

**BIOLOGICAL CONTROL OF *PHYTOPHTHORA MEGAKARYA* IN NIGERIA.**

Activity no. PM1-1

**Project:** Research and technology transfer  
**Component:** Integrated pest and disease management  
**Executing Partners:** Agbeniyi Remi, Sunday, CRIN, Ibadan, Nigeria

**Objective:** Integrated pest and disease management

**Background/Justification:**

STCP baseline surveys revealed a relatively high level of expenditures on fungicides in Nigeria to control blackpod disease. Most farmers use either Ridomil Plus (copper oxide plus metalaxyl) or Bordeaux mixture to control *P. megakarya*. The severity of the disease in Nigeria is particularly pronounced in the cocoa growing regions of Cross River State where precipitation is higher. Financial constraints and limited availability of rural credit prevent farmers from achieving the desired control and a low cost environmentally friendly alternative would be a welcome addition to the currently limited IPM arsenal against this disease. In 2002, CRIN pathologists participated in a two week workshop on biocontrol of *P. megakarya* in Cameroon that was hosted by IRAD with the support of the USDA, Mars Inc, and the STCP. At this workshop one of the hypotheses examined was that the origins of *P. megakarya* could be the Korup National Park on the border of Cameroon and Nigeria.

**Location/Target Group:**

Liquidity constrained cocoa small holders with serious *P. megakarya* disease pressures (Cameroon and Nigeria, parts of Ghana and RCI)

**Methodology/Implementation Strategy:**

1. Collect microorganisms found in the cocoa ecology of Nigeria. Collections will be undertaken in Oyo, Ondo, and Cross River States of Nigeria.
2. Isolate and screen for their ability to control *P. megakarya* in pathology lab at CRIN. The leaf disc biocontrol screening biotest and the cacao pod husk pieces biotest that have been developed by IRAD and USDA ARS are used for screening biocontrol candidates.
3. Identify promising and effective biocontrol agents that would be employed in small-scale field tests.

**Expected Results/Deliverables:**

A preliminary set of biocontrol candidates in Nigeria based on laboratory evaluations of their control of *P. megakarya* as document in the technical reporting of this activity.

**Milestones:**

Laboratory testing of microbial collections established by September 2003  
Completed assessment of year one isolates by August 2004.

**Key Findings to date:**

This is the first year of biocontrol activities in Nigeria.

## **BIOLOGICAL CONTROL OF *PHYTOPHTHORA MEGAKARYA* THE CAUSATIVE AGENT OF CACAO BLACK POD DISEASE IN CAMEROON.**

Activity no.s PM1-2 to PM1-6

**Project:** Research and technology transfer  
**Component:** Research  
**Executing Partners:** Tondje, Pierre, Plant Pathology Lab/ Biocontrol of Plant Diseases Unit, IRAD, P.O.Box 2067 Yaounde Cameroon

**Objective:** Integrated pest and disease management

### **Background/Justification:**

Blackpod disease of cocoa is caused by two species of *Phytophthora*. The more virulent of the two *P. megakarya* can completely devastate smallholder production and income if left untreated. This species is dominant in Cameroon and Nigeria.

Promising results are arising from recent work on isolation and screening of potential biocontrol agents in a collaborative effort between IRAD, USDA, and IITA scientists within the USAID-Chocolate industry sponsored Sustainable Tree Crops Program (STCP). Field samples from pods, leaves and soil were collected from cacao farms and used to isolate microbial populations. •More than 1000 fungal and 274 bacterial endophytes, epiphytes and saprophytes have been isolated and screened. Special interest is now being focused on *Trichoderma* spp. (more than 100 isolates from the natural forest reserve of Dja), *Geniculosporium* spp. (wood decay fungi), *Bacillus* spp (spore producing bacteria), and on Actinomycetes .

Several isolates of *Trichoderma species*, were found to be very effective against *P. megakarya*, the black pod disease pathogen. Some microbial strains, exhibiting high antagonistic activity in lab tests are now being field-tested. The preliminary results suggest that biocontrol agents can effectively reduce disease levels in the farm. More effort is needed to understand mechanisms of action of the promising biocontrol candidates, and increase the efficacy of the microbial formulation method developed by IRAD, to insure that farmers will be able to make practical use of them.

### **Location/Target Group:**

Liquidity constrained cocoa small holders with serious *P. megakarya* disease pressures (Cameroon and Nigeria, parts of Ghana and RCI)

### **Methodology/Implementation Strategy:**

Five activities are currently being implemented supported by the STCP and USDA.

