasingly stringent, there must inevitably be reductions in the amount of pesticides applied to cocoa. Resistance breeding programmes to reduce the quantity of fungicides required should therefore receive the fullest possible support in every location where major losses arise due to a cocoa disease. Furthermore, additional research is also needed in all cocoa-producing areas into methods of integrated pest management (IPM) to reduce the amount of pesticides (both insecticides and fungicides) used while still achieving the same degree of control. Hopefully, this will also reduce the costs of pest and disease control on cocoa.

3. Fertiliser Application

In West Africa, it is very rare for farmers to apply fertilisers, except on some of the young hybrid plantings in Côte d'Ivoire where all the jungle shade has been removed (on the apparently ill-advised recommendation of SATMACI). The growing of cocoa in this way is likely to increase the risk of capsid attack, shorten the economic life of the cocoa farm and may cause desertification, though neither of the last two effects have yet been proven. Furthermore, when the farmer's price was halved recently, there was reportedly a dramatic reduction in the amount of fertiliser being applied, which will have shortened the economic life of the cocoa farms in the areas of marginal soils or climate. Given low rates of fertiliser application in West Africa, the removal of jungle canopy is seen as inappropriate.

Considerable tonnages of fertiliser were applied to cocoa in Brazil during the period 1970-1984 when cocoa prices were very high. As the prices went down, farmers stopped applying fertiliser and disease control was also abandoned in all but the highest yielding fields. As the cocoa price in Brazil is about 70 per cent of the world market price, the "low" prices since 1983 have given serious problems to many cocoa farmers, especially those who borrowed substantial sums of money to replant their farms with the new "superior hybrid seeds" provided free of charge by CEPLAC. Many of these seeds have performed very poorly.

In Malaysia and Indonesia, the smallholders and plantations receive a price which is about 80 per cent of the world market price at the farm-gate. Now the higher cost producers in Malaysia are removing any cocoa fields with yields less than 1,500 kilos/hectare, as it is uneconomic to continue. It is likely that the land will be replanted with oil palm or rubber in place of the cocoa. Most of the growers in Indonesia are in a better competitive position because labour rates, fertiliser costs and pesticide costs are all lower and the soil is more fertile, and has been planted with the latest planting material, which has higher potential yields.

4. Labour Requirements

Cocoa is an excellent crop for smallholder cultivation, because it is labour intensive and many smallholders have adequate family labour readily available. It is estimated that the labour requirements are 25.7-96.0 man-days per ha for cocoa, in contrast to the requirements for rubber at 120 man-days, oil palm at 43.7, robusta coffee at 93.7 and tea at 400.0 man-days per hectare (Lass, 1985). While the labour requirements for rubber and for tea are often higher than those for cocoa, it must be remembered that these crops demand that a processing factory should be sited nearby, as the raw product must move into secondary processing quickly. Even the smallest cocoa farmer can prepare cocoa for sale in a convenient form with no equipment at all.

It is rare that labour is the limiting factor for cocoa small-holders except in some of the more rural areas of Côte d'Ivoire, where the farmers have to depend on migrant labourers both from the Sahel zone. On the other hand, in Malaysia the availability of labour prepared to work on any plantation whether it be cocoa, rubber or oil palm, and the cost of labour are becoming major constraints. A number of plantations situated close to towns believe that it will be impossible to obtain adequate labour by the end of this decade. They are attempting to mechanise the cultivation of all crops as much as possible, but so far it has been difficult to significantly reduce the labour requirements for cocoa, though good progress has been made with rubber and oil palm. Abundant labour is potentially available to cocoa growers in Brazil, but due to the low world prices farmers currently cannot afford to pay for anything other than minimal labour needs to keep their farms on a care and maintenance basis.

5. Other Inputs

In addition to all the items mentioned above a smallholder needs a cutlass, a long handled pruner and some bamboo drying mats. In some countries though, due to economic difficulties even these simple requirements have occasionally been in

short supply. For instance, prior to 1982/83, farmers in Ghana could not acquire any of the necessary inputs required to run a cocoa farm, including a cutlass. In 1982/83, at a very early stage in the Economic Recovery Programme in Ghana, a series of substantial devaluations made these minor, but necessary items easily available once more in adequate quantities through normal commercial channels. This was therefore an early beneficial effect of structural adjustment for the Ghana cocoa farmer.

While these simple implements have always been available in Nigeria, and are still currently available in Cameroon and Côte d'Ivoire, price liberalisation has often meant that farmers have had to pay a higher price for some inputs. While this has been offset by a higher producer price in Nigeria, lower producer prices in Cameroon and Côte d'Ivoire make inputs less affordable.

6. Quality Considerations

The price difference between a tonne of good quality cocoa, such as Good Fermented, Ghana, and poor quality, such as smallholder cocoa from Sulawesi, Indonesia, is currently between £100 and £150 per tonne after adjustment to the same price basis for fat content, shipping, insurance etc. The uses for these cocoas by industry are different, but nevertheless the opportunity for the Indonesian smallholder to achieve the quality of the Ghana smallholder exists. The planting material is the same, or very similar. In reality, it is the post-harvest treatment of the wet beans which defines the flavour quality of the final product. The Ghana farmer takes great care to produce well-fermented and thoroughly dried cocoa beans, and does not allow poor quality cocoa or foreign matter in the bags. On the other hand, the Indonesian smallholder does not ferment his cocoa at all and attempts to sell it to the first buyer who passes, resulting in very high moisture contents. This produces cocoa of unacceptable flavour for chocolate manufacture (being both mouldy and unfermented) and so it can only be used for processing into intermediate products such as cocoa butter, powder and cake.

Both Ghana and Nigeria have historically been known for their well fermented quality beans. This has been the result of a long tradition of farmers fermenting and drying their beans according to methods developed and promoted by domestic research institutions, extension services and UK chocolate manufacturers. The marketing boards of both countries also helped ensure the quality and uniformity of cocoa shipments.

With the disbandment of the Nigerian Cocoa Board (NCB) under the SAP, quality control was lost and, despite farmers' continued ability to achieve high quality output, shipments were very variable, ranging from unfermented beans to the well fermented grade. While this is discussed at greater length in Part III, it is appropriate to note here that quality is a function first of farmers' preparation, and second of an infrastructure to monitor and evaluate the quality and consistency of cocoa shipments.

Recent Developments in Cocoa Extension and Research

1. Background on Research

Substantial sums, mostly from Governments, have been allocated to cocoa research in recent decades in all the countries in this study, and much useful basic data have been gathered and published. However, the success of the various government funded extension services in translating the research results into practical

advice for farmers and then getting that advice adopted by farmers has been limited. A rewarding farm-gate price which makes cocoa cultivation a profitable business has almost always been a far more successful extension tool than has been the work of the extension services themselves. Cocoa cultivation expanded spontaneously in Ghana from negligible tonnages in 1900 to some 230,000 tonnes in 1930, in Nigeria from 20,000 tonnes in 1920 to 140,000 tonnes in 1940, in Malaysia from zero in the late 1950s to some 250,000 tonnes in 1990 and in Indonesia from insignificant levels to the 1990/91 output of nearly 150,000 tonnes. All of this happened with minimal extension effort. On the other hand, the efforts of SATMACI (the Government and World Bank funded extension service) in Côte d'Ivoire, combined with a planting premium and a rewarding price, increased cocoa production from 180,000 tonnes in 1970/71 to the current level of over 750,000 tonnes. In this case, the extension service was implementing a key government policy, but most definitely did play a significant part in the increase in cocoa production. A key role was also played by the extension services in the increase in Brazilian cocoa production from 140,000 tonnes in the mid-1960s to 325,000 tonnes in the early 1980s, though again they were implementing a key policy of the Government of Brazil under a programme known as Procacau.

A comprehensive review of the needs of cocoa research was prepared by a number of subject matter specialists in 1985 and was published by the World Bank (Wood and Lass, 1985). This indicated that a considerable amount of knowledge already existed, but the very substantial losses of potential cocoa production evidenced in a number of countries would continue until there was more effective practical control of a wide range of pest and diseases. It also pointed out that there was a considerable need for effective extension services. In the intervening years these problems have moved no nearer to a solution. The importance of cocoa production in Malaysia and Indonesia has increased, but with little government funded research or extension other than that done through the various land settlement schemes sponsored by both governments. Witches' broom disease has spread to the traditional cocoa growing areas of Bahia in Brazil. A new species of Phytophthora has been identified in the drier cocoa areas of Ghana. The cocoa pod borer has now spread to Peninsular Malaysia and Vascular Streak Dieback is advancing through the islands of Indonesia. More trees than ever before are awaiting cutting from CSSV infections in Ghana. These developments are hardly encouraging ones and, combined with the insufficient R & D expenditure on cocoa genetics, can have only further worsened the competitiveness of cocoa cultivation as a crop, in comparison to other tropical crops which could be planted in the areas concerned.

Research on the cocoa tree, its genetics, its pests and diseases and its preparation for the market has lagged behind research on crops such as oil palm, rubber and tea, partly because cocoa has not,until recently, had plantation interests pressing for the results of research or, in many cases, carrying out the research themselves. Progress on cocoa research has also been slow because of the nature of some of the problems involved, as well as the socio-economic structures of many of the cocoa-producing countries, where on average farmers have holdings of 1 hectare or less. Research on cocoa has been, and still is, largely financed by the governments of cocoa-producing countries and the government research bodies of some ex-colonial administrations, along with a little support from consumers (i.e. chocolate manufacturers and cocoa bean processors). Increasingly though, the larger

plantation companies in South East Asia are seriously investigating novel cultivation techniques and mechanisation, and are actively breeding new varieties for their own cocoa plantings as well as for sale to other plantations, or occasionally to the more prosperous small-holders.

In the biotechnology field, there is also little doubt that cocoa is well behind the majority of the other so-called plantation crops. The main problem has been that an efficient tissue culture system has not yet been developed for cocoa. Despite a substantial volume of work carried out at a large number of centres, it has so far proved impossible to regularly regenerate plantlets from callus cells, whatever the initial plant organ utilised and whatever the conditions to which the callus has been subjected. Without a reproducible system to do this, the single cells cannot be regenerated into plants and thus new genetic information can not yet be inserted into single plant cells of cocoa.

2. Background on Cocoa Extension

In common with the situation for many other tropical crops, there is a substantial body of research knowledge and information resulting from the work of the many cocoa research institutions in recent decades. This has not always been 'converted' into practical recommendations for the farmers. Some observers would propose therefore that further research is unnecessary, and that productivity advances in the immediate future could come entirely from the preparation of media material to promote recommendations for farmers based on the results of past research which would be actively promoted by revitalised extension services. While it is possible to have a certain sympathy with that view, this position is somewhat limited. There is no doubt of the need for revitalised extension services (for cocoa as well as for other crops) in a number of cocoa-producing countries, including some of those in this study. However, this would require considerable resources allocated across a number of countries on a long-term basis, which are hardly likely to be available at the current level of cocoa prices.

In the foreseeable future, it seems that the diffusion of traditional techniques by revitalised extension services would be insufficient to achieve the meaningful advances in productivity that are necessary for cocoa to increase its competitiveness relative to other crops which might be planted on the same land. The future availability of new high yielding and disease resistant planting material (produced with or without biotechnology) would have a much greater impact on cocoa productivity. If such planting material was to be available, it seems highly likely that 'spontaneous' plantings would once again be made by farmers, as cocoa growing would once more be seen to be a good, and profitable, business.

III. THE PUBLIC/PRIVATE BALANCE IN THE DEVELOPMENT AND DIFFUSION OF TECHNOLOGY IN COCOA-PRODUCING COUNTRIES

After briefly touching on the first research efforts and developments, this chapter analyses the evolution in publicly versus privately funded research in the cocoa sector. It examines how this balance has been affected by structural adjustment measures in the different case study countries.

Earliest Research

An early attempt to develop hybrids was undertaken in Central Java on a private plantation, when in 1888, two cocoa plants from Caracas, Venezuela, (undoubtedly of fine and flavour cocoa) were received and planted at the Djati Roenggo estate. One was killed by termites, but the other flourished and started to produce pods in 1892. For the next 30 years many of its seedlings were planted throughout Java with great success. Likewise, in the 1920s the United Fruit Company started a substantial programme to select local high yielding trees in Costa Rica. This was done in order to diversify away from bananas which had become seriously infected with Panama disease. The programme continued for almost 20 years and some of these selections are still valued.

As mentioned already the first cocoa research station was started in 1901 in Central Java, Indonesia (then under Colonial Administration) with one member of staff and was funded by the private Dutch estate owners in that locality. It worked specifically on two pests (Cocoa Pod Borer and Helopeltis), both of which remain major threats to cocoa in Indonesia (and now also in Malaysia). They jointly agreed to fund it with contributions based on their area planted to cocoa. The research provided a considerable volume of basic information on the pest, but did not provide any economic methods of control. In 1910, the estate owners stopped planting cocoa, research funds became inadequate and so the cocoa researchers were transferred to work on other crops. At that time the cultivation of Hevea rubber and Robusta coffee had become much more profitable than cocoa.

Cocoa had been an extremely profitable crop in Java in the 1880s and so it was natural that these concerned estate owners should finally have co-operated in this way. For the growers in Indonesia and Malaysia, now afflicted with the same pests, it is unfortunate that the research on these pests did not continue after 1920. It is quite possible that if the work at that time had been funded and continued by the Colonial Administration it might have produced an economic control method and the current dramatic increase in Indonesian cocoa production might have taken place much sooner.

In 1925, another experimental station was created by another and larger group of estate owners in Java, but this was to work on a wider range of tree crops (cocoa, coffee, tea and rubber). These stations were taken over by the Colonial Administration in 1933 to avoid bankruptcy.

Public Sector Research and Extension

Since that time nearly all the world's cocoa research has been carried out at the research institutes in cocoa-producing countries under programmes funded by the Governments of the respective countries (either initially by the Colonial Administration or subsequently through the national budgets). The investment has been substantial, but unfortunately the research results have not always reflected the magnitude of that investment.

In Ghana (then called the Gold Coast) cocoa research was initiated in 1938 at Tafo. In 1944 this station became the centre for cocoa research in West Africa (and was named the West African Cocoa Research Institute) with a sub-station at Ibadan in Nigeria. After independence in Ghana and Nigeria, WACRI gave rise to the Cocoa Research Institutes of Ghana and of Nigeria (CRIG and CRIN) respectively in 1964. The funding of CRIG was taken over by GCMB, the Government controlled Cocoa Marketing Board at that time.

The discovery of swollen shoot virus was the catalyst to start cocoa research and so work at Tafo was initially directed to identification and control of Cocoa Swollen Shoot Virus (CSSV). After having been first noted in 1920, or perhaps earlier, CSSV was identified as a complex of viruses in 1938. The only control proposed then, and now, is the removal and burning of diseased trees.

In Nigeria, cocoa research continued on the WACRI experimental sub-station with the establishment of CRIN in 1971, and the headquarters were relocated to a new site outside Ibadan. This work was initially funded by the Nigerian Cocoa Board on a similar basis to the GCMB financing of CRIG, but was transferred to the Ministry of Agriculture in the 1970s. CRIN has six sub-stations in other ecological zones.