*PM1-2 Isolation and screening of antagonistic fungi, bacteria and yeast from cocoa agroforests for biocontrol potentials against Phytophthora megakarya.*

From Center South West and South cacao growing zones of Cameroon, biocontrol candidates are being isolated quantified and stored. The leaf disc biocontrol screening biotest and the cacao pod husk pieces biotest that have been developed by IRAD and USDA ARS are used for screening biocontrol candidates. Biocontrol agents are expected from: *Pseudomonads*, *Actinomycetes*, *Bacillus spp*, yeast, *Trichoderma*, *Gliocladium spp* in different cocoa agroforests of Cameroon.

*PM1-3 Compatibility of promising biocontrol candidates with commonly used chemical fungicides in Cameroon.*

This study will establish the compatibility of promising biocontrol candidates with commonly

used fungicides in cacao farming in Cameroon. The objective is to determine threshold use of these chemicals in IPM strategies including biocontrol agents.

PM1-4 *In-vessel and on-farm small scale composting of cacao pod husks using cellulolytic and mycoparasitism potentials of Trichoderma asperellum*,

This trial aims to assess the potential of promising *T. asperellum* strains isolated by IRAD to reduce *P.megakarya* primary inoculum on infected cacao pod husks, and to accelerate degradation during composting.

PM1-5-*Development of appropriate fermentation and formulation methods..*

Some preliminary experiments have already started in 2002 and are expected to be pursued and improved using local agricultural waste materials and some promising Biocontrol strains already available

PM1-6- *Field trials. Yearly starting date: early February.*

Field trials for the promising biocontrol strains from Cameroon cacao agrosystems, that has proven to be effective in lab experiments represent the last step of screening for effective biocontrol candidates

Two experimental zones from the main cacao growing zones of Cameroon will be considered:

- Center Province (Nkenlikok) - Nyong et Kelle Division
- South Province (Ebolowa)-Mvila Division

#### **Expected Results/Deliverables:**

- Preliminary indications of the on-farm efficacy of four isolates of *Trichoderma aspergillum* in the mycoparasitism of *P. megakarya*.
- Improved formulations of mycopesticides using *Trichoderma aspergillum*.
- Feasibility of using *T. aspergillum* on decomposing cocoa pod husks in farmers' fields to reduce inoculum of *P. megakarya*

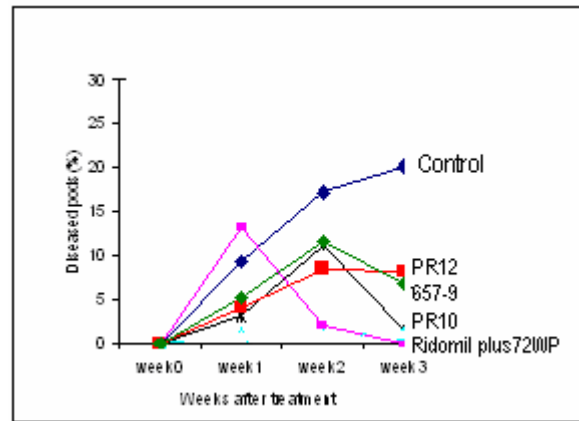
#### **Milestones:**

On-farm trials established in two locations by June 2003

#### **Key Findings to date:**

- The presence of mycoparasites of *P.megakarya* within 735 endophytic fungi isolated from cacao (*Theobroma cacao*) leaves were screened using the pre-colonized plate method. Nine of isolates (BC177, BC108, BC252, BC134, BC150, BC181, BC118, BC13, BCX) expressed mycoparasitism against *P.megakarya* of which only [BC177], a *Genicospodium* species isolate expressed some degree of necrotrophic mycoparasitism; the rest exhibited biotrophic mycoparasitism. However eight (BC108, BC252, BC134, BC150, BC181, BC118, BC13, BCX) was observed with. Necrotrophic mycoparasitism has much potential for biocontrol of black pod disease and can be used as any commercial fungicide, but could also be exploited as natural regulators of the disease by reducing the level of primary inoculum of the pathogen in the farm.
- A complex of three very promising biocontrol candidates for *Phytophthora megakarya* the causative agent of cacao black pod disease, (PR10, PR11, PR12) was isolated from a rotten tuber of *Xanthosoma sagittifolium* in a farmers' mixed crop field near Yaounde. A similar level of effectiveness was observed for a microbial agent isolated from the forest reserve of Dja by Dr. Gary Samuels USDA-ARS. These isolates from different origins were identified as isolates of *Trichoderma asperellum*. In the lab, these isolates of *Trichoderma asperellum* has proven to be a very powerful mycoparasite of *P.megakarya*. These strains were also tested by Dr. Prakash Hebbar Masterfoods Inc USA against witches' broom, *Crinipellis perniciosa*, and reportedly expressed mycoparasitism for in lab conditions
- Following demonstrated control in the laboratory, a small preliminary field trial was conducted in 2002 during the month of October in southern Cameroon comparing three isolates, the systemic