In Côte d'Ivoire and Cameroon (and other ex-French Colonies) cocoa research was started after a decision taken in 1957 by the colonial government that the 'Institute Francais du Cafe, du Cacao et des Autres Plantes Stimulantes' (or IFCC) should be established. The objective of this new institution (with headquarters in Metropolitan France and funding from the French treasury), was "to provide adequate technical means as regards plant material, growing techniques, disease control, pest control and crop processing techniques to make produce (from the French colonies) more competitive with produce from elsewhere". From the start, two overseas research centres were established — at Bingerville in Côte d'Ivoire in 1959 on cocoa (with two substations) and in Madagascar on coffee. The name was changed from IFCC to IRCC (Institute de Recherches du Cafe et du Cacao) in the mid-1980s. Since its inception, the majority of the funds have originated from the French Government, though the governments of the countries in which it is operating have also contributed to the local operating costs and local staff payments. The IRCC effort on cocoa research was extended to Cameroon in 1964 and stations were established at Nkolbisson near Yaounde and at Nkomvoene where the field trials are conducted. In 1975, the Cameroon government took over all aspects of cocoa (and coffee) research,

though staff of IRCC have subsequently been seconded to work for the new Cameroonian body called Institute Recherches Agronomiques Tropicales (or IRAT). Work in Cameroon has centred on management systems to control Phytophthora pod rot and canker.

In Brazil , as already mentioned, research into cocoa started early at Urucuca and Jucari stations in the cocoa zone of the State of Bahia in 1923 and continued until 1957 when the 'Comissao Executiva de Plano de Lavoura de Cacau' (CEPLAC) was created. This new body took over the existing stations and in 1963 established a significant research Institution (CEPEC or 'Centro de Pesquisas de Cacau'). A large complex of laboratories and experimental plots were started, all funded from a 10 per cent retention tax on the cocoa export price. Studies were started on all aspects of the agronomy and economics of cocoa. In the early years, the effect of CEPEC was seen in the quality of the scientific publications and the rapidly increasing quantities of fertilizer and pesticides used by small and large growers in the cocoa zone, together with the substantial areas of new plantings made with CEPLAC provided planting materials.

Private Sector Research

1. Malaysia and Indonesia

In Malaysia many of the commercial plantation companies have well established research stations of their own which supplement efforts by the Malaysian Agricultural Research and Development Institution (MARDI). As cocoa cultivation by these plantation groups [such as CDC, Dunlop, Golden Hope (ex Harrison and Crossfield), Guthrie, Sime Darby, United Plantations etc] increased, so did their research efforts. Much basic agronomic research was (and still is) carried out to solve particular problems perceived to be of the greatest importance to the various companies. Most of the results of this privately funded research have been published in scientific journals, or in the reports of their research departments which have a somewhat restricted circulation. The results are also often passed on by word of mouth, sometimes very rapidly. However, a part of the work of these research departments has been on planting material. Information on the parent material and subsequent successful crosses involved has normally been kept confidential, as many companies are suppliers of cocoa planting material on a commercial basis once their own requirements have been satisfied. It has, however, proved to be difficult to keep such information totally confidential.

The arrangements for privately funded cocoa research in Indonesia have already been mentioned in Part II.

2. BCCCA and ACRI

The UK and US Trade Associations for the chocolate and confectionery industry (BCCCA and ARCI respectively) have created funds to support cocoa research projects carried out in both cocoa consuming and cocoa-producing countries. Their objective is to improve the long-term competitiveness of cocoa cultivation versus other tropical crops. Their members make a contribution to this fund based on their

annual usage of cocoa beans and cocoa products and the projects concentrate particularly on giving training to scientists from cocoa-producing countries. These scientists pursue higher degrees, with their thesis research concentrating on cocoa (in particular pests and diseases or genetic resources); they are often carried out partly at their local cocoa research institution and partly at a relevant University in Europe or North America. None of this research is considered confidential to the Trade Association and the publication of the results in refereed scientific journals is a condition of the grant from these research funds. A large number of projects have been completed in the last 30 years since these funds were created.

BCCCA has also taken a particular interest in the work on conservation and characterisation of cocoa genetic resources in Trinidad and have been long-term donors to this work. A major part of the other research projects funded by BCCCA has also been related to genetic resources.

ACRI have recently created a substantial research institution at Pennsylvania State University which is working on various aspects of the biotechnology of the cocoa plant including micro-propagation, tissue culture, isozymes, and gene mapping. This work is being carried out by a large team of post-graduate students.

Private Sector Extension Projects

From 1982 to 1986, BCCCA (in association with many other major chocolate manufacturers and cocoa processors) were involved in an extension project with SATMACI and the Government of Côte d'Ivoire based in the town of Gagnoa in the West of the country. The greatest quality problems of cocoa from Côte d'Ivoire are its variability and the problem of mixing beans of good and bad quality with just enough good beans to meet the required quality standard by a very small margin.Therefore this project was exploring the necessary arrangements in the field to enable buyers to deliver consistently high quality cocoa to external buyers. Not surprisingly, the project found that large quantities of good quality cocoa were obtainable if care was exercised by both the buyer and the farmer. The result was shown to be equivalent to the best available quality elsewhere in West Africa, but required much more attention to quality by the internal buyers than was normal. However, the project was suspended in 1986 as the cocoa price on the world market started to decline.

Naturally individual cocoa bean processors and chocolate manufacturers have their own confidential research and development programmes, but these rarely extend back to the cultivation of cocoa. Research work at the farm level is considered to be "pre-competitive research" and thus tends to be funded by Trade Associations. Nevertheless some companies have become involved in cocoa growing (Cadbury: 1956 — 1970 in Cameroon; 1960-1969 in Sabah; Hershey 1980-mid 1991 in Belize; various companies in Malaysia: 1960-1972) and have created demonstration estates to encourage improved methods of cocoa cultivation. Others (Hershey in Ghana; M & M/Mars in Brazil and Ghana; World's Finest Chocolate in St. Lucia) have established such operations to assist them with their cocoa sourcing requirements. None of these operations are extensive and do not impact on the world cocoa production statistics.

Collaboration Between Public and Private Sectors

1. International Cocoa Research Projects

There have been a number of substantial cocoa research projects on major problems of international significance (such as capsids, Phytophthora and now witches' broom disease). These projects have been funded by the cocoa processing industries and the chocolate manufacturers in the consuming countries through their international trade associations, known as IOCCSC, or the International Office of Cocoa, Chocolate and Sugar Confectionery. The fieldwork has been carried out at the national cocoa research institutes, and the institutes, or their Governments, have made a substantial contribution by provision of facilities, laboratories and experimental plots. It has always been a condition of funding that the project results should be published in refereed scientific journals and that the research of the project should be integrated into the national programmes, so that something of lasting value remains after the completion of the project. Even though the research leadership has been carried out by experienced expatriate scientists, there has always been the fullest co-operation with, and by, the staff of the national institutions concerned.

These projects are intended to increase the knowledge base of the pest/disease concerned for the benefit of all cocoa producers and consumers. The research cannot be considered as confidential. Until now, these projects have not become involved in the transfer of the results of the research to farmers.

The first project of this type started in 1965 and as the current project on witches' broom disease draws to a close, careful consideration is now being given to the design and content of the next internationally funded project. This successful formula is likely to be repeated.

These initiatives are undertaken because bean processors and chocolate manufacturers as a group are concerned that the national research institutions responsible for cocoa research have inadequate resources in terms of finance, trained staff or equipment to improve the productivity of cocoa cultivation in parallel with other competitive crops. Despite this effort, however, the overall average productivity of cocoa plantings has not advanced dramatically in recent decades whereas that for rice, for example, has increased by a factor of several times.

2. Cocoa Research in Cocoa Consuming Countries

Historically there has also been a considerable amount of cocoa research funded by IRCC in France by the French government as part of their aid programme to Francophone country cocoa producers. This work is currently centred at Montpellier, which is the headquarters of IRCC.

A small amount of work has been done on cocoa at Wageningen in the Netherlands at the Royal Tropical Institute. A number of scientists based there have worked in cocoa-producing countries as part of the Dutch aid programme. Likewise a number of researchers at UK universities have been associated with cocoa research projects funded by ODA.

National Cocoa Research and Extension Projects

There is currently no significant private sector involvement in the cocoa research efforts in Ghana, Nigeria, Côte d'Ivoire, Cameroon or Brazil. Apart from the consumer funded projects, mentioned above, there appears to have been little such involvement in the past decade. The processes of Structural Adjustment thus appear to have had no measurable impact on the balance between the resources allocated by public and private sectors to cocoa research in those countries. The main impact of structural adjustment has been to squeeze domestic resources available for local publicly financed research. At least in the case of Ghana, World Bank assistance has been provided to help fill this need.

The new developments in biotechnology have not resulted in any new forms of collaboration between public and private sectors in those countries.

The situation concerning cocoa research in Malaysia and Indonesia is, and always has been, somewhat different from that in Ghana, Côte d'Ivoire, Nigeria, Cameroon and Brazil because a higher level of resources have probably been allocated to cocoa research by the private sector than by the public sector. It seems likely that this balance will change in the fairly near future as the major plantation companies invest less in new cocoa plantings and in managing their established cocoa due to the lower world market prices. This is, however, not a direct effect of Structural Adjustment, but the result of depressed cocoa prices and more remunerative returns from other crops.

IV. STRUCTURAL ADJUSTMENT IN THE MAJOR COCOA-PRODUCING COUNTRIES AND THE IMPACT ON THE COCOA SECTOR

Introduction

This section of the study defines in broad terms the meaning and content of structural adjustment. It then details, country by country, the impact of structural adjustment on the cocoa sector of the case study countries. It analyses the influence of structural adjustment on research, development training, extension, quality control and production in each of the countries.

In undertaking this study, several methodological problems immediately present themselves. The first is the obvious question of how to define structural adjustment. Concisely put, despite the potential oversimplification, we will define it as the adoption of measures, be they economic, institutional, social or other, to adapt to a relatively large and rapid set of economic changes. In the case of many developing countries, the changes are supported by IMF short-term financing for aiding a country to right macroeconomic imbalances, particularly external, fiscal and supply/demand accounts. Attached to the financing is ordinarily a programme of conditionality related to correcting macroeconomic imbalances. Medium-term finance from the World Bank often accompanies the IMF package, generally, although by no means always, supporting macroeconomic and sectoral reform. Here, for purposes of simplification, and to avoid taking up too much of the paper on this topic, we will limit the review to the following areas of structural adjustment which broadly and specifically affect the cocoa sector on three levels. These are:

(i) *Macroeconomic*: involving exchange rate reforms, changes in tariff/tax structure, inflation policy and interest rates, fiscal/budgetary incentives or cutbacks (which can in turn effect the cocoa sector through cutbacks in inputs, research and extension), and institutional restructuring or support, for instance through credit services.

(ii) *Agriculture sector*: encompassing research and extension programmes, infrastructure, and rebalancing an economy which discriminates against the agricultural sector.

(iii) *Cocoa sector*: these can include changes in producer prices, marketing boards, research and extension, quality controls, export taxes, subsidies for agricultural inputs and staff cutbacks. This section also looks at developments in the local cocoa processing industries.

How to separate the difficulties resulting from the crisis preceding structural adjustment (e.g., indebtedness, neglect) from actual structural adjustment measures (e.g., budget cutbacks, withdrawal of the state from research and extension) is problematic. However, where structural adjustment programmes directly affect some area of the cocoa sector, whether addressing some problem or ignoring it, they have been included in the assessment.

There is a similar question regarding how to treat problems resulting from only a partial adoption of a structural adjustment programme (e.g. lowering producer prices, but maintaining an overvalued exchange rate, as in the case of the Côte d'Ivoire and Cameroon). If structural adjustment programmes proceed under such circumstances, however, the direct impact on the cocoa sector cannot be avoided, and is analysed in the context of this paper.

This era of structural adjustment happens to coincide with (and, in some cases result at least in part directly from) a sustained period of falling world prices for cocoa. Low world prices have been the result of several factors, including the adoption and large scale plantings of hybrids, especially in Malaysia and Indonesia, leading to much larger yields and rising output, and arguably extending the period of world surplus. Other factors include the failure of the International Cocoa Agreement's buffer stock mechanism, which has exacerbated the surplus and stock overhang, and the withdrawal of eastern Europe (in particular the former USSR) from the market at a time when, under ordinary circumstances, a continued steady rate of growth in Soviet demand would have meant that global consumption would have overtaken production. Diagram 2 depicts the evolution of world cocoa supply, demand and prices.

This coincidence of low world prices and economic adjustments sometimes makes it difficult to disentangle the causes for the financial crisis afflicting the cocoa sectors of most of these major producer countries; nevertheless, we will try to address this in the analyses of each country.

One final topic covered in this section is cocoa processing at origin, which has traditionally been an area of controversy. The rationale for promoting local processing has been to generate employment, promote industrialisation, add value to raw materials and to process sub-quality beans that would otherwise be unexportable or which would pull down the average price of bean exports. There has been much discussion about the lack of competitiveness of local processing compared with processing in consumer countries. Processing at origin suffers from a number of drawbacks, including sourcing of beans from only one origin (often, but not always, stipulated by law in the producer country), transport costs to end-users, shipment of cocoa liquor and butter in solid form as contrasted with shipment by processors in consumer countries in liquid and heated form, and competition from industrialised-country processors who ship on a just-in-time basis, as contrasted with producer countries who have less control over the delivery date. Furthermore, many origin processing companies have not met quality and hygiene standards demanded by end-users. Given these marketing constraints, producer country processors have had to compete primarily on a cost basis. This has been possible either through subsidised inputs or through the use of low quality beans and low costs of production. It has also been shown in a number of cases that, when premium quality beans are used, the country concerned would most likely have received a higher return from exporting raw cocoa than cocoa products, once the costs of processing are taken into account. Finally, there are a number of reports maintaining that cocoa processing does little to generate employment, given the capital intensive nature of the technology, and does not make a significant contribution to industrialisation. Under each country section, a brief analysis of the impact of structural adjustment on the domestic processing industry is given.

West Africa

The four West African countries covered in this paper are unique in several respects when compared with the other major producers included in the study. To begin with, cocoa is cultivated almost exclusively by small-scale farmers, as contrasted with Indonesia, Brazil and in particular Malaysia, where a significant portion of the crop is grown on large plantations. This is an important distinction with respect to the financing of research and the ability to target extension services and transfer developments in research. Furthermore, from colonial days these West African cocoa sectors have been under the direct supervision and control of marketing boards. Coffee has also been included under the functions of these boards. To date, only in Nigeria has the marketing board been completely eradicated, and this has been as a direct result of the Nigerian structural adjustment programme. However, there has been considerable, and most recently in Cameroon, successful attempts by the World Bank to significantly reduce the scope, if not eradicate altogether, the other marketing boards. It should also be noted that, in contrast to Brazil, Malaysia and Indonesia, earnings from the cocoa sector, especially in combination with coffee, have comprised a significant portion of these countries' foreign exchange and fiscal revenue, except in the case of Nigeria subsequent to the oil boom. For instance, cocoa and coffee accounted for 10 per cent of the Côte d'Ivoire's GDP and 40-50 per cent of its export earnings in the mid-1980s (Akiyama & Larson, 1989). For Ghana it amounted to 63 per cent of export earnings in 1986/87, but due to the fall in world prices declined to about 40 per cent by 1990. In sub-Saharan Africa as a whole, for the period 1984-86, cocoa and coffee comprised 24 per cent and 30 per cent respectively of total agricultural exports. Consequently, the cocoa sector has been addressed specifically in the context of the structural adjustment programmes of these countries.

In order to further clarify and classify the impact of structural adjustment on technological practices in the cocoa sectors of these four West African countries, they are divided into two sub-groups, the Francophone and CFA currency based countries of Côte d'Ivoire and Cameroon, and the Anglophone countries of Ghana and Nigeria. The former group has had a cocoa marketing structure based on the French Caisse de Stabilisation model, while the latter group controlled cocoa production and sales through marketing boards. The difference between these types of marketing institutions is fundamental in explaining the development of cocoa in their respective countries and in deciphering and analysing the impact of structural adjustment on technological developments and competitiveness in their cocoa sectors.

The Francophone countries shared for many years several important features; among the most significant, especially in recent years, is that both Côte d'Ivoire and Cameroon have belonged to the French Franc based CFA-franc zone of Africa. Since 1948, the CFA has been fixed for the 13 African member states at 50 CFA francs to the French franc. They also inherited similar price stabilisation and quasi-marketing structures from their former French colonial ruler, in the form of the Caisse de Stabilisation et de Soutien des Prix des Produits Agricoles (CSSPPA) in the case of the Côte d'Ivoire and the Office National de Commercialisation des Produits de Base (ONCPB) in the case of the French-speaking regions of Cameroon. (In the English speaking and formerly English-occupied area, the marketing structure, also controlled by ONCPB, resembles more closely the anglophone model). These marketing systems

established a complex structure of payments at the beginning of each crop year, which included specifying producer prices and payments for marketing services from the farmgate through to the port. Unlike marketing boards, it also involved a mix of private sector participation in the internal marketing side, through the use of "traitants" who are licensed to compete in specified regions in the purchase of cocoa from the farmer, as well as on the export side through use of private traders. The CSSPPA sets down an export reference price, and if the price negotiated by the exporter is higher, he pays the CSSPPA the difference; if the negotiated price is less, the CSSPPA is supposed to reimburse the difference. The CSSPPA has left quality control and transport in the hands of the traitants and exporters. The Côte d'Ivoire's more recent adoption of cocoa farming combined with the lack of emphasis on quality control by the CSSPPA and traders, has meant that Ivorian cocoa fetches a lower price than cocoa from Ghana or, until recently, Nigeria. In the case of the Cameroon, the ONCPB regulated the marketing to an even greater extent, determining the area in which internal buyers could purchase the crop, fixing the date on which the purchase had to take place, arranging transportation and negotiating export sales. In the case of cocoa from the Anglophone regions, the ONCPB acted as a marketing board, with cooperatives acting on behalf of the government in the case of internal transport of the crop to factory or to exporters, and the ONCPB handling exports. Until recently, it also oversaw quality control and crop grading. Cameroon's cocoa is considered by chocolate manufacturers to be of poor quality for making chocolate; nevertheless its red colour and relatively high fat content makes it inherently desirable for processing cocoa butter and powder almost regardless of quality, enabling it to fetch a price premium over cocoa from Côte d'Ivoire. Nevertheless, for reasons to be discussed later, the lack of an extensive centralised grading structure has not been essential to maintaining a market niche in the way it has for Ghana or Nigeria.

The Anglophone countries also inherited marketing systems from their former colonial rulers, although of a somewhat different structure. These were marketing boards which handled everything from setting producer prices and quality control to undertaking exports. The only difference was that the Nigerian Cocoa Board (NCB) allowed farmers to sell either directly to the NCB or to licensed buying agents (LBA) who would in turn sell to the NCB. In the case of Ghana, the Cocoa Marketing Board (CMB) has been the sole agent for much of the time. Early on after independence, LBAs were operating, but enough of them went out of business and were not paying the farmers that the NCB decided to assume the entire responsibility for buying cocoa. The quality and grading oversight of both boards meant that Nigeria and, even more so, Ghana shared another common heritage: they were known for their longstanding tradition of careful fermentation and drying practices, which gave their cocoa a distinctive flavour much sought after by European chocolate manufacturers, as well as their high and consistent quality cocoa shipments. This was no coincidence, since much of the cocoa cultivation which had been encouraged after the Second World War in both countries occurred under the supervision and guidance of the large British confectionery companies. The marketing boards which were established under colonial rule were particularly effective with their training and extension to farmers, as well quality control, and these controls were maintained beyond independence. For this reason, Ghana has traditionally fetched the highest premium on the world market for bulk cocoa (as distinguished from fine and flavoured cocoa) followed closely, until the disbandment of the NCB in 1986, by Nigeria's cocoa price premium. In the area of

exchange rates, unlike their Francophone counterparts, for most of the period between 1970 and 1990, Ghana and Nigeria had independent currencies at government-fixed exchange rates, which were not convertible. With the structural adjustment programmes, both countries have moved to flexible, auction-determined fully convertible exchange rates.

Below we take each of the four African countries in turn. Producer prices (i.e., at the farmgate) for these countries are shown for 1985/86-1990/91 in Diagram 3 below.

1. Côte d'Ivoire

a Macroeconomic

One of the most distinguishing features of the Ivorian economy from the 1960s onwards, as contrasted with many of its other sub-Saharan African neighbours, has been the government's encouragement of the agricultural sector in pursuit of its social and economic objectives. Through control over its major export crops, cocoa and coffee, the government was able to tax the exports while maintaining a sufficiently favourable producer price to stimulate expansion in output and generate surpluses for investment in agricultural diversification, import substitution and export processing industries.

From its creation until 1985, the extension service in Côte d'Ivoire (called SATMACI) was very active in its encouragement of cocoa planting, often with World Bank support. It offered subsidised spray chemicals and other inputs, and from the mid- 1960s until 1989/90, the farm-gate price (at which the cocoa was always supposed to be purchased and which was fixed by Government) was very rewarding, stimulating widespread planting of cocoa on land from which timber had just been extracted and exported. A substantial planting premium and free planting material was also offered by SATMACI for each hectare of new hybrid cocoa that was planted following SATMACI guidelines. However, many farmers planted cocoa with no support from SATMACI, simply because they believed that cocoa cultivation was profitable.

Unfortunately, not all of the government's investments were sound. This alone may not have been problematic. However, throughout most of the 1970s and into the 1980s the CFA became increasingly overvalued as the export market to neighbouring countries contracted and, particularly in the 1980s, the domestic market shrank and inflation increased. Furthermore, since 1977/78 world cocoa prices were declining, with only a brief rebound between 1982/83 -1984/85. With the combined collapse of world cocoa and coffee prices in the latter half of 1980s, an economic crisis ensued. Meanwhile, until late 1989 the CSSPPA continued to raise the producer price from 300 CFA/kilo in 1979/80 to 400 CFA in 1985/86, which encouraged planting and production during a time when world market signals would ordinarily have favoured cutting back. Furthermore, much of the new plantings were of high yielding varieties (HYV), although to date only about 10-15 per cent of the total hectarage is of HYV. Nevertheless, because cocoa trees do not begin to yield fruit for 4-5 years, and peak between 10-20 years, much of the planting which continued through the early 1980s has been maturing, further adding to the world surplus and depressing prices in this

period of historically low world cocoa prices. The farm-gate price in Côte d'Ivoire was halved in 1989/90 to reflect the low world price ruling at the time; nevertheless some farmers are still planting cocoa — albeit only small areas, even though the planting premium has long since been withdrawn.

The CFA has remained fixed and become increasingly overvalued given the terms of trade shock. The only alternative left to the CSSPPA, which had not stored away sufficient funds from the surpluses accrued during price boom periods to offer subsidies in the price trough, was to cut internal prices, particularly the producer price. However, it refused to do so, and consequently the CSSPPA rapidly moved into deficit, accumulating an ever growing debt.

The Côte d'Ivoire undertook a first structural adjustment programme between 1981-1986 which concentrated on macroeconomic stabilisation and rebalancing internal demand by reducing public investment, restructuring the parapublic sector, tariff and tax reform and monetary control. Little was altered in the area of cocoa production and marketing. While there was a short-lived recovery, in no small part due to the temporary boom in cocoa prices, after 1986 the economic situation deteriorated rapidly. The more recent World Bank financing and conditionality for adjustment has focused on the agricultural sector.

b Agriculture Sector

Among the measures put forward in the 1989 agricultural sector adjustment loan, part of the World Bank's ongoing support for structural adjustment, are:

- to improve internal pricing policy in favour of agriculture;
- modify the incentive systems so as to encourage crop diversification away from cocoa;
- cut the costs of the agro-industrial sector so as to restore its competitiveness both internally and in export markets;
- curtail or restrain public sector involvement in directly productive activities and improve the effectiveness of parapublic enterprises which provide essential support services to farmers;
- reorient public expenditure towards high priority areas in rural zones;
- improve financial services and access to credit and savings in rural areas, and;
- improve the management of natural resources in the country.

For numerous political reasons a devaluation has so far been resisted, despite being urged upon the country by the World Bank and IMF. While the World Bank has emphasised the need to offer a premium for quality in both the coffee and cocoa sectors, this has only been taken up by the CSSPPA for coffee.

c. Cocoa Specific

In addition to the sector adjustment loan, the World Bank funded a training and extension project from 1985-1990, one of the aims of which was to coordinate the research of the French-based Institute de Recherches du Café, du Cacao et Autres Plantes Stimulantes (IRCC) with the Ivorian Société d'Assistance Technique pour la Modernisation de l'Agriculture en Côte d'Ivoire (SATMACI). Among the objectives were to promote the adoption of simple husbandry methods which did not require modern inputs and to improve the extension services so that innovations in field research, improved credit facilities and input distribution could reach small scale farms.

SATMACI, which has traditionally been partly self-financed and partly funded by the government, ran into financial difficulties and managerial problems in the late 1970s and early 1980s. Thanks to the infusion of World Bank financing, it worked with increasing effectiveness after 1985, providing farmers with hybrid seedlings, distributing inputs such as fertilizers and agro-chemicals, and recommending pruning and maintenance of cocoa. Nevertheless, only about 10 per cent of cocoa farmers in the Côte d'Ivoire have regularly used fertilizers and agro-chemicals and although the area coverage is expanding, application has amounted to less than 10 per cent of annual requirements. Furthermore, the amount of new hybrids intensively cultivated has always appeared to be low, and although yields are impressive by West African standards at more than 700 kilos of dried beans per hectare on the most modern plantations, on average for the country they are lower than their full potential at about 550 kilos per hectare (albeit the lack of sufficient monitoring and evaluation makes this hard to assess). More recently, emphasis has switched from selecting hybrids for fat content and bean size, to choosing on the basis of durability and resistance given the relatively low application of inputs. While cocoa quality had declined through to the mid-1980s, with project financing SATMACI was also successful after 1985 in improving the quality of cocoa through its training and extension programme.

By the beginning of 1991, counterpart funds from the government for the project were not forthcoming. Furthermore, a key position in the agency remained unfilled for more than half a year; consequently, SATMACI's field operations have ground to a halt, the IRCC has discontinued its research and development programme, and research agencies have ceased training extension workers. A follow-up to the training and extension project was planned, but it has been postponed due to political constraints. The aim of the World Bank project, if it were to go ahead, would be to reduce the involvement of the government to areas that would not be undertaken by the private or cooperative sector (such as research and extension), to implement cost-recovery for services, to reform the institutional structure and reduce numbers. Plans were drawn up several years ago for another project involving radical restructuring of agricultural research, but so far it has been delayed by the government due to administrative and political complications. Consequently SATMACI currently has little funding, and the IRCC has also suffered budget cuts.

The Côte d'Ivoire agreed to a reduction in the producer price in 1989, first to 250 CFA/kilo and then to 200 CFA/kilo in 1990. Consequently, real cocoa producers incomes have fallen. Nevertheless, as will be discussed more fully in Part V, cocoa production remains profitable, although far less so than previously. The World Bank has been pushing the government of the Côte d'Ivoire to restructure the CSSPPA, to include producers, exporters, representatives from commercial banks and the Central Bank on the Board, and to devolve more functions to the private sector. It is also encouraging more reliance on cooperatives as well as private investment in areas such as training and extension, and together with the IRCC and other agencies is trying to promote intensive rather than extensive cultivation as a means for reducing the costs of production and increasing profitability. However, the budgetary crisis and the impasse over negotiations for the implementation of the training and visit system as well as for the research loans mean those governmental and cooperative agencies that are responsible for communicating this to the farmer are not able to do so.

Currently, perhaps the most serious threat to the Ivorian cocoa sector lies in the lack of spraying against capsid, which will affect both yields and tree longevity. The fall in the cocoa producer price will further discourage preventative measures. However, as we will see from the experience of other cocoa producer countries, the lack of attention to the cocoa crop is a feature common to all in this period of low prices, even those with a history of liberalised marketing systems. Hence, it is difficult to conclude that it is structural adjustment alone that has directly resulted in declining application of even rudimentary technology; rather, the sector adjustment loan has brought pressure to bear on the need for addressing incentives for quality and the benefits of more intensive farming, as opposed to the extensive and more costly methods now employed. It has also pressured the government to cap expansion, recognising that this would only add to world supplies and further depress prices. As for the adoption of improved technology, the largest threat is the economic crisis and

the impasse in negotiations for devaluing the currency and for agreeing on a follow-on training and extension project and a research restructuring project (which would probably have the largest impact on the development and adoption of technology in agriculture).

The government has withdrawn from its involvement in cocoa processing after the companies in which it has had at least a partial stake went bankrupt, and is selling any remaining shares as part of the World Bank privatisation push. All the factories are now operated by the private sector in joint ventures with European companies, which provide them with marketing and technical assistance. The factories have been renovated, and the quality of their products is considered excellent. These joint ventures also provide the Ivorian companies with a marketing channel to end-users in Europe. Because of the constraints discussed earlier, including being limited to only Ivorian beans, and the lag in the transport and timing of delivery, these companies must compete by offering lower prices. It is not confirmed that these processors receive any price discount or subsidy in their operations, but the profitability of the ventures indicates that they do benefit from concessions. Furthermore, they can obtain lower quality beans for a substantially discounted price. Capacity is fully utilised in the Côte d'Ivoire, and at least one company would expand its factory, except for the large

debt currently owed to it by the CSSPPA, which has constrained its ability to borrow from commercial banks.

2. Cameroon

a. Macroeconomic

While Cameroon, like several of its West African neighbours, is heavily dependent upon cocoa exports (being its second largest agricultural export after coffee), oil has been a valuable source of revenue as well. Furthermore, the agricultural sector is relatively well diversified. Consequently Cameroon's economy grew at a healthy rate between 1980-1985, despite the fall in world cocoa prices. However, as oil production declined, cocoa and coffee prices fell, and macroeconomic policy failed to adjust to the declining terms of trade, Cameroon moved into a crisis. It accepted a stabilisation programme and structural adjustment support from the IMF and World Bank. However, one of the cornerstones of stabilisation programmes, devaluation, has been denied due to Cameroon's participation in the CFA-zone. Consequently, internal prices, and specifically cocoa producer prices, as well as the ONCPB and extension service budgets, have born much of the burden of the adjustment programme.

b Cocoa Sector

The cocoa sector has been explicitly addressed under the structural adjustment programme. As explained above, Cameroon, like the Côte d'Ivoire, has traditionally set producer prices and marketing margins. Furthermore, like the Côte d'Ivoire, it set producer prices relatively low during the periods of high world prices, although it adjusted them upwards to keep real incomes from declining in the mid-

1980s, despite the fall in world cocoa prices. Predictably, Cameroon lost money on its exports during the late 1980s, and was finally forced to cut the producer price from 420 CFA/kilo for grades I and II cocoa (and 310 for below grade cocoa) in 1988 to 250 CFA in 1989 and again to 220 CFA in 1990.

The enormous investment by SODECAO in selected areas of Cameroon from 1974 to 1989 has had little or no impact on cocoa production. In its heyday a very high proportion of the resources of SODECAO were allocated to doing the work of the farmers for them. For example, SODECAO used to spray the farms in the Centre-South cocoa zone with copper fungicides against Phytophthora and with insecticide on behalf of the farmer free of charge. This undoubtedly maintained many low yielding (and thus uneconomic) areas of cocoa in cultivation and, in retrospect, was probably a very poor use of scarce government resources. Furthermore, Cameroon's cocoa output had stagnated at around 100,000-120,000 tonnes a year since the late 1960s. The high incidence of black pod disease combined with the age of the trees meant that Cameroon's yields averaged 380 kilos per hectare in 1985/86. Furthermore, the lack of replanting and an exodus of younger people from rural areas resulted in an ageing tree stock and an older farming population, which pointed to a longer term decline in production.