fungicide Ridomil Plus and a no treatment control. After the removal of all diseased pods and cherelles, a count of healthy non infected pods and cherelles per tree was made. The isolates and fungicides were applied in week 0 and week 2. At weekly intervals the infected pods per tree were counted and removed; the number of infected pods and cherelles are expressed as a percentage of the healthy pods and cherelles at week 0 (see Figure). The cumulative losses over the three weeks of observation were: control—48%, PR12—21%, Ridomil—16%, PR10—16%; and 657-9—21%.



**The use of molecular markers to assess genetic diversity present in germplasm collections in four West African countries. (USDA Collaborative Activity)**

Activity no. GP1-1

**Project:** Research and technology transfer  
**Component:** Research  
**Executing Partners:** Kolesnikova-Allen, Maria, IITA Ibadan, CRIG plant breeders, CRIN plant breeders, CNRA plant breeders, IRAD plant breeders, CFC participatory germplasm collection and testing project, STCP technology transfer.

**Objective:** Germplasm improvement and the production and widespread dissemination of quality planting materials

**Background:**

An adequate supply of cocoa beans of consistent quality through the use of improved planting materials by farmers is a fundamental aspect of sustainable cocoa production. About 70 % of world's cocoa output (2.94 million metric tones) is grown in West Africa with Côte d'Ivoire, Ghana, Cameroon and Nigeria being major producers. Cacao, *Theobroma cacao* L., germplasm, first introduced into West Africa in the 18<sup>th</sup> century by the Portuguese and Spaniards, consists of genotypes from diverse populations including Amelonado, Upper Amazon Forastero, Trinitario, Criollo and hybrids among these populations. A wide range of genetic diversity is present both in field gene banks on research stations and in farmer's fields, however, the extent of which information is scarcely available. The use of molecular markers provides the most efficient means of assessing genetic diversity present in germplasm collections.

**Location:** Major cocoa producing regions of Cameroon, Nigeria, Cote d'Ivoire and Ghana for germplasm collection.

**Methodology:**

1. Establishment of research network in Nigeria, Cameroon, RCI, and Ghana.
2. Use of a common strategy for germplasm to generate unified database.
3. Sampling of field gene bank collections (Upper Amazon parental clones, F1 and F2 clones) and farmers' collections (sample best and worst performing trees in terms of bean size, productivity, disease resistance etc.)
4. Germplasm collections to remain with NARS, leaf tissue of DNA samples to IITA for molecular analysis
5. Develop capacity of NARS in advanced breeding and molecular biology technologies
6. Linkages with advanced research institutes (USDA, CIRAD, CABI)

**Expected results:**

1. Comparison of diversity in farmers' fields with the relatively restricted basis of germplasm in breeding programs
2. Comparison of the level of heterozygosity of these materials to assess the possible level of inbreeding
3. Collection of interesting genetic diversity (such as high yielding trees, trees with suspected black pod resistance, ) for evaluation in observation plots at research stations and in the planned on-farm trials in the CFC project.

**Milestones:**

- MOUs signed with Ghana, Nigeria, and Cameroon

- 344 germplasm accessions collected from two gene pools (research and onfarm) in Nigeria
- Ongoing collection in Cameroon, Nigeria and Ghana
- Visits to CABI, CIRAD, USDA
- Joint planning meeting with CFC project on 'Cocoa Productivity and Quality Improvement, a Participatory Approach' and STCP in April 2003
- Two MSc, and 1 PhD student in training

**More details on this research are to be found in the Annual Report 2002/2003 for this project. It is available upon request from the STCP secretariat. Contact [STCP-WCA@cgiar.org](mailto:STCP-WCA@cgiar.org)**

**Ex ante economic evaluation of the costs of alternative methods of delivering improved planting materials to farmers**

Activity no. GP1-2 and IA2-1

**Project:** Research and technology transfer  
**Component:** Research and Impact  
**Executing Partners:** Gockowski, J., and David, S., STCP, Pilot project managers in Ghana, Cameroon, Nigeria, RCI.  
**Objective:** Germplasm improvement and the production and widespread dissemination of quality planting materials

**Background:**

One of the findings of the baseline surveys was that in general farmers lack access to improved planting materials. A majority of farmers (67% to 90% depending on country) reported using seedling material from their existing tree stocks as their chief source of planting material. Although improved materials have been developed by research, it appears that market failures associated with the dissemination of these materials are a constraint on West African competitiveness vis-a-vis other producing regions. As part of the strategy to address this issue, an economic evaluation of the various alternative approaches for bringing these materials to farmers is needed.

**Location:** Four cocoa producing sites and one cashew producing site of STCP

**Methodology:**

- Site visits to existing dissemination centers of cocoa planting materials to collect information on technologies and costs.
- Calculation of economic costs and returns of seedgardens, tissue culture, budwood gardens & grafting, hand pollination, cooperative nurseries vs. individual nurseries, bareroot seedlings versus polybag, etc using net present discounted value and economic and social prices.

**Expected results:**

Recommendations for low cost effective dissemination of improved planting material

**Milestones:**

- Research protocol and workplan by Sept. 2003
- Site visits to Ghana, Nigeria, Cameroon, RCI completed by January 2004
- Country trip reports
- Technical report by March 2004
- Journal article by June 2004

**Key findings to date:** New activity

**The establishment of multi-strata cacao agroforests in *Chromolaena odorata* and *Imperata cylindrica* fallow**

Activity no. RE1-1

**Project:** Research and technology transfer

**Component:** Research

**Executing Partners:** Norgrove, L., Hauser, S. and J. Gockowski. IITA-HFC Cameroon, BP 2008 Yaounde Cameroon, l.norgrove@cgiar.org

**Objective:** Rehabilitation of existing tree crop farms and establishment of new farms on already deforested lands.

**Background/Justification:**

As agricultural productivity for staple food crops increases and as the rural exodus from the forest zone proceeds, short fallow land dominated by *Chromolaena odorata* and grasses is increasingly available for conversion to agronomically more sustainable land use systems such as mixed tree crop systems. In addition to the revenue potential of these land use systems, they may also conserve important biodiversity, maintain watershed and landscape functions and may help in stabilizing local climatic patterns by supporting hydrological cycles. However, short fallow dominated by *C. odorata* and grasses is likely to present serious fertility and weed competition constraints during the establishment phase due to previous nutrient depletion and a built up of the weed seed bank caused by repeated cycles of annual cropping. In addition there may not be any shade available in such land use systems to protect the young cacao during the establishment phase.

Farmers in the IITA research village of Nkometou III have expressed a strong interest to re-establish such systems and a researcher designed on-farm trial was implemented.

**Location/Target Group:**

Asset- poor smallholders in areas of degraded forest with extensive degraded *Chromolaena* and *Imperata* fallows.

**Methodology/Implementation Strategy:**

The experiment had a two-factorial design, conducted in nine replicates. Plot size is 17.5 m x 17.5 m. Factor 1, shade treatment with four levels: plantain; cooking banana; *Inga edulis* Mart. and alleys of natural regrowth dominated by *Chromolaena odorata* were established / created in September/October 1999. Factor 2 is fertilizer regime. Four fertilizer regimes were imposed: nil; N only; P, K, Ca, and Mg; and P, K, Ca, and Mg with N. Fertilizer was applied in one dose in October 2000 to the cacao plants.

The research objectives are to:

1. Determine with farmers options for establishing cacao agroforests in degraded short fallow bush land
2. Assess the ability of two *Musa* spp. varieties to provide shade to the young cacao and generate income through production of plantain and banana bunches during the first 3 to 4 years after planting the cacao.
3. Determine the effect of fertilizer on growth of cacao, fruit trees, timber trees and the yield of the *Musa* spp.
4. Evaluate the economic costs and returns of establishing multistrata cacao agroforests in *Chromolaena odorata* and *Imperata cylindrica* fallow.
5. Determine the dynamics of carbon sequestration in such cacao agroforest

All plots were planted to upper strata trees, replacing 9 of either the *Musa* spp. or *Inga edulis* plants. Five fruit trees: three *Persea americana* and two *Dacryodes edulis*, two timber trees (*Terminalia ivorensis*), and two timber / fruit trees, *Ricinodendron heudelotii* were planted on a three by three pattern in each plot. Planting dates were September / October 1999 for *D. edulis* and *P. americana*, June 2000 for *R. heudelotii*, and July 2001 for *T. ivorensis*. Seedlings from selected trees of a local cacao variety were planted in May 2000 at 1600 ha<sup>-1</sup>.