However, in the mid-1980s, and again in 1988, in conjunction with the structural adjustment programme and under a World Bank programme for rehabilitating the cocoa sector, the government provided an infusion of cash and other incentives to farmers through the parastatal SODECAO, encouraging them to replant using free improved variety pods and a cocoa planting premium. (On behalf of ONCPB, SODECAO covers an area accounting for about two-thirds of the national production, while the Ministry of Agriculture covers the remaining area.) However, farmers have been abandoning hybrid varieties in favour of traditional cocoa varieties due to the drought and disease resistance of the latter. Only about 10-15 per cent of the total area is planted to HYVs. Consequently, yields are not expected to improve dramatically as a result of this effort.

SODECAO was to launch a pilot programme in farmer training and participation in capsid spraying and surveying. SODECAO also dispensed grants towards 50 per cent of the cost of knapsack sprayers and encouraged higher applications of fertilizer. Under the rehabilitation project there were also the following components:

- the establishment of a medium-size plantation program supported by a credit scheme;
- restructuring and improving SODECAO's efficiency;
- expansion and construction of additional feeder roads;
- a reorganisation of the extension service along the training and visit system;
- improving the agents' capability while cutting numbers, and;
- financing of adaptive research by the Institut de la Recherche Agronomique (IRA) for studying cocoa disease.

Finally, differential prices and end of season bonuses for quality were paid to farmers for good fermented cocoa, resulting in an apparent increase in the share of grade I cocoa and an improvement in fermentation such that the majority of cocoa seems to have moved from fair to good fermented. However, buyers of the cocoa do not care whether the cocoa is fair or good fermented, and are unwilling to pay a premium for the latter. Demand for Cameroon cocoa is based on the high fat content and the reddish colour of their cocoa beans, which is highly desired for producing premium cocoa powders. This colour is intrinsic to the variety of cocoa found in Cameroon, and does not depend on whether it is fair or good fermented.

Under the World Bank project SODECAO is provided with subsidised inputs (although with the proviso that the subsidies are expected to be reduced over time), particularly free fungicides and insecticides for spraying as well as low cost herbicides.

Subsidies on chemicals and spraying machines will be gradually eliminated over the next three seasons and the low farm-gate price will be maintained. It is inevitable that many low-yielding fields of cocoa will be abandoned.

Just as the benefits of this rehabilitation effort of SODECAO were bearing fruit ONCPB began to lose large sums of money due to the unsustainably high producer price relative to the world price for cocoa, and the spraying efforts against capsid and fungicide distribution were cut back. The project's assumptions for financing provided for a real cocoa price fall, but not of the magnitude which occurred, and consequently it became uneconomical, especially given the producer price. SODECAO's fungicide distribution was of about 13 million packets in 1988/89, but in 1990 it had sold less than a million packets. The Ministry of Agriculture had even greater financial difficulties, so inputs in their areas were severely curtailed and the replanting programme abandoned. The implementation of cuts in spraying subsidies has been the most problematic action, since the costs of mechanical sprayers to an individual farmer are high, and spraying on individual farms is of limited value if others do not spray. In 1989/90 the government introduced charges for fungicides covering 25 per cent of the cost and rising gradually to 100 per cent by 1993/94. The fall in applications of inputs has led to a rapid growth in black pod disease, a spread of insects and a potential fall in yields of 50-80 per cent. While the impact of a rise in capsid takes three to four years to be felt, black pod fungus reduces output quickly. A rough cost-benefit analysis has shown that the benefits of applying fungicides and pesticides would outweigh even the full costs. Farmers have reportedly been searching out supplies, but the financial crisis has led to the liquidation of FONADER (Rural Credit Bank), and CENADEC (the Cooperative Assistance Agency) is being terminated. Both these agencies were responsible in theory (although not much, in practice) for components of the World Bank Project, and their collapse means that there is little or no credit available to farmers, forcing a reduction in input utilisation. SODECAO had been closed for some 18 months, but has just started operations again on a very restricted basis.

The ONCPB grading function was transferred to the Ministry of Agriculture in 1989, but due to lack of financing in the ministry, no official grading was undertaken. The premium for good fermented quality cocoa, after being reduced gradually, was removed altogether in 1989/90, although without any apparent decline in overall quality; however, there has been more mixing of fair grade cocoa with the good grade. This has not affected the premium for Cameroon cocoa on the world market, since it is fetches a premium on the basis of the reddish colour beans rather than the grade. Furthermore, the recent fall in the supply of these beans has helped to push this premium up.

Finally, in 1990 and 1991, under pressure from international donors, cocoa marketing was liberalised and the functions of the ONCPB reduced to the collection of statistics, monitoring of exports, quality control, and perhaps levying an export tax if and when world prices improve. Internal marketing has been liberalised, and exporters may buy directly from the farmer or cooperatives can sell onto the world market.

The main problem now plaguing the industry is the continued lack of input use against capsid and black pod. While SODECAO has tried to encourage the formation of formal cooperative groups of 50-100 farmers for the purchase of sprayers and treatment of trees, past poor experience with cooperatives puts the likelihood of success low. There is, however, considerable scope for farmers to form informal groups which would have minimal bureaucracy but which could perhaps evolve into cooperation with formal rules on a voluntary basis. Such groups could have an important role in establishing primary collection points in villages for the purposes of cocoa marketing.

Recognising the crisis, and given the standstill of the rehabilitation project due to a shortfall of financing, the World Bank has proposed a restructuring of the project. The objectives have shifted, and recognising the imminent collapse of the cocoa sector, the goal is:

- to protect the farmer during this period from government-managed to private sector oriented marketing;

- to directly support productivity increases and lowering of production costs at the farm level;

- and to preserve Cameroon's comparative advantage in the cocoa market.

It explicitly recognises that without the involvement of SODECAO and its distribution system farmers will have to wait too long in the transition to developing a private distribution network, with potentially disastrous consequences for the cocoa sector and the economy, a conclusion drawn from the shortcoming of the privatisation of the fertilizer sub-sector. Liberalisation of input imports and distribution and cooperative management will proceed, and SODECAO will assist in this by training farmers' groups and transferring their input distribution and pest control programme to them. Phasing out of SODECAO will proceed, as the extension and provision of improved planting materials will be transferred to the Ministry of Agriculture, research to Research Centres, and road construction shifted to the Ministry of Public Works.

The risk of this approach is that farmers will not be organised as quickly and as effectively as envisaged, although there is some budgetary provision in the event that targets are not met. Another problem could be that, as in 1988/89 when banks and exporters faced a liquidity crisis, farmers are still not paid the full producer price (and rarely have been paid the full price, even prior to structural adjustment), thereby limiting their ability to contribute to the price of inputs. Another risk is that the current political unrest will render much of the current effort ineffective. Ports are periodically blocked, and although this has driven up the premium on Cameroon's cocoa, it has thrown bottlenecks into much of the system.

Cameroon resembles the Côte d'Ivoire in that local processing is owned and operated by a private company. Furthermore, its parent company is a processor based in France, and provides it with marketing and technical assistance as well as an outlet.

The company also produces small quantities of chocolate for the domestic market. There do not appear to be any plans for expansion, or encouragement by the government to invest in processing, although capacity has been fully utilised. However, given the decline in output, there are worries that supplies of cocoa will be inadequate to meet the domestic industry's needs. Furthermore, given the premium attached to Cameroon's cocoa because of its distinctive colour the economics of processing have long been considered doubtful, except perhaps in the case of inferior beans. (However, for the processor — as distinct from the country — this is a good business considering the low fixed purchase price and the further discount for inferior beans.)

3. Ghana

a. Background

The climate and soils of Ghana are well-suited to smallholder cultivation of cocoa and there remain substantial areas of virgin forest (especially in the Western Region) which are suitable for successful cocoa planting. The holding size still averages less than 1 hectare and yields are still low at 200-300 kilos/hectare. Cocoa in Ghana is, and always has been, planted under thinned forest shade and in these conditions the application of fertilizer is very unlikely to be economic, and so has never been recommended. On experimental plots in which the shade was removed, some very high yields have been attained, but shade removal, which requires fertilizer application, has never been suggested for the small farmers in Ghana largely due to the greatly increased risk of capsid attack on unshaded cocoa as well as the very high cost of the fertiliser itself.

Thanks to a programme of rapid expansion after the Second World War, Ghana grew to be the world's leading cocoa producer. A programme of providing subsidised spraying machines and chemicals to control the capsid insect, which caused widespread damage in Ghana, was introduced in 1958/59 when the crop was 255,000 tonnes. Production rose to 433,000 tonnes by 1960/61 and 557,000 tonnes in 1964/65, in large part due to the application of spray chemicals by farmers. The effective implementation of this was due to the successful extension effort by CSD. When output peaked in 1964/65 at 550,000 tonnes, Ghana accounted for approximately 33 per cent of the world's supply. However, from the 1970s to the early 1980s cocoa production declined to a low of 178,000 tonnes in 1983/83 due to falling producer prices, resulting in abandonment of farms, lack of maintenance, inadequate harvesting, inadequate application of insecticide for capsid control, and the absence of control of mistletoe (a very debilitating parasitic plant), a low level of replanting, an increasingly ageing stock of trees, the spread of capsid and the low level of HYVs. Throughout these large fluctuations in cocoa production from 1964/65 until 1985, the extension service maintained the same number of staff, but almost always had inadequate resources to function effectively.

With the change of government in 1982, the government undertook a programme to rehabilitate the cocoa sector in conjunction with the adoption of a structural adjustment programme, both of which were financed by the World Bank and other donors.

b. Macroeconomic

One of the key elements of the structural adjustment programme was the steady devaluation of the cedi through the mid-1980s and the gradual conversion to a floating exchange rate through the use of a foreign exchange auction. Furthermore, exporters were allowed to retain foreign exchange earnings. These changes acted as incentives to agricultural producers, although they also raised the cost of imported inputs. Support for reforms was provided under the Economic Recovery Programme (ERP) 1 and 2, the Agricultural Services Rehabilitation Project (ASRP) and the Cocoa Rehabilitation Project (CRP). The CRP and the ASRP were financed by the International Development Association and other donors. In the case of the CRP, the government also financed the project.

c. Cocoa Sector

The focus of the ERP I, II, ASRP and CRP cocoa rehabilitation effort has been on price adjustment and restructuring of the Ghana Cocoa Marketing Board (GCB). The programme has been based on the assumption that Ghana has a comparative advantage in cocoa production and should try to increase cocoa output, although not necessarily to the record level. The first programme has included:

- a gradual increase in the producer price as a share of the world price, accompanied by the devaluation of the cedi;
- massive retrenchment of staff and reduction in overhead costs of the GCB;
- compensation to farmers for replanting trees infected with cocoa swollen shoot virus (CSSV) and limited spraying for capsid;
- improvement in the delivery of support services and concentrating them in areas with the greatest production potential;
- improving the roads and storage facilities, and;
- privatising several parts of the industry.

It has been proposed under the ASRP that the Ghana Seed Company be opened up for a joint-venture. There have also been infusions of financial assistance for the rehabilitation of the cocoa processing industry which is owned and operated by the GCB. Another thrust of the programme has been to gradually reduce and finally eliminate subsidies on fertilisers, herbicides, insecticides, farm equipment and other inputs. The elimination of the fertiliser subsidy has had no noteworthy impact on the cocoa sector, as farmers did not use it prior to the adjustment programme.

In a survey conducted of the Ashanti cocoa growing region (Commander, Howell & Seini, 1989) looking at the impact of these various donor-assisted

programmes, cocoa production has increased for two fundamental reasons. The first is that cocoa has been brought into official marketing channels, so some of increase witnessed was due to the rising producer price and falling price in neighbouring countries in 1989. A second reason is that a significant number of farmers have been replanting as well as rehabilitating their cocoa areas. The current farmer's price (fixed by the government) has become more rewarding as a result of the Cocoa Rehabilitation Project (CRP) and SAP, and so planting with Government provided planting material, as well as with farmer's own selections, was re-started in 1985/86, especially in the Western Region. Farmers are making both re-plantings of old cocoa fields and new plantings under thinned forest shade in the traditional way.

In the 1980s, a reasonable number of farms were replanted with higher yielding hybrids developed at CRIG. These start to bear fruit after only two years in the field and have achieved yields of over 2.0 tonnes per ha in the eighth year after planting on well-cared for plots. Unfortunately, the hybrids are not resistant to CSSV, though probably the rate of spread of CSSV through a field of these hybrids would be about half that seen with the traditional Amelonado type. In order to derive the maximum benefit from the increased yield potential of these new hybrids, the farmers need to make more harvest rounds at the beginning and at the end of the season. So far, farmers have shown great reluctance to do this on a regular basis, because it conflicts with other activities such as trading. Consequently, only a few farmers have derived the full yield benefit from planting this new hybrid material.

The aim of the World Bank programme has been to increase producer prices to at least 55 per cent of the world cocoa price. However, while the producer price has risen considerably as a share of the world price, it has remained low relative to producers in other countries, notably Malaysia and Brazil, although it recently surpassed the price in the Côte d'Ivoire. However, one of the successes of the programme has been the rapid and fair payment of growers through the Rural Banking system.

The World Bank is also persisting in its objective to further reduce the overhead marketing costs of the GCB, and has tried to promote the privatisation of most or all of the GCB's functions. To date the GCB has held out, choosing instead to make further deep cuts in the staffing numbers and hence operating costs.

One distinctive feature of Ghana cocoa, as mentioned above, is its high and uniform quality, with over 90 per cent of the crop Grade I. On top of being a low cost producer, this has enabled Ghana cocoa to fetch the highest premium on the world market and sell out its crop even in times of a large world production surpluses. The high quality can be attributed to successful extension and training programmes in fermentation and to careful monitoring of the crop by the GCB. This is one of the primary rationales given by the GCB and major end-users for keeping the Board. Many look to the Nigerian example as a reason for keeping the GCB intact, although outside proponents for the GCB believe that there remain to be made economies in the GCB, and have encouraged various divisions of GCB to become "financially and organisationally autonomous with urgency".

The World Bank is encouraging the GCB to privatise its cocoa processing activities, yet at the same time financing the rehabilitation of these factories which are owned and operated by the GCB. While installed capacity at the GCB's three factories is nearly 80,000 tonnes, capacity prior to the rehabilitation effort was only around 15-20 per cent. Given the premium for Ghana cocoa on the world market, the economics of processing appear doubtful. Furthermore, the quality and hygienic standard of Ghana's cocoa products are such that they have to be sold at a significant discount to European products, unlike its premium quality cocoa. Ghana has recently entered into a joint venture with a German company to toll process its beans in Germany, thereby in theory giving it better access to the European market. However, it is not clear to what extent the Government of Ghana will benefit financially from this move.

Cocoa Swollen Shoot Virus (CSSV) remains a very serious problem whose only known method of control is to cut-out and burn the infected tree and all its contact trees. At present, it is estimated that over five million trees are infected with this virus and thus are awaiting removal. In Ghana between 1936 (when CSSV was noted) and 1962, the task of extension and of the cutting-out programme was undertaken by one Government agency. It is now called the Cocoa Services Division, or CSD, and is part of the Ghana Cocoa Board, or GCB. These two roles, that of the legal enforcer of an unpleasant regulation and that of being the farmer's friend, did not easily fit together, inducing much mistrust of extension agents in farmers. From 1962 to 1964, the farmers were required to cut down their own infected trees and remove them themselves. The farmers did not do this and so, when the Government again took over the responsibility in 1965, many million more trees needed to be cut out. Today the total needing eradication is over 5 million, without counting the contacts which should also be removed. Many million more contact trees should also be eliminated; meanwhile the infection continues to spread. The only reliable long-term solution to the disease has to be the planting of material resistant to CSSV, but unfortunately no such material has yet been identified as primary germplasm, let alone incorporated into hybrid material for distribution to farmers. The diagnostic techniques to identify resistance are not yet available.

Capsids remain a very important pest on cocoa in Ghana. While they can be controlled by the regular application of insecticides at appropriate times of year, since all Government subsidies on machines and insecticides were removed in 1988, many farmers have not been able to afford to spray in the way recommended for this pest. As has been discussed earlier, the high initial capital outlay which is required by the farmer to buy a spraying machine is a major constraint to him. Anything which can be done to spread the cost (such as the formation of informal farmers' groups, credit facilities, encouragement of commercial agricultural contractors, etc.,) would be most welcome and is likely to result in increased productivity from the country's cocoa farms.

A new, more virulent, species of Phytophthora has recently been identified in the northern part of the cocoa zone in Ghana, and the area affected by this new species is slowly expanding in a southerly direction into the major cocoa areas in the country. The relative humidity is quite low throughout the season in the infected area and so it is something of a surprise that there should be a problem with Phytophthora in Ghana. At present, the only practicable method of control which can be proposed

is the application of regular and massive doses of a copper-based fungicide. Many farmers do not presently have the expertise or the necessary financial resources to purchase the spraying machine or the fungicides themselves, and so many farms which should be sprayed are not being treated. The re-vitalised extension services are, however, now starting to take a more active role in this activity.

4. Nigeria

Cocoa production developed later in Nigeria than Ghana, expanding spontaneously from 20,000 tonnes in 1920 to 100,000 tonnes in 1940, with an insignificant extension effort. CSSV was found in Nigeria in 1944 and removal of the diseased trees was started at once. At that stage the extension service of the Colonial Administration became active in the cutting-out programme. However, the strain of the virus is not as virulent as the one in Ghana and so cutting-out was stopped in the 1950s. Work over many decades in Nigeria has successfully produced new hybrids which are suitable for the conditions there and which exhibit good tolerance to the Nigerian strains of CSSV. This material has been quite widely planted as part of the various cocoa rehabilitation projects in Nigeria over the last twenty years.

The cocoa extension effort in Nigeria has always been part of the functions of the Ministry of Agriculture and Natural Resources (MANR), which has also been responsible for the Government extension efforts for all other crops, even when the World Bank funded Cocoa Rehabilitation Projects were in operation. The MANR extension service has always been short of resources and their cocoa effort has tended to concentrate merely on the provision of planting materials. The soils are of similar structure and fertility to those in Ghana, and experiments on unshaded cocoa have also been conducted with similar results. As growing conditions and the risk of serious capsid damage is similar in Nigeria to Ghana, farmers have been advised not to completely remove the thinned forest shade and use fertilizer.

Phytophthora pod rot is, and always has, been a major problem in Nigeria and can cause very severe losses in a wet or humid season. Spraying machines and chemicals for control of Phytophthora and capsid were widely available at subsidised prices until the privatisation of the cocoa marketing system in Nigeria in 1986. Now imports and sales are handled by private traders with almost no Government control on the type, or quality, of machines or agrochemical products offered for sale by the private traders. There are therefore some concerns about the efficacy and the quality of the spraying machinery and of the agrochemicals. Four species of Phytophthora, including the most virulent one just identified in Ghana, are present in Nigeria. They can cause up to 90 per cent loss of pods in Nigeria if not controlled on a regular basis with a copper or systemic fungicide or a mixture of both. The mixture is usually recommended to avoid the build-up of resistance. The Phytophthora species of fungi cause the most damage to developing pods when the relative humidity is very high. This is the case through most of the country and throughout much of the growing season in Nigeria (as in Cameroon and Brazil).

Because there has never been a specific extension service for advising cocoa farmers in Nigeria, and because the present general agricultural extension service is poorly funded, there is considerable difficulty in advising cocoa farmers in Nigeria of

any important technological advances. However, while never that good, the output of the agricultural extension service has deteriorated since the privatisation of cocoa marketing in Nigeria.

a. Macroeconomic Reform

The structural adjustment programme, begun in late 1984 with a home-grown austerity programme and later supported with World Bank financing in 1986, was the result of a balance of payments crisis which followed several years of low world oil prices. Nigeria had spent or exported the earnings of the oil boom, partly on the assumption of expected future earnings equal to those during the high oil price years. It also experienced the phenomenon known as "Dutch disease", whereby resources, including labour and capital, move into the sector of the economy experiencing a price boom (in this case the oil sector) and out of other sectors, such as agriculture.

Nigeria's structural adjustment programme was fairly classical in emphasis, concentrating on fiscal and monetary policies as well as trade policy to correct the macroeconomic imbalances. One of the centrepieces of reform was the introduction of a two-tiered foreign exchange market, with the first tier a fixed but progressively depreciating official exchange rate, and the second tier floating, using an auction mechanism for equilibrating supply, demand and price. Gradually the first tier was devalued until it was unified into a single flexible exchange rage market (FEM).

b. Sector and Cocoa Specific

Prior to market liberalisation in 1986, Nigeria's output of cocoa had declined progressively for more than a decade, from 183,500 tonnes in 1976/77 to 110,000 for 1985/86. Among the reasons for the poor performance of the cocoa sector were the oil boom in the 1970s and early 1980s, resulting in an outflow of labour and capital from the agricultural sector, an overvalued exchange rate, declining producer prices in real terms, and lack of investment in cocoa. Some cocoa was reportedly being diverted through neighbouring countries where farmers could earn a higher return in a convertible currency. Consequently, earnings of the Nigerian Cocoa Board (NCB) dwindled, and as a result the provision of services suffered.

As part of a general move towards the liberalisation of pricing systems, the Nigerian Government disbanded a number of commodity marketing boards, including the NCB in 1986. The NCB was eliminated outright, without any transition from a state controlled body with all the concomitant functions involved, such as grading, transport, handling and selling. The aim of terminating the NCB was to tie farmers' earnings more closely to world prices, which would effectively raise their income, and thereby increase exports of cocoa through stimulating production and bringing cocoa sales back into official channels. In turn, this was meant to boost revenue and foreign exchange reserves. Exporters were initially required to deposit 100 per cent of their foreign exchange with the Central Bank, but were subsequently allowed to retain their foreign exchange earnings as an export incentive.

The elimination of the NCB did have some of the intended effects. As seen from Table 1, Nigerian production and exports responded positively and quickly in

subsequent years. The explanation for these figures lies partly with a genuine rise in production, but also in part with a gradual redirection of Nigerian output back into the formal economy, rather than being diverted through neighbouring countries. Furthermore, farmers' incomes rose precipitously, especially in the first two years following liberalisation; for example the price paid to farmers went from 1,600 naira in 1985 to more than 7,000 naira just one year later.

Table 4.1: **Nigerian Production and Exports**
(tonnes)

Year	Production	Exports	Exports to UK as per cent of total exports
1982/83	160 000	208 761	19.60
1983/84	118 000	97 923	42.41
1984/85	154 700	104 239	37.08
1985/86	110 000	58 664	63.27
1986/87	100 000	80 000	44.71
1987/88	150 000	141 347	20.12
1988/89	165 000	152 000	14.82

Source: Landell Mills Commodities Studies (1990)

There were also several unintended and unfortunate consequences of the cocoa market liberalisation. In the first few years of liberalisation, the government's foreign export earnings from cocoa shrank because exporters opted to keep their earnings in overseas accounts, wary lest the government turn back on its programme for floating exchange rates and retention of foreign exchange earnings. The second, and more serious problem was the rapid decline in the quality of cocoa and in the reliability of shipments. These factors can be attributed primarily to the existence of the two-tier exchange rate mechanism and the lack of simultaneity in the movement towards a unified and fully flexible exchange rate with the rapid transition to flexible prices for agricultural commodities. Many inexperienced cocoa traders entered the cocoa market (as well as other newly liberalised commodity markets) for purposes of arbitrage, using cocoa for conversion into foreign exchange earnings. A plethora of undiscerning novices bought and sold any cocoa available, much of it of very poor quality. Without the grading infrastructure previously provided by the NCB, cocoa shipments proved notoriously unreliable, and on the world cocoa market Nigeria quickly lost its price premium and its reputation for honest dealing built up by the NCB.

The situation today has improved, partly as a result of the exchange rate stabilisation resulting from the unification of the market into a single floating auction-determined rate. Furthermore, more reputable traders have emerged from the pack, judged on the reliability and quality of their shipments, with the remainder being marginalised or going out of business.

Today, a mix of public and private grading systems are in place, both at the state level, at the storehouses in Lagos and at the moment of export. Nevertheless, exporters generally insist on grading the cocoa themselves as well. While the quality of Nigerian cocoa has reportedly improved since the first days of liberalisation, there are still reports of poor cocoa shipments, with a number of bean arrivals in 1991/92 containing as much as 40 per cent mould. Furthermore, as seen in Table 1, Nigeria's share of its main market, the UK, has eroded as manufacturers sought more reliable sources in Ghana and the Côte d'Ivoire. The discount on Nigerian cocoa has narrowed; as of December 1991 it was selling in Europe after inspection for £20 under the May 1992 contract, or the same as the discount on cocoa from the Côte d'Ivoire and up from the discount of £50-75 in 1986. However, this compares with the £15-25 over the terminal price prior to 1986. Furthermore, while the NCB was able to sell forward, since it could guarantee cocoa delivery, exporters today can not sell using longer term physical forward contracts due to their lack of dependability.

The government levies a small tax on cocoa beans exports (as it does with all agricultural produce). In the past, NCB revenue, much of it in the form of implicit export taxes, was used to finance the Cocoa Research Institute of Nigeria (CRIN); today, however, CRIN is reportedly nearly paralysed due to lack of financing, which is the responsibility of the Federal government. This presents a serious problem, given the relatively old age profile of the tree stock (at least 60 per cent of Nigerian trees are more than 30 years old), the problems of black pod and swollen shoot. Furthermore, farmers have cut back on their use of inputs, such as fertilisers, fungicides and insecticides, due to the higher prices resulting from the reduction or elimination of subsidies. There is also little pre-crop financing available to farmers for purchasing inputs, primarily due to the lack of enforceable delivery.

Some states in Nigeria have picked up from where the Federal government left off. In Ondo State, the largest cocoa growing area, the Ministry of Agriculture and Natural Resources undertakes and maintains training and extension, various cocoa projects, a Cocoa Development Unit (CDU) responsible for replanting, and a Smallholder Management Unit (SMU). However, while the CDU and SMU are charged with supplying subsidised replanting material (plants and cuttings), in practice two out of three farmers are supplied by the private sector. One constraint on the Ministry's budget is the high level of tax on Ondo state cocoa used to support these efforts, which has resulted in large quantities of cocoa going through other states with lower tax levels, thereby reducing the potential resources. While the state government appears to subsidise farm chemicals, there is currently a shortage. Privately-sold products are available at prohibitive prices, consequently the crop appears to be suffering from insects and black pod disease. Furthermore, because many of the newer trees are planted in marginal zones, they require greater applications of inputs, and are the most sensitive to the cut in their utilisation.

Cocoa processing declined significantly in the 1980s. While installed capacity is estimated at 40,000 tonnes, capacity utilisation has only been 5-10 per cent. Liberalisation harmed the processing industry even more, as the companies could not afford to compete with cocoa exporters who had bid up the price of beans beyond their reach. However, the government is encouraging the domestic processing industry by providing concessional loans through the Import-Export bank and other financial

institutions. It is permitting joint foreign ventures, and has legalised the import of cocoa beans, allowing for blending. It had also planned to ban the export of beans commencing in 1990/91 in order to support the domestic processing industry, but the ban was lifted when it was apparent that there would be insufficient capacity on stream to process the full crop. However, it appears that the government intends to press ahead with the ban at a later date, and there has been a surge in investment in processing capacity.

Brazil

Cocoa production in Brazil is concentrated primarily in Bahia, which is responsible for 85-90 per cent of output. Cocoa has been cultivated in Bahia for over 100 years. More recently, cocoa cultivation has expanded to the Amazon state of Rondonia. Production in Rondonia grew to represent as much as 10 per cent of the entire Brazilian crop, but due to the higher losses resulting from the lack of control of witches' broom in the area, output has fallen and will soon amount less than 5 per cent of the total. Brazilian cocoa farming is divided into the estate sector and the smallholder sector. In Bahia nearly 90 per cent of the farms surveyed are of holdings of less than 50 hectares. Nonetheless, about 55 per cent of Bahia's output is from the estate sector, which accounts for around 12 per cent of the farms.

Compared with the West African cocoa producers, Brazil has had much less direct government involvement in cocoa pricing, production and marketing. From 1957, when it established a cocoa programme under the newly-formed Comissao Executiva do Plano da Lavoura Cacaueira (CEPLAC) until recently, the structure of the Brazilian cocoa sector had changed little. Cocoa producer prices for Brazil, Malaysia and Indonesia, which are primarily determined by world prices, are depicted in Diagram 4.

CEPLAC used to be responsible for research (through the CEPEC), training (through DEPEX), agricultural education (through EMARC), construction of infrastructure in Bahia, and legal assistance. Until 1981 CEPLAC had financial autonomy, raising its resources from the 10 per cent levy on cocoa exports. From 1981 onwards, the Federal government assumed responsibility for its budget, and CEPLAC came under increasing criticism for its large number of employees, its declining service and training, and the politicisation of the institution itself once the government took direct control. As cocoa's importance, both in Brazil and in Bahia specifically, has diminished over time, and with the fall in world market prices in the 1980s, the government found itself less able and willing to support the activities of the cocoa sector through CEPLAC. The cut backs imposed on CEPLAC were not part of a formal structural adjustment programme per se, but were part of a general governmental move towards fiscal austerity and cutbacks in subsidies to the agricultural sector necessitated by structural adjustment, to the detriment of the various programmes. Credit for investments and subsidies through CEPLAC were gradually eliminated, and CEPLAC has recently been absorbed into the Ministry of Agriculture. All of CEPLAC's funds now come from the Brazilian Treasury.

CEPLAC now performs basic monitoring functions. In 1990, it cut 1,340 staff, closed a number of its offices in Bahia, and sold most of its property. The proceeds from the sale were to be administered by a committee with representatives of the

producers and government. Hence the role of the government in the cocoa economy has diminished substantially. The discovery of a new major pathogen (witches' broom disease) in May 1989 in the traditional cocoa zone of the State of Bahia has further reduced the already scarce technical resources of CEPLAC. It has also put farmers and their extension agents into conflict because the only useful control method which can be proposed at present is the removal of all the diseased vegetative tissues (called sanitation pruning). CEPLAC has undertaken to do this for the farmers, but with their participation. This is a major programme of activity which is now consuming a very large part of the now scarce financial resources of CEPLAC. The active extension programme to improve the agronomy of the crop has been effectively suspended to concentrate on control of witches' broom disease.

The only remaining area of direct government involvement in the cocoa sector was through what until recently was known as the Carteira de Comercia Exterior (CACEX), but is now known under the acronym DECEX, which, among other responsibilities, oversees all exports of cocoa beans and products. It is charged with issuing export certificates and ensuring that export earnings are deposited with the Banco do Brasil.

There is currently pressure on the government to provide debt refinancing to farmers so as to avoid them having to sell off their properties, to enable them to repay exporters and the processing industry and to improve productivity through application of needed inputs. Currently, interest rates are prohibitively high for farmers to borrow from commercial banks.

Brazil is expected to witness a fall in production in 1991/92 of nearly 25 per cent as a result of the low world prices and the lack of application of inputs for controlling disease, particularly black pod and the recently appearing and rapidly spreading witches' broom disease in Bahia. As a result of President Collor's plan to squeeze credit, financing from the government and exporters has dried up. Farmers have cut back significantly on labour as well, further enabling the rapid spread of pests and disease. This is doubtlessly one of the most difficult periods in history for Brazilian cocoa farmers. CEPLAC appears to have insufficient resources to combat witches' broom. In response, the National Cocoa Producers' Council has created a private fund, financed by growers' contributions, to control the outbreak of witches' broom. The fund was estimated to exceed US$1 million. Unfortunately, despite the length of time witches' broom has been present in the Amazon region, research efforts in Brazil have been concentrated on developing more productive varieties of cocoa suitable for Bahia rather than cocoa trees which are more resistant to witches' broom. It was always assumed by CEPLAC that witches broom would not spread from the Amazon to Bahia or that if it did, the disease would not thrive in Bahia.