It is also intended to continue with the tree crop component measurements in all fields as before.

#### **Expected Results/Deliverables:**

1. Agronomic evaluation report of establishment trial
2. Economic evaluation report of establishment trial including cost of carbon sequestration over four years.
3. Recommendations for establishing multiproduct cocoa based agroforests on degraded land.
4. Three conference presentations
5. Two book chapters
6. One draft articles for publication in peer reviewed journals.

#### **Milestones:**

- Tree crop component measurements made in May 2003, November 2003, March 2004, May 2004, November 2004.

#### **Key Findings to date**

- After two years the estimated costs per ha to establish the trial ranged from 376,000 to 1,299,000 FCFA/ha (See Tables 1-3) depending on treatment.
- Fire hazards in the dry season are a major constraint to the establishment of agroforests particularly on Imperata lands
- Initially, cooking bananas had more leaves, larger and higher pseudostems and more suckers than the plantains, thus provided more shade, yet may have caused more competition. *Inga edulis* trees had reached up to 4 m height.
- Survival of cacao of the first dry season until January 2001 was 73.4% and neither affected by the shade regime nor by the fertilizer regime. Survival was higher in blocks with good growth of shade plants.
- Growth of timber and fruit trees was assessed twice per year. After measurements on all components in May/June 2002, fields were weeded in October and all system components were re-measured (height, girth, leaf numbers etc). In all years, shade treatment had no impact upon survival. By October 2002, growth was generally best in the plantain temporary shade treatment and fertilizer regime had no significant effects. Plantain is susceptible to root nematode pests and leaf diseases therefore it is prone to uprooting and maintains fewer leaves than cooking banana. This treatment produced the least shade and, given that local plantain (AAB) has a poor performance relative to (ABB) cv. Fougamou cooking bananas, competition would be lower in these plots.
- By October 2002, survival of *Terminalia ivorensis* was 71 % across treatments and trees averaged 245 cm height. Stem diameter and branching were significantly higher in the plantain treatments and growth was worst in the bush. However, number of non-lignified juvenile green branches was highest in the bush treatment, suggesting a developmental delay. By October 2002, growth of *Ricinodendron heudelotii* was generally unaffected by shade treatment although stem diameter was higher in plantain plots than in others.
- By June 2003, survival of safoutiers was significantly lower in the bush treatments than in the other shade treatments with highest survival in the inga (66%) and plantain (54%). Remaining trees were significantly taller (276 cm), with a higher mean diameter (50 mm), higher canopy cover and branching level in the plantain shade treatment than in the other treatments. By June

2003, survival of *Terminalia ivorensis* was affected by treatment with highest survival in the cooking banana (74%), plantain (71%) and inga (69%), all significantly higher than in the bush plots (47%). Remaining trees had a significantly higher diameter (61 mm) in plantain plots than in the other treatments. Fertilizer had an effect on branch formation with greatest formation in the 'all fertilizer' and exchangeable cations and P treatments, with least in the unfertilized control. There were few treatment effects on the growth of *Ricinodendron heudelotii* although stem diameter was higher in plantain plots than in others.

- The two indigenous fruit trees and *Terminalia ivorensis* are robust enough to establish on short fallow land. Early growth was best in the least shaded plantain treatment. The system might be adjusted so that the trees are planted concurrently with the temporary shade crop.
- Fertilizer had few impacts on survival or early growth so is not recommended

Table 1. Partial establishment costs for year 1 and 2 of four temporary shade treatments, no fertilizer application (F cfa per ha).

	Shade treatments			
	Inga edulis	Cooking banana	Plantain	Bush control
Labor costs	208,770	204,440	206,857	152,348
Variable costs	251,207	278,189	278,189	171,980
Fixed costs	51,906	51,906	51,906	51,906
Total costs	511,883	534,535	536,953	376,234

\$1 USD= 740 F cfa

Table 2. Additional costs of fertilizer treatments (F cfa per ha)

	Fertilizer treatments			
	No fertilizer	Nitrogen	Cations	Cations plus Nitrogen
Labor costs	0	1,586	5,340	5,868
Variable costs	0	11,700	746,824	758,524
Fixed costs	0	0	0	0
Total costs	0	13,286	752,163	764,392

\$1 USD= 740 F cfa

Table 3. Total costs of establishment for year 1 and 2, all treatment combinations (F cfa per ha).