Brazil, unlike its West African counterparts, is a more significant grinder of cocoa and consumer of chocolate. This is in part the result of incentives provided to the local industry following the Second World War as part of a general philosophy of industrialization and adding value to agricultural products. Consequently local processing expanded significantly during the 1950s, 1960s and 1970s, and Brazil became not only the largest grinder among producer countries, but also until recently the second largest cocoa grinder in the world. For most of the 1980s cocoa processing

in Brazil accounted for between 50-60 per cent of cocoa production, averaging around 235,000 tonnes per year. With the more recent withdrawal of incentives and subsidies necessitated by fiscal austerity measures, local processing has diminished, and slipped below 200,000 tonnes in 1988/89. Strong world demand for cocoa products in 1989/90 gave some boost to production, although it still remains weaker than during the mid-1980s.

ASIA

Governmental participation in the cocoa sectors of Malaysia and Indonesia has been similar to Brazil but different from West Africa in that, since inception, cocoa has been produced and traded in a relatively free market. Although now a crop of significant size, cocoa is relatively recent in both countries. Nevertheless, while important, cocoa is not as significant a source of foreign exchange in either of these countries as it is in the major West African cocoa-producing countries, excepting Nigeria. Finally, much of the cocoa is grown on relatively large scale industrial estates, although in both countries there is also a significant smallholder sector.

1. Malaysia

a. Macroeconomic

Unlike all of the other countries covered under this study, Malaysia is the only one not to have undergone any type of radical macroeconomic adjustment. While the collapse in world oil prices did have an impact on Malaysia's balance of payments and balance of trade, Malaysia's economy and revenue were sufficiently stable to enable it to accommodate the price drop. In a sense, this could permit us to see Malaysia as the control case, in which changes in technological adoption proceed in the absence of structural adjustment.

b. Cocoa Sector

The first cocoa trees were probably planted in Peninsular Malaysia in 1800, although commercial planting only started in the 1950s on a very small scale. The high prices in the 1970s stimulated enormous expansion. Cocoa expansion in Malaysia was undertaken with the support of the Malaysian government through its Ministry of Agriculture. It was promoted as an intercrop with coconut, especially as part of a poverty alleviation and crop diversification programme for smallholder estates. Plantations also moved towards intercropping of cocoa with coconut in order to diversify incomes. The government has provided some subsidised inputs, such planting material, as well as financed cocoa research through MARDI (the Malaysian Agricultural and Development Institution) which started cocoa research in the 1970s at its Hilir Perak Station to produce high yielding planting material. MARDI has done some useful background research and produced a limited range of improved material for the smallholders in Malaysia.

In Malaysia the plantations do not receive any Government extension support, though some assistance is directed to smallholders who are located on the Government settlement schemes. The arrangements do not exist in Malaysia to advise

farmers of any important technological advance should the need arise, except by use of radio and television advertisements.

Throughout the 1980s, a period when all the other case study countries were adopting massive structural adjustment programmes, the government of Malaysia continued to provide institutional support, mainly in the form of legal controls and regulations for the cocoa sector. In 1980, the Federal Agriculture Marketing Authority (FAMA) instituted the Cocoa Marketing Regulations which stipulated that all cocoa buyers be licensed, and that all exported cocoa beans are graded and certified by FAMA. The objective was to ensure greater control over the quality and marketing of smallholder cocoa, where the greatest quality problems lay. The following year FAMA introduced its Wet Bean marketing Programme, which undertook to process and market smallholders' cocoa in order to improve its quality. In 1983, the Cocoa Grading and Certification programme was launched, and all exported beans were required to bear the trademark of the organisation. Grading centres were established for carrying out the programme. This effort appears to have been successful in improving the quality of cocoa exported, as Malaysia's discount on the world market has narrowed.

Cocoa was also addressed explicitly in the Fourth Malaysian Plan (1981-1985), which aimed to increase the area and production of cocoa. Assisting in this effort were the Federal Land Development Authority (FELDA), the Federal Land Consolidation and Rehabilitation Authority (FELCRA), the Integrated Agricultural Development Projects (IADPs), State Economic Development Corporations (SEDCs) and Regional Development Authorities (RDAs).

Finally, the government established the Malaysian Cocoa Board (MCB) in 1989, and it became fully operational in 1990. While it was modelled on the Rubber and Palm Oil Boards, it has a broader role, since cocoa is a relatively smaller crop. One aim has been to gather cocoa research, previously carried out in several different bodies, under one organisation. It will also be responsible for registration, licensing and promotion of Malaysian beans and products. The MCB is being funded by the government. While there has been discussion of levying a cess on cocoa exports to finance the MCB, to date, and perhaps for the foreseeable future, it is unlikely to happen, especially given low world cocoa prices.

It is ironic that as West African countries are abandoning or being pressured to greatly reduce the activities of their commodity boards, that Malaysia is establishing one. However, it is important to stress that the MCB is not undertaking to market the cocoa and set producer and marketing prices, but aiming to increase coordination within what was a very free and unorganised cocoa producer sector.

Cocoa processing in Malaysia has expanded rapidly from 30,000 tonnes in 1986/87 to nearly 90,000 tonnes in 1990/91. The government of Malaysia has promoted value added through processing of primary commodities. It appears to be offering tax holidays for companies which are established in less developed areas of Malaysia, but other than that it does not seem to be offering any other types of subvention.

2. Indonesia

Indonesia was one of the earliest centres of cocoa cultivation — cocoa was first planted in the Celebes in 1560. In the 18th century a number of selections of high yielding flavour types were made and planted in Java. Cocoa cultivation continued at a low level, but with limited success largely because of two major pest problems (Conopomorpha cramerella or Cocoa Pod Borer and Helopeltis spp.). From 1910 until about 1980, many cocoa trees in the Celebes were gradually cut-out and the land replanted with other crops due to the inability to control the Cocoa Pod Borer, even when insecticides became available in the later years.

a. Macroeconomic

In 1983, following the collapse of oil prices, Indonesia undertook a massive structural adjustment programme. The aim of the policy at the outset was to ensure macroeconomic stability, and focused on the exchange rate and trade regime, fiscal policy, monetary policy, financial policy reform and revision of the regulatory framework.

Indonesia undertook its first major devaluation (28 per cent) relative to the US dollar in 1983, followed by another 31 per cent following the oil price collapse in 1986. Since that time there has been an average depreciation of 5 per cent per annum. One important aim and outcome of this programme has been the incentive to develop non-oil exports, including cocoa.

Another cornerstone of the programme was the liberalisation in 1985 of the trade and tariff system and reform of the customs, ports and shipping regimes. One of the purposes was to shift Indonesia from an import substitution policy to an export oriented one. These reforms enabled producers and investors to have access to inputs at world prices, and abolished export licenses for most items. It also relaxed conditions for foreign investment. For investors in manufacturing, the programme also liberalised and decontrolled licensing systems.

b. Cocoa Sector

Ownership in the Indonesian cocoa sector falls into three broad groups: the government estate sector, know as Perseroan Terbatas Perkebunan (PTPs), which were previously foreign-owned estates and nationalised after independence; private estates otherwise known as Swasta PT, and smallholders. The PTPs are the oldest plantations, and are responsible for between 45 per cent - 50 per cent of output, although accounting for only around 25 per cent of total land planted to cocoa. Many PTPs cultivating various crops were provided with financing from the World Bank, the Asian Development Bank and other lenders on the condition that smallholder plots were attached to some the nuclear estate. These estates with smallholders attached are known as Perushahaan Inti Rakyats (PITs). Most PITs are not cultivating cocoa, but other crops; however, there are two schemes for cocoa, one in East Java and one on PTP XXIII in South Sulawesi, with the nuclear estates responsible for purchasing, processing and marketing the cocoa.

Other smallholders are entirely private, and vary in size, from 10-20 hectares in Sulawesi to less than 0.25 hectares allocated through the transmigration programmes. They account for about 40 per cent of production, but on an area nearly three times that of the PTPs. Poor planting material, which are not high yielding, is reportedly the main reason for lower productivity, although some smallholder plots have recorded yields of 1.0-1.5 tonnes per hectare. Some smallholder areas do suffer from poor husbandry methods though. The small growers on the Transmigration Schemes often receive inadequate advice; the amount and the quality of assistance generally depends largely on the arrangements made by Government for the management of each individual Transmigration Scheme. However, some of the advice is good, and high quality media material is used.

In the mid-1980s a project was commenced in the provinces of North Sumatra, Bengkulu and Lampung with the aim of promoting exports. This was to be done through expansion, rehabilitation and replanting. The loan was originally financed by the World Bank through National Banks, and were on-lent to smallholders for procuring seeds, seedlings, fertiliser and other inputs. However, financing was terminated from the World Bank because project aims were not met. While the project and some staff remain in place, with the scarce resources available it only provides advice, together with Estates Crop Services which are run at the provincial district level.

The third group of cocoa cultivators are the private estates, or Swasta PTs. Most have appeared within the last ten to fifteen years, and are the outcome of liberalised land allowances and access to credit at competitive rates. They comprise approximately 10-15 per cent of cocoa production on around 8 per cent of the land under cocoa cultivation.

The most recent government 5 year plan, known as Pelita V, gives explicit emphasis to encouraging the cocoa sector, as well as to encouraging other export crops. It has set targets for planting and production. Production is expected to rise as a result of cocoa husbandry, replanting and new plantings.

Some financing of the cocoa sector has been made available which should improve the adoption of technology. The European Commission financed a detailed cocoa sector review, and the analysis and proposals contained therein included a number of recommendations concerning research, extension, quality improvements, marketing and support for the industry associations. UNCTAD/ITC/GATT have also given financial support for developing the software to improve the marketing, trading, shipping and hedging of Indonesian cocoa. While not directly a part of the structural adjustment programme, this assistance has been incorporated as part of Indonesia’s strategy for promoting non-oil/liquid natural gas exports.

On the whole, the structural adjustment programme in Indonesia has had a minimal direct affect on the cocoa sector. The government continues to finance research through 3 of its laboratories, although it has recently undergone an administrative change, being moved under the association of research labs which is funded by the government state-owned plantations. It has been charged that the state-operated research, while adequately funded, is removed from the more immediate needs of cocoa growers, and does a poor job of communicating its findings. Both

private and public estates tend to undertake their own research on areas such as fermentation, drying and quality improvement of the cocoa beans.

As indicated in Chapter II, estate owners in Java established a research station for cocoa in 1901 and another for tree crops in 1925, which were taken over by the Colonial Administration in 1933 to avoid financial difficulties. Until the 1980s cocoa had not been an important crop in Indonesia, but the Government (usually through their own plantations) continued to carry out research at a low level to improve the productivity and enhance the quality of cocoa, and funded an advisory service and a series of experimental gardens for the testing and demonstration of superior selections and the propagation of budwood or seed. In addition, both the government owned and the privately owned estate groups interested in cocoa have employed one or several agronomists to carry out field testing and decide on new agronomic practices. This structure has continued until the present day.

In Indonesia, the plantations receive no Government extension advice on cocoa cultivation and unfortunately not all of the very substantial areas of cocoa presently being planted are being established under the best possible conditions. It is becoming clear that even some of the largest growers could benefit from advice derived from better agronomic research. This situation has arisen because cocoa is such a new crop on the islands of Indonesia where it is now being established in large quantities over a short time period.

According to private cocoa estate sources in Indonesia, since 1983 the government has "de-bureaucratised" its involvement in cocoa, and the private sector has replaced it in a number of its previous functions. These include research, training and extension and marketing. The role of the private sector in the diffusion of technology is covered in greater depth in the next section.

Until recently, the quantity of locally processed cocoa in Indonesia was relatively small, at only 12,000 mt in 1986/87. However, the industry is expanding, although with private financing. The government has promoted cocoa processing primarily in its rhetoric. It has also provided tax allowances or holidays for industries in remoter areas. There have also been some tax-free arrangements for foreign investment, but in general government support has been minimal.

V. THE CONSEQUENCES OF STRUCTURAL ADJUSTMENT ON THE COMPETITIVENESS OF COCOA-PRODUCING COUNTRIES

This Part of the study ties together the implications of the previous four Parts by looking at the impact of structural adjustment on the competitiveness of the main cocoa producer countries. Specifically, it analyses how structural adjustment has affected the resources and efforts for research, development and adoption of technology in the cocoa sector. It concludes with a series of findings and recommendations emphasising the importance of cocoa research and development and the necessary components for advancing them.

Competitiveness of Cocoa Producers — Definition

Factor costs have traditionally been the most important determinant of competitiveness in the cocoa sector, with those countries which have the lowest factor costs being the most competitive. The main cocoa producers continue to be dependent on natural resources and unskilled or semiskilled low cost labour or family labour rather than technology as the dominant portion of their total costs. Given that cocoa technology is relatively simple and widely available (e.g, there are no technological barriers to entry as there are in industries such as consumer electronics or fine chemicals), countries which have traditionally been heavily dependent on cocoa production are vulnerable to the entry of new competitors, such as Malaysia and Indonesia, who will be able to compete on cost grounds.

Nevertheless, even basic technology can and has influenced the competitive advantage of cocoa producers by lowering their costs of production. Technology which raises output per hectare and/or per labourer, or which improves the quality of production and thereby raises the selling price of cocoa, provided it costs less than the benefits, can improve a country's competitiveness. This is exemplified by the performance of high yielding varieties which have given greater returns to land and labour, and of mechanical fermentation and drying facilities which have enabled economies of scale and a reduction in costs. Furthermore, where there has been product differentiation, for instance in Ghana, which provides a high and consistent quality of bulk cocoa which sells at a premium price, new technology appears to be enabling a replication of this quality on a large scale and could enable low cost potentially efficient producers such as Malaysia and Indonesia to begin to compete on qualitative grounds as well. Certainly if all cocoa-producing countries were to adopt even these basic advances in technology, the combination of higher yielding cocoa and high quality cocoa would drive down prices overall and would lead to the elimination of the price premium for the higher quality cocoa such as that found in Ghana.

As mentioned in the introduction, this paper is confined to examining a specific chain of causal effects: how structural adjustment affects the use and adoption of technology in cocoa, and how in turn, this has and may alter the short to medium term competitiveness of producer countries. The causal chain depicted in Diagram 1 is expanded to include the impact of structural adjustment on competitiveness in Diagram 5.

Risk and Price Uncertainty

Investment in technology can be and often is accompanied by risks. For instance, if there are certain strains of high yielding varieties which are more susceptible to disease or require a greater application of inputs than traditional varieties, then farmers will have to calculate the benefits against these risks before deciding to embark on planting with these new varieties. If the producer price to the farmer or the price of inputs is fixed, then it may be much easier for the farmer to calculate the trade-offs. However, if the producer price is not set, then the decision of whether or not to adopt new but more insecure techniques will depend upon the farmer's risk preference or risk aversion, with the latter requiring a much higher pay-off from the new technology than the former to induce him to go ahead with the employment of new technology.

While price uncertainty always exists, it can be increased in several ways, including fluctuations in producer prices and prices of inputs as well as exchange rate fluctuations. As we examine how structural adjustment may have affected the competitiveness of individual countries' domestic cocoa industry *via its effect on technology*, we will analyse the extent to which price uncertainty has been changed in this chain of relationships.

It is important to note that fixed exchange rates and/or producer prices may also elevate uncertainty. Although historically, cocoa prices have gone up in nominal terms, this has not always been the case in real terms, particularly in Ghana and Nigeria before structural adjustment. An inappropriately fixed producer price, as was seen in Côte d'Ivoire during the 1980s, which encourages farmers to continue expanding cocoa in the face of a world surplus and falling prices, can exacerbate world price depressions, ultimately resulting in greater price uncertainty. Furthermore, if prices are fixed too high relative to world prices, as seen in Côte d'Ivoire and Cameroon in the 1980s, there can often be an expectation that governments will resort to massive, unannounced devaluations or reductions in producer prices. Consequently, a pre-announced or fixed price is no guarantee of greater certainty and/or less risk.

Impact of Structural Adjustment on Absolute and Relative Costs of Production

By and large, the most important effect of the structural adjustment programmes on the costs of production and competitiveness in cocoa-producing countries has been through labour costs. In all the countries covered in this paper, cocoa cultivation is labour intensive, to a greater or lesser degree. Generally, given the capital scarcity and labour abundance of these cocoa producer countries, savings have come about through layoffs and reduced wages. Low world cocoa prices have further influenced this trend. It appears that few of the major producers, excepting Malaysia, are looking

to the development and use of technology, including planting of high yielding varieties, greater utilisation of pesticides, fertilisers or other inputs which would raise output per hectare, or the adoption of mechanical fermentaries and dryers for cocoa, to reduce costs of production and increase competitiveness. Nearly all of the countries appear to be cutting back on the use of inputs, which in the short run may enable them to lower costs and withstand this period of low prices, but in the longer term could be harmful to yields and overall production. Only in Ghana, Indonesia and, questionably, in Nigeria is planting going ahead. While Indonesia is using HYV varieties, which should improve their longer run costs of production, Ghana appears to be using a mixture of both the traditional Amelonado and some HYVs. Brazil's cutbacks on labour and crop maintenance are already resulting in a substantial drop in output, and could have long term implications for the productivity of the cocoa sector. For each country, we examine to what extent the structural adjustment programmes have affected competitiveness through technology.

1. Côte d'Ivoire

At the macroeconomic level, the most important impact of the SAP on the cocoa sector is due to the country's refusal to devalue, which has forced the producer price rather than the exchange rate to bear the burden of low world cocoa prices. However, this was a government decision (although whether one can ascribe responsibility for this decision to the French government or the Ivorian government is difficult to say) rather than a World Bank/IMF directive. By cutting the cocoa producer price in 1989/90, the government has enabled the CSSPPA to move out of its budgetary deficit, although not out of debt; consequently, research and extension is seriously under-funded. There appears to be little or no private sector support to fill or replace the public sector's role.

While farmers have an apparently high degree of price certainty due to fixed exchange rates and producer prices, this is little cause for comfort given the current relatively low level of the latter. One study on producer price stability in the Côte d'Ivoire concluded that, while the pricing policy adopted by the government since independence has reduced the instability of incomes from cocoa for both cocoa producers and handlers, "the extent of the reduction does not seem to have been that great, particularly when compared to the impact on the instability of public sector revenue. In the case of cocoa, income instability was not lowered as much as it could have been, largely because the pricing policy introduced a strong positive correlation between the fluctuations of the producer price and output." (Todd, 1990, p.73). Producers now have every incentive to cut back costs, particularly wages and the number of day labourers. While this has significantly improved the Côte d'Ivoire's short term competitiveness since 1986/87, when the Côte d'Ivoire was ranked sixth out of sixteen of the largest cocoa producer in LMC's survey of costs of production, it could have longer term consequences. For instance, the use of chemical inputs and fertilisers has been noticeably curtailed. However, while these reductions in pesticide inputs will not significantly affect the costs of production, because even in the best of times the Côte d'Ivoire's outlay on chemicals of fertilisers did not amount to more than 3 per cent of the total costs of production and covered only a fraction of the total cocoa area, Ivorian yields are expected to stabilise or fall back in the mid-1990s due to the rise of capsid attacks largely due to the cutback on pesticides.

Although the Côte d'Ivoire is now classified in the group of lowest cost producers, it will have to maintain or increase yields in order to sustain this position, especially if producer prices are ever to be raised. Yields per hectare have risen steadily over the last decade, exceeding 600 kilos per hectare, but are unlikely to continue to rise and are liable to fall due to the rise in capsid attacks and the cutbacks on labour and maintenance. One positive offsetting factor is the continued increase in the number of trees falling in the maximum bearing age of 8 to 20 years, which should sustain or even augment yields for the next decade.

Financing from the World Bank enabled SATMACI to continue operating in the mid-1980s, thereby supporting farmers and the government through a difficult period. Unfortunately, the current impasse in negotiating a follow-on project for training, extension and research, combined with low cocoa producer prices, could harm the competitiveness of the Côte d'Ivoire in the medium term. This is highly unlikely to seriously jeopardise its position as the number one producer in volume terms, given the size of its tree stock and the few alternatives available to the large number of smallholders; it is conceivable though that the situation will make them less cost competitive. The question is, can this be ascribed uniquely to structural adjustment? Surely, much of the current difficulty lies with the low producer price necessitated by the incomplete adoption of structural adjustment, especially the insistence on maintaining a fixed exchange rate.

2. Cameroon

The structural adjustment programme in Cameroon was supported with a project that specifically addressed the coffee and cocoa sector. The World Bank-funded training and extension project and sector adjustment loan propped up SODECAO and its efforts. It provided financing for training, extension and distribution of inputs for the latter part of the 1980s. Unfortunately, low world cocoa prices, together with an unsustainably high producer price at the time forced the government to cut back its financing of inputs and extension. Furthermore, SODECAO's efforts and resources were channelled to the marginal cocoa growing areas, rather than the areas with greatest potential. Consequently, as in the Côte d'Ivoire, the government in Cameroon, unwilling to devalue, resorted to halving the producer price at the same time as it was liberalising the prices for inputs, and, not surprisingly, farmers have cut back on costs, particularly labour. This move alone has lowered the costs of production substantially, moving Cameroon from number seven in 1986/87 in LMC's survey of costs of production to being amongst the very lowest cost producers. However, with the producer price doing most of the work in pulling the ONCPB out of a budgetary deficit, if not far out of debt, and with the structure of the research, extension and training institutions nearly gutted, Cameroon's competitiveness in the near to medium term is under threat.

Farmers have not, for the most part, picked up where the government left off in terms of spraying. Furthermore, little if any private sector support for research, inputs and extension has materialised to fill the gap. Yields per hectare are declining, due to the aging stock of trees and the spread of Phytophthora, and many farms have been abandoned. The World Bank is trying to address these problems under a revised version of the training and extension project to rehabilitate and restructure the cocoa

sector, particularly by explicitly recognizing the need to continue supporting SODECAO and its distribution of inputs, even at subsidised prices, until world cocoa prices recover. The greatest remaining obstacle to implementation, however, is the low producer price, which is discouraging farmers from replanting and maintaining their crop, and inadequate access to credit for purchasing necessary fungicides.

3. Ghana

One of the key elements of Ghana's SAP at the macroeconomic level has been the move to a floating exchange rate. While adding an element of insecurity to farmers' income, the exchange rate has remained relatively stable for the last few years. Furthermore, the government has tended to move the fixed producer price up in line with or above the level of devaluations, and farmers real earnings from cocoa as a proportion of the world price have gradually risen since the beginning of the SAP (although it still remains significantly below the producer price in Malaysia and Indonesia at about half of their level). It is this increase in income which has been the greatest incentive to the rise in replantings and the rehabilitation of Ghana's cocoa stock. Trade liberalisation and improved access to even basic inputs, such as cutlasses, have been essential to the rehabilitation of the cocoa sector.

Cocoa has been one of the main foci of the ERP, ASRP and CRP programmes, which has sought to raise output and strengthen the infrastructure and support services to the sector, as well as to cut the overhead costs of the GCB. While the gradual elimination of subsidies for inputs has raised the cost of inputs to farmers, this has been partly offset by higher producer prices. Nevertheless, in 1990/91 pesticide usage dropped significantly. However, there has traditionally been very little use of inputs by farmers, so rising prices have not had a dramatic effect on overall costs of production or competitiveness. Readier access to credit, thanks to the SAP supported rural credit programmes, has made it easier for farmers to purchase necessary fungicides, insecticides and pesticides. Nevertheless, it has not encouraged the wider applications of such products necessary to raising output and making production more cost effective.

In the 1986/87 production costs survey, Ghana ranked first as the lowest cost producer, primarily because of its low wage costs. While somewhat higher producer prices have pushed up wage costs slightly, they have also boosted output. However, given past bush fires, the ageing tree population and a slowing in the replanting rate (albeit of some HYV trees) that appears to be only equal to or less than the attrition rate, the harvested cocoa area has declined between 1982/83 and 1990. Offsetting this is better maintenance and planting of HYVs, such that output per hectare should increase, resulting in a relatively stable production level of approximately 300,000 tonnes of dry cocoa per annum. This modest rise in yields per hectare should help compensate for the gradual rises in real producer prices, and Ghana's position as one of the lowest cost producers, both now and in the future, should be maintained. Finally, given that Ghana also receives the highest price for bulk cocoa amongst the major cocoa producers, its low costs of production will ensure that it remains one of the most competitive cocoa producers.

The ERP, ASRP and CRP must be assigned much of the credit for the improved situation and outlook, especially through its promotion of higher producer prices and lower overhead costs. One potential caveat could be that if the World Bank pushes the privatisation of the GCB without very careful attention to a quality maintenance programme, it could lead to a decline in quality and, with it, revenues accruing from Ghana's price premium, which would be tantamount to a Nigeria-style calamity.

4. Nigeria

The elimination of the NCB had a positive impact on cocoa output, and a negative one on cocoa quality. Skyrocketing producer prices, which had previously been controlled and set at a very low level relative to the world price, induced better maintenance and replanting. Yields per hectare rose in the first few years following liberalisation. However, the wide gyrations in internal producer prices resulting from liberalisation, combined with the continued devaluation of the naira in the auction, resulted in widespread confusion and speculation in the cocoa market (recall Diagram 3, where producer prices rose in excess of world prices in 1988/89!). While some inputs are still subsidised by state governments, the price for fungicides has risen significantly due to the devaluations, with some reports of a 400 per cent increase in costs (although the producer price has risen in excess of fivefold). Some traders have been extending credit for inputs, but there are reports of difficulty in securing reimbursements. Spraying against capsid or Phytophthora pod rot has become difficult, as there is little or no support now from extension workers, and it is costly and difficult for the small scale farmers themselves to undertake the spraying, which requires expensive mistblowers or knapsack sprayers. Replanting appears insufficient to replace dying or dead trees, so area as well as yield per hectare could fall in the medium term. Meanwhile, the research efforts of the CRIN are effectively moribund.

While far from the highest cost cocoa producer in the world, Nigeria's position (which was eighth in 1986/87) does not look set to improve in the medium to longer term. Higher producer prices were offset by higher output, and cutbacks on input utilisation have also contained rises in the costs of production. However, the reduction in financing and staffing of research and extension facilities, the lack of application of insecticides and fungicides, and the variable quality of Nigerian cocoa could conceivably undermine Nigeria's competitiveness in the longer term. On top of this, fluctuating cocoa prices and exchange rates make it difficult for farmers to plan for the future, as is evident in the low level of cocoa replanting. Cocoa farmers appear to be increasingly dissatisfied with this commodity, and are beginning to look for possibly more lucrative alternatives. The long term outlook for Nigeria is one of steady decline, punctuated by brief revivals as and when world prices rise, and a potentially permanent loss of revenue it once had from its quality premium.

5. Brazil

The Brazilian cocoa sector is going through possibly the largest crisis in its history. Low world prices, higher fertilizer prices, cut backs on labour (which in turn is contributing to the spread of witches broom and Phytophthora), and the consequent falling yields per hectare, are causing considerable distress to cocoa farmers, and this

is likely to continue for several years. If world cocoa prices were to rise quickly and significantly, the cocoa sector would likely recover and resume its previous reasonably healthy status. However, more ominous has been the gradual decline in the financing and staffing of CEPLAC, and the termination of much of its research. Combined with the relatively uncontrolled spread of witches broom and Phytophthora, Brazil, which is already a high cost cocoa producer relative to the other countries covered in this study (it ranked thirteenth out of sixteen in terms of producers covered in LMC's survey), may have even greater difficulty competing with producers such as Indonesia, Ghana and the Côte d'Ivoire.

Economic austerity programmes have affected Brazil's cocoa industry, although primarily indirectly. Other than through CEPLAC, the Brazilian government has traditionally had little to do with the cocoa sector, and producer prices have been determined by world market prices. The decline of CEPLAC has been primarily a result of low cocoa prices, although one could argue that Brazil's ongoing adjustments to a series of economic crises has also forced it to make cutbacks across governmental institutions. However, many in the cocoa industry felt that CEPLAC had become overstaffed, with negative consequences for research and extension budgets, and that at least cutting back on staff numbers has had some positive benefits. More indirectly, the series of exchange rate devaluations and periodic bouts of inflation have affected investment in the cocoa sector through the accompanying increase in uncertainty. Perhaps the greatest uncertainty has been injected by the current administration, with President Collor's plan to control credit having one of the most debilitating effects on cocoa traders and the local bean processors, and in turn on the farmers. Liquidity constraints have turned some business' cash flow problems into disasters, resulting in periodic bankruptcies. The cocoa sector appears set to contract in the short to medium term.

6. Malaysia

Malaysia's position as a cocoa producer has been relatively free of the effects of structural adjustment, since Malaysia has had the singular distinction of not having had to take this medicine on any large scale. While in 1986/87 Malaysia ranked fourth in the costs of production survey, it has fallen back due to the rising cost of inputs, including labour and fertilisers. The transition to a semi-industrialised country has driven up wage rates in Malaysia, forcing many plantations to turn to immigrant Indonesians for lower cost workers. A number of plantations are removing fields with yields of less than 1,500 kilos per hectare. Nevertheless, Malaysia remains cost competitive, given the high yields per hectare and the intercropping with other crops on many estates, enabling the plantations to cover periods of low prices with revenue from alternative sources. Furthermore, the government has supported the move to greater quality control by introducing new regulations and oversights, which could reduce somewhat the discount and increase the returns to Malaysian cocoa. Nevertheless, cocoa production has now stabilised at 230,000 tonnes of dry beans per annum and in the long term is likely to contract. The biggest threat to the Malaysian cocoa sector lies not with competitors from elsewhere, but from the loss of much of its low cost labour force, more attractive returns from other crops and from selling the land to industrial estates as Malaysia continues on its trajectory to an industrialised country.

7. Indonesia

Structural adjustment has had little, if any, direct impact on technology and the competitiveness of the Indonesian cocoa sector. The devaluation and the goal of increasing Indonesia's non-oil exports has helped the producers indirectly: the devaluation raised domestic producer prices, which are determined on a free market basis, and the promotion of non-oil exports resulted in the reform of the trade and tariff regime. By enabling producers to have access to inputs at world prices rather than higher domestic prices, there were greater returns to farmers purchasing these inputs. While the government has set targets for planting and production, it has taken a largely hands-off approach to implementation, and has been disengaging from (or "debureaucratising" its involvement in) activities affecting the cocoa sector. While the private sector (e.g., some of the private estates) has traditionally been involved in some of these areas of activities, including research and extension, it does not appear to be replacing the governmental endeavours.

Indonesia's position as one of the lowest cost producers (it was third in 1986/87) is due to two main factors: low wage rates and high yields per hectare, especially on plantations. Furthermore, unlike Malaysia, Indonesia's position as a low cost producer has remained, and should remain secure for some time to come, because wages have not risen significantly. Furthermore, as the Malaysian cocoa sector cuts back on some of its managerial staff, these experts have migrated to Indonesia, bringing their expertise with them.