	No fertilizer	Nitrogen	Cations	Cations plus Nitrogen
Inga	511,883	525,169	1,264,046	1,276,275
Cooking banana	534,535	547,821	1,286,698	1,298,927
Plantain	536,953	550,239	1,289,116	1,301,345
Bush	376,234	389,520	1,128,397	1,140,626

\$1 USD= 740 F cfa

## **Effects of shading, soil water content, fertilizer, soil type on germination and growth of local cacao**

Activity RE1-2

**Project:** Research and technology transfer

**Component:** Research

**Executing Partners:** Norgrove, L., and Hauser, S. IITA-HFC Cameroon, BP 2008 Yaounde Cameroon, l.norgrove@cgiar.org

**Objective:** Rehabilitation of existing tree crop farms and establishment of new farms on already deforested lands.

### **Background/Justification:**

In recent trials in Cameroon, we have found no relationship between shade level and cacao growth. Therefore a microcosm experiment has been started to assess the effects of various shade levels and the interaction with soil water content, fertilizer and soil type on cacao germination and early growth under controlled conditions. This is being conducted at IITA Mbalmayo using soils from forest and chromolaena systems adjacent to the sites of the agroforest trial established in 1999.

### **Location/Target Group:**

On-station trial in Mbalmayo. Results will be used to make recommendations to farmers on the establishment of cacao

### **Methodology**

The experiment is a four-factorial design in five replicates. Shade levels are 0 and 67% imposed with shade cloth. Soil water contents are 50 and 25% saturation. The soils were initially analysed for N, P and exchangeable cations and it was found that the chromolaena soil was lower in total N ( $0.60 \text{ mg g}^{-1}$ ), exch. Ca ( $0.08 \text{ mg g}^{-1}$ ) and exch. Mg ( $0.045 \text{ mg g}^{-1}$ ) than the forest soil with  $1.60 \text{ mg g}^{-1}$  total N,  $0.48 \text{ exch. Ca}$  and  $0.171 \text{ mg g}^{-1} \text{ exch. Mg}$ . The fertilizer treatment was the addition of urea, calcium and magnesium carbonate fertilizers to the chromolaena soil so the total amount of nutrients in the microcosm was equal with that in the forest soil microcosm. This permits to separate effects of nutrients and other factors different between chromolaena and forest soils. Microcosms are covered by moveable clear plastic tents during rain showers and during the night but left open at all other times.

Variables, measured weekly, are establishment success, leaf and flush leaf number, height and jorquette formation. At termination, dry matter and nutrient content of plants will be assessed, permitting a full nutrient budget to be calculated. Soil evaporation rates are measured and plant transpiration estimated. Soil temperature measurements are made in a weekly basis.

Given the low available P status of both forest ( $0.0031 \text{ mg g}^{-1}$  Mehlich P) and chromolaena ( $0.0028 \text{ mg g}^{-1}$  Mehlich P) soils, a companion experiment has been established comparing different levels of TSP fertilizer application in full light conditions. Variables measured are identical to those described above.

### **Expected Results/Deliverables:**

- Technical report on the impacts of shade, soil water, fertilizer and soil type and their interactions on cocoa establishment and early growth.
- Draft article for publication in peer reviewed journals.

**Milestones**

Trial initiated in May 2003

Trial to be completed in December 2003 and repeated in 2004, ending in December 2004

Results to be communicated to local farmers groups near Mbalmayo

Key findings to date: **n/a New**

## Establishment of cocoa in timber plantations thinned to various densities

Activity RE1-3

**Project:** Research and technology transfer

**Component:** Research

**Executing Partners:** Norgrove, L., and Hauser, S. IITA-HFC Cameroon, BP 2008 Yaounde Cameroon, l.norgrove@cgiar.org

**Project Output:** Rehabilitation of existing tree crop farms and establishment of new farms on already deforested lands.

### Background

Past research efforts (see above) of establishing cocoa on degraded land have been hampered by drought conditions. Neither shade nor fertilizer had consistent significant effects on cocoa survival and early growth. The most likely factor, water availability, during the dry season cannot be managed under the given circumstances, as irrigation is not economically feasible.