Indonesia continues to plant cocoa, which remains profitable even at the current low world prices. If the government and private sector are effective in exerting more control over quality, Indonesia's discount for cocoa could narrow and its returns rise. In any event, Indonesia is set to remain one of the world's most competitive cocoa producers, although only very indirectly and insignificantly because of the effects on technological adoption due to trade liberalisation and devaluation under the structural adjustment programme.

Conclusions and Policy Implications

It is estimated that 80-85 per cent of the world's cocoa production is grown by small holders with less than 5 ha of cocoa. In large part it is likely to remain a smallholder crop, although the estate sector will continue to account for a substantial proportion of cocoa production. Low labour and maintenance costs in key smallholder producer countries, particularly West Africa and Indonesia, are important reasons for the continued significance of smallholder production. Large estates are more dependent on labour and other inputs, which make them more vulnerable to low world prices. It is thus inappropriate to consider or refer to cocoa as a "plantation crop" — a classification with which the crop has been branded for many years. Small cocoa farmers need support from the international donor community as much as small food crop farmers. Furthermore, for the financial stability of the economies of the major cocoa growing countries, the governments need the export revenue, arguably as much as they need to generate savings from import substitution.

The chocolate industry is most concerned with ensuring the supply of good quality cocoa. There are significant legal and technical limitations on using substitutes for chocolate products. While there is an allowance in parts of the European Community for using up to 5 per cent cocoa butter substitutes, it is unlikely that there will be any significant growth in the use of replacements. A few confectionery companies are researching into alternatives to chocolate, but are likely to have only limited success, for the legal and technical reasons given. For the most part, confectionery companies rely on field contacts and traders for obtaining good quality cocoa. Some also have ongoing projects in cocoa producer countries, as described in Part III. They also contribute financially to their trade organisations, which in turn help finance institutes such as ICG,T and CATIE.

Despite organisations such as ICG,T and CATIE cocoa research is far behind other "plantation" crops in terms of work on plant breeding genetics and biotechnology, mainly due to the lack of development of an efficient tissue culture system. Consequently, it will be at least ten years before any commercial application of new biotechnologies will be realised. The efforts at breeding higher yielding more vigorous and disease resistant planting material during the decades of the fifties, sixties and seventies were only partially successful. The yields of some of the so-called hybrids (HYN) are little better than those of the traditional planting materials which they were supposed to replace. Farmers in some areas are therefore now showing a preference for the traditional types, if only because planting them is less risky than planting HYNs. Many of the problems noted in Part II require work on genetic resources for which long-term secure funding would be desirable. This in turn demands greater international coordination of effort for conservation, characterisation, classification and exchange of cocoa genetic resources, and breeding aimed at the production of new hybrid varieties; consequently, much of the ground work is beyond the scope of one or several individual country efforts. There is little investment in modern biotechnology for cocoa being made in the industrial countries and cocoa is of enormous importance to a number of Third World economies. Cocoa therefore, together with coconut and banana/plantain fits well into the definition of an "Orphan Commodity" as described by Persley (1990). It was suggested by Sondahl (1990) that substantial constraints to cocoa productivity presently exist which are only likely to be solved in the longer term.

Certain diseases affecting cocoa, particularly Phytophthora, witches broom and cocoa swollen shoot virus would be most effectively combatted in the long run by developing resistant strains of cocoa. As for capsid, the best remedy is well known — adequate canopy cover and protection of predatory ant nests — but this information is inadequately disseminated or applied. Meanwhile, the development of improved planting material and control of specific pests and diseases unique to each countries' needs are hampered by under-funding both internationally and within producer countries. This is primarily due to a general lack of coordination amongst cocoa producers, consumers and donors, exacerbated by the current low world cocoa prices resulting from the structural surplus overhanging the market.

Where individual country efforts are concerned, the news is not much better. In West Africa, where cocoa is grown exclusively by smallholders, and governments are heavily dependent upon cocoa for revenue, the problem of under-funding is magnified by low world prices. Nevertheless, it is in Côte d'Ivoire, Ghana and

Cameroon where structural adjustment programmes have attempted to address more explicitly the needs of research and extension with the provision of financial and technical assistance. However, in view of the world surplus and low prices, the World Bank is also discouraging any significant expansion in cocoa production. Much of the effort to improve the economic performance of the cocoa sector in these countries has been hampered by domestic political, financial and other constraints. In Brazil, the government has withdrawn much of CEPLAC's political and human capital for research and extension, although this action is partly in response to a dissatisfaction in the direction taken by CEPLAC in the last ten years.

It is significant that, of the countries covered in this paper, the few places where cocoa research has continued apace are those countries with a notable plantation estate sector, e.g., Malaysia and to a lesser extent Indonesia. Be they private or public, a number of large cocoa estates undertake their own research, some of it for public dissemination. Currently, the biggest impact on their budgets and efforts is low world cocoa prices, not structural adjustment. It must be remembered that some of the larger plantation companies in Malaysia have recently decided to up root some cocoa fields where yields are less than an average of 1.5 tonnes per planted hectare. They are replanting them with rubber or oil palm in the place of cocoa. It should be recalled that only the best cocoa farms of the small farmers in West Africa ever achieve a yield as high as 750 kilos per hectare! While in theory the Indonesian government looks after extension to smallholders, in practice the effort has generally proved inadequate. In Malaysia, the provision to smallholders is only marginally better, with the government supplying some HYV planting material and advice, but not much more. Neither government provides direct assistance to private estates. Government macro-economic policies have encouraged the export sector generally, including the cocoa industry. Hence, structural adjustment measures have had an indirect impact on privately or publicly funded research. In Malaysia economic policy has shied away from setting prices, and hence economic adjustment has had no impact on producer prices or on variable or absolute costs of production, which remain functions of world cocoa prices and other domestic factor costs. In Indonesia, structural adjustment, which resulted in the liberalisation of the trade and tariff regime, has lowered the costs of production marginally by making available imported inputs at world prices.

Where cocoa is grown primarily by smallholders, particularly West Africa, colonial and post-independence governments have born the largest responsibility for cocoa research. Extension, which has not always been successfully tied to research, has been the responsibility of the African governments. Prior to the structural adjustment programmes of the 1980s, there was little consistent funding for research, and even less practical output and extension of research findings, with the exception of the Côte d'Ivoire's SATMACI in the 1980s, which, along with attractive producer prices, deserves much credit for the expansion of the Ivorian cocoa sector.

Low world cocoa prices for most of the 1980s contributed to the financial crises of the cocoa marketing bodies of Côte d'Ivoire, Cameroon, Ghana and Nigeria, and research and extension suffered. In the case of the first three countries, structural adjustment has opened the way for a re-infusion of much needed cash and periodic technical assistance. In the case of Nigeria, it has resulted in a sweeping eradication of all public support systems, save the barely existing research institute, with almost no replacement by private sector assistance.

In the short term, it has been the change in the producer price which has determined the direction of cocoa production. Higher real cocoa producer prices in Ghana and Nigeria, one outcome of the structural adjustment programmes, have stimulated output and the use of greater inputs. Furthermore, ODA assistance for structural adjustment in Ghana has also marginally improved the medium term outlook by providing grants in support of research and extension. Counteracting both of these is the liberalisation and resultant increase of input prices, which has recently depressed utilisation; however, if the government was to further increase producer prices in Ghana, which remain relatively low compared with Malaysia and Indonesia, then one would expect to see a greater use of inputs and rising yields, improving Ghana's status as one of the lowest cost producers. Even though the farmers' price (guaranteed by the Ghana Cocoa Board) is a relatively low percentage of a very low world price, farmers acknowledge that the system is honest and fair, and the necessary farm inputs are available, as are food and consumer goods. That farmers are planting cocoa once again is testimony of their overall optimism about cocoa. In turn, this should benefit the country's foreign exchange reserves, thanks to the 3 per cent to 5 per cent quality premium received by Ghana cocoa.

In Nigeria, structural adjustment has meant short term improvements in producer prices and the competitiveness of the cocoa sector, but at the cost of completely losing its quality reputation and a premium equal to Ghana's prior to liberalisation. If no system is developed to replace the quality control infrastructure and extension services, and to revitalise research, then Nigeria's longer term position as a competitive cocoa producer is in jeopardy.

The Côte d'Ivoire and Cameroon's position as competitive cocoa producers has been harmed most in the short run by trading off the maintenance of their fixed exchange rate for low cocoa producer prices. However, cocoa prices in the Côte d'Ivoire had to be reduced somewhat in order to discourage an expansion in output. In the long run, competitiveness will be adversely affected by their low producer prices, overvalued exchange rates, inadequate quality control and poor management of funding for research and extension, despite the availability of project financing as part of SAPs.

In sum, the most significant impact, positive or negative, of structural adjustment programmes on technological development and adoption in cocoa has been in Africa. In the short run the greatest influence has been through changing the producer price. Future efforts on a country level to rehabilitate and improve the competitiveness of the cocoa sector must emphasise the importance of giving a remunerative price to the cocoa farmer. This is far more effective than any program

of subsidised inputs or the provision of extension workers who undertake the work of cocoa farmers, such as the spraying campaigns in Cameroon.

Macroeconomic stability is also very important to supporting the cocoa sector. This stability ought to comprise realistic and sustainable exchange rates and inflation rates. Microeconomic support in the form of liberalised capital markets accompanied by institutions providing credit to smallholders, research and extension agencies and encouragement of either formal or informal cooperatives would also be very beneficial. In the longer run, structural adjustment has contributed to, or undermined, competitiveness by supporting (Ghana) or subverting (Nigeria) research and extension efforts, including the quality control infrastructure. Clearly a lesson is to be learned from these two countries' experiences, and more effort must be given to preserving the infrastructure for quality control and for undertaking research and extension. This is particularly true for countries where smallholders predominate (e.g, all West African countries, as well as parts of Malaysia, Indonesia and Brazil). Smallholders have traditionally been unable to support their own research needs, and generally the public sector has had to fill this gap in order to maintain the basic informational requirements of the cocoa farmers. The provision of such services, including technical advice and access to improved varieties of cocoa, does not have to mean that in turn cocoa production will expand rapidly, thereby depressing prices (the "fallacy of composition argument"). Good research and development can, and indeed should concentrate on improving the awareness of good cocoa cultivation, harvesting, drying and fermentation practices, "Integrated Pest Management" (IPM) which improves the effectiveness of input applications while reducing the overall need for pesticides, herbicides and fungicides, and concentrating on intensive rather than extensive farming.

Given cocoa's importance to the economy as a whole, and to a large proportion of the smallholder farmers who depend on cocoa, it is important that structural adjustment programmes give the most careful consideration to those factors which support the long term as well as short term competitive advantage of these countries; this comprises low costs of production and the production of good quality cocoa. This need is most obvious in the case of Nigeria. When the cocoa marketing in Nigeria was privatised and the NCB disbanded, very little attention was given to the quality and market for Nigerian cocoa, or to the design of an infrastructure to preserve the quality and price premium while providing the benefits of higher prices to farmers and lower marketing costs which resulted from liberalisation. In the case of Cameroon and the Côte d'Ivoire, the liberalisation of inputs, especially fungicides for preventing the spread of Phytophthora and sprays for halting capsid attacks, could harm the longer term competitiveness, especially given the current low producer price. Cameroon is especially vulnerable considering the virtual dismantling of the ONCPB and the near demise of SODECAO. Fortunately the restructuring of the project for rehabilitating the cocoa sector in Cameroon has attempted to address these problems by providing for subsidised inputs, at least for the next few years.

The government, research and extension services in cocoa producer countries also bear responsibility for some of the current and foreseeable limitations and potentially damaging consequences of structural adjustment on the competitiveness of their cocoa sectors. By offering an even more rewarding producer price to farmers

in Ghana, the GCB would help offset the rise in prices for pesticides and fungicides. In Cameroon, better management of rural credit schemes and more support for informal cooperative groups would have a more lasting positive impact on cocoa maintenance than having SODECAO employ much of its human and financial resources on applying inputs in marginal cocoa growing areas. Both the Côte d'Ivoire and Cameroon have been limited by their inability to devalue, which has forced them to severely cut the producer price in order to remain competitive. If they could devalue, they could raise farmers incomes, thereby encouraging better maintenance of their cocoa crops, without damaging their competitiveness or their marketing boards' financial situation.

However, as mentioned several times already, the largest impact on the competitiveness of cocoa producers will not, and indeed cannot, come from changes at the country level. Much of the fundamental work on technological innovation and development, including the collection and conservation of genetic resources, characterisation and documentation of cocoa germplasm, and propagation and tissue culture of cocoa which could produce the most significant increases in productivity, quality, and pest and disease resistance require greater international cooperation and research funding. Such an effort appears beyond the scope and terms of reference for structural adjustment programmes in part because of their emphasis on the short to medium term and also because action is limited to domestic markets and institutions. However, successful research in this area will require sustained support and is unlikely to achieve results for at least a decade. Moreover, it will depend upon greater coordination and contributions from cocoa consumer and producer countries, and from international donors. With such action, cocoa could cast off the tag of being an "orphan commodity"; without such action, the small cocoa farmers who produce the vast majority of the world's cocoa production will never achieve their full potential.

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LIST OF ACRONYMS

ACRI	American Cocoa Research Institute	USA
ASRP	Agricultural Services Rehabilitation Project	Ghana
BCCCA	Biscuit, Cake, Chocolate & Confectionery Alliance	UK
CATIE	Centro Agronomico Tropical de Investigacion y Costa Rica Ensananza	
CCCA	Cocoa, Chocolate & Confectionery Alliance	UK[1]
CEPLAC	Comissao Executiva de Plano da Lavoura de Cacau	Brazil
CGIAR	Consultative Group on International Agricultural Research	
CMA	Chocolate Manufacturers Association	USA
CPA	Cocoa Producers Alliance	International[2]
CRIG	Cocoa Research Institute of Ghana	Ghana
CRIN	Cocoa Research Institute of Nigeria	Nigeria
CRP	Cocoa Rehabilitation Project	Ghana
CRU	Cocoa Research Unit	Trinidad
CSSV	Cocoa Swollen Shoot Virus	West Africa
EDF	European Development Fund	EC
EET	Estacion Experimental Tropical	Ecuador
ERP	Economic Recovery Programme	Ghana
GCMB/GCB	Ghana Cocoa Marketing Board (now GCB)	Ghana
HYV	High Yielding Variety	
IBPGR	International Board of Plant Genetic Resources	
ICG,T	International Cocoa Genebank, Trinidad	International
ICS	Imperial College Selection	Trinidad

IMC	Iquitos Mixed Calabacillo	Primary Germplasm
IOCCC	International Office of Cocoa, Chocolate & Sugar Confectionery	International[3]
IRAT	Institut du Recherches Agronomiques Tropicales	Cameroon
IFCC	Institut Français du Cafe du Cacao et Autres Plantes Stimulants	France[4]
IRCC	Institute Recherche du Cafe et du Cacao et Autres Plantes Stimulantes	France
MARDI	Malaysian Agricultural Research & Development Institute	Malaysia
NCB	Nigerian Cocoa Board	NCB
ODA	Overseas Development Administration	UK
PA	Paranari	Primary Germplasm
PNG	Papua New Guinea	
SAP	Structural Adjustment Programme	
SATMACI	Societé d'Assistance Technique pour la Modernisation de l'Agriculture en Côte d'Ivoire	Côte d'Ivoire
SCA	Scavina	Primary Germplasm
TSH	Trinidad Selected Hybrid	Primary Germplasm
VSD	Vascular Streak Dieback	South East Asia
WACRI	West African Cocoa Research Institute	West Africa[5]

1. Pre BCCCA.
2. Based in Nigeria.
3. Based in Belgium.
4. Pre IRCC.
5. Pre CRIG/CRIN.