It appears that other niches for cocoa need to be identified and tested. One such system can be timber plantations with timber rotation times similar to the productive lifetime of cocoa. However, the success of such systems may depend on the density of the timber trees, affecting both soil water regimes and shading.

Rehabilitating logged over forest by converting to timber plantations is a common practice in Cameroon and the most common species used is *Terminalia ivorensis*. *Terminalia ivorensis* produces a straight bole and a small crown and therefore can be felled with low damage to the understorey crop.

### Location / Target groups

On farm. Farmers with forest resources willing to establish smallholder agroforests with *Terminalia* and cocoa.

### Methodology

It is proposed to plant cocoa as an understorey in a 14-yr old *Terminalia ivorensis* plantation. These plantations have tree densities, imposed in 1995, of 0, 40 and 192 stems per hectare. It is proposed to clear the understorey of the plantation and plant cocoa and monitor the effects of different tree densities and intercropping with food crops on cocoa survival and growth, and if the experiment is extended, on production.

### Expected results/deliverables:

By December 2003, peer reviewed journal article in press on the development of such systems

By January 2005, technical report on the agronomic feasibility of establishing *Terminalia* – cocoa agroforests in logged over secondary forest.

By January 2005, draft article for peer reviewed journal

### Milestones:

By July 2003 establishment of cocoa seedling nursery (2000 trees).

By August 2003, all timber trees measured.

By August 2003, discussions completed with collaborating farmers

By September 2003, full biophysical assessment of site and initial land preparation

By December 2003, full assessment of aboveground carbon stocks in different treatments

By December 2003 peer reviewed journal article in press on the development of such systems

By April 2004, planting of cocoa

Measurement of cocoa establishment and growth, shade canopy development from April 2004 on a monthly basis, as well as soil water content

**Key findings to date:**

**n.a. NEW**

**Effects of fungicide application upon yield and sustainability indicators (third year trial)**

Activity ER1-1

**Project:** Research and technology transfer**Component:** Research**Executing Partners:** Norgrove, L. and Hauser, S. IITA-HFC Cameroon, BP 2008 Yaounde Cameroon, l.norgrove@cgiar.org**Objective:** Enhancing environmental services provided by tree crop based cropping systems**Background/Justification:**

Fungicide to control blackpod (*Phytophthora megakarya* Bras. & Griff) is the main external input used in cacao (*Theobroma cacao* L.) systems in southern Cameroon. However, at fluctuating cocoa prices, the spraying regime recommended by the manufacturer is not always profitable. Therefore the effects of a reduced spraying regime need to be assessed.

Since 1994 farmers have been subject to extremely variable farmgate prices, ranging from less than USD\$0.50/kg to \$1.60/kg. When prices are low, many cocoa farmers either reduce resource allocations to cocoa or even abandon production altogether and devote their efforts to other enterprises. In a survey by Norgrove conducted in eight southern Cameroonian villages, on average farmers classified 33 % of their cacao holdings as abandoned. Given increased interest in cacao production due to higher market prices, it is important to know what yields can be attained in previously abandoned fields and what is the yield response to fungicide.

This research is examining the recuperative capacity of a 35 yr old cocoa agroforest in southern Cameroon that had been abandoned for three years during a period of low prices prior to the implementation of the trial in 2001.

**Location/Target Group:**

Farmers' abandoned cocoa farms near Zoatoupsie, southern Cameroon (3° 51'N and 11° 27'E)  
Diversified smallholder producers with mature shaded cocoa agroforests in southern Cameroon

**Methodology/Implementation Strategy:**

The experimental design is an on-farm randomised complete block design in three replications with three treatments: (1) 'high concentration' Ridomil® plus 72 WP (active ingredients 600g kg<sup>-1</sup> Cu<sub>2</sub>O and 120 g kg<sup>-1</sup> metalaxyl (methyl N-(2,6-di-methylphenyl)-N-(methoxyacetyl)-DL-alaninate, C<sub>15</sub>H<sub>21</sub>NO<sub>4</sub>) at the manufacturer's recommended application rate; (2) 'low' concentration' at one third of the recommended rate (3) zero- no spray. Also, a secondary forest control (unsprayed) was used as a comparison for each block. The experiment was replicated three times. Plot size was 25 m x 25 m.

The research objectives are to assess the effects of high and low fungicide applications versus a zero-spray control on *P. megakarya* incidence, cacao flowering, cherelle production and yield, environmental parameters and nutrient cycling in cacao fields previously abandoned for three or more years. Environmental parameters include litterfall, soil faunal activity, termite species richness, understory plant diversity, decomposition rates. Additionally a full inventory of overstorey tree species, as well as carbon stocks of the cocoa farm will be calculated.

**Expected Results/Deliverables in 2003/2004:**

Technical report on third year of trial

Draft article for peer reviewed journal

Presentation of research results with collaborating farmers and the cocoa associations of the surrounding villages

#### **Milestones:**

By March 2003 Litter and soil sampling completed

By April 2003 Assessment of understorey plant diversity and biomass followed by weeding

By May 2003 Assessment of flowering and cherelle production of cocoa

June – December 2003 cocoa harvests, with estimates of cocoa yield and nutrient exports including production per tree

Bi-weekly assessment of soil faunal activity during rainy season

Fortnightly assessments of yield losses to *P. megakarya* and physiological wilt

By April 2004 data analysis and reporting

#### **Key Findings to date**

**Spraying recommendation.** In the first year of rehabilitation, returns to capital were higher in the high application rate treatment whereas in the second year, returns were higher in the low application rate treatment. Yields of cocoa were 358, 203 and 48 kg dry beans ha<sup>-1</sup> in the high, low and zero spray treatments, respectively in the first year of rehabilitation yet generally much lower due to lower pod set early in the second year, probably due to rainfall differences and this was a general feature in the area. In 2003, harvests up until early September 2003 are 266, 95 and 8 kg dry beans ha<sup>-1</sup> high, low and zero spray treatments, respectively and thus are projected to exceed previous years in the sprayed treatments once the main crop data are added. The profitability of the spraying depends on the yield level and thus farmers are recommended to spray at the recommended rate in years when pod set is high and at the low rate in years with poor pod set.

**Blackpod and yield losses.** There are no differences between treatments in flowering and cherelle production at the beginning of the season, thus there are no differences in yield potential.

Conservative estimates of losses to blackpod to date this calendar year, based on mass of diseased pods of mature size only, converted to dry bean mass, were 189 kg ha<sup>-1</sup> in control plots, 71 kg ha<sup>-1</sup> in low and 37 kg ha<sup>-1</sup> in high. Evidently, without spraying, yield losses to blackpod disease approach 100%, even with weekly phytosanitary harvests and complete removal of infected material from the cocoa field. This confirms data from previous years. Therefore phytosanitary harvest is not recommended because it cannot prevent complete yield loss. Consequently 'organic' cocoa is not an option in shaded cocoa fields. In addition, removal of diseased pods is a significant nutrient export which may have negative long-term consequences on sustainability.

**Ecology.** In the first and second years, there was no effect of fungicide treatment on soil faunal activity. Cu concentrations of earthworm casts were lower than Cu concentrations in soil for the cacao plots. This suggests that, unless the Cu is being compartmentalized at the sub-cellular level inside earthworms, that earthworms are avoiding copper uptake. Earthworms could avoid copper uptake by feeding at deeper soil layers. Casts derived from the high fungicide application plots had a higher clay proportion than those derived from the low fungicide application and zero-spray treatments. This suggests that the earthworms may be feeding more in the deeper soil layers where the clay content was higher to avoid the soil with higher Cu concentrations near the surface.

**Cocoa quality.** Fungicide treatments have no significant effects upon cocoa bean size, although individual bean mass was significantly greater at the late season harvests. Copper concentrations in cocoa beans were extremely low (13-17ppm) and were not different between treatments.

## Comparison of shaded and unshaded cocoa systems

Activity ER1-2

**Project:** Research and technology transfer

**Component:** Research

**Executing Partners:** Norgrove, L., and Hauser, S. IITA-HFC Cameroon, BP 2008 Yaounde Cameroon, l.norgrove@cgiar.org

**Project Output** Enhancing environmental services provided by tree crop based cropping systems

### Background

This work is being conducted in west-central Cameroon where unshaded cocoa is far more common than in the south.

**Location/Target Group:** Small holder cocoa agroforests in southwest Cameroon near Nyombe

### Methodology/Implementation Strategy:

Establishment of experiment using paired shaded and unshaded sites, of similar age and management history are being selected for ecological and economic characterisation to assess shade effects.

In each plantation, 10 m x 10 m plots will be delineated.

Within each of these plots, the following are sampled/measured/counted:

1. Cocoa tree density and growth characteristics
2. Non-cacao tree species density and girth. Tree mass of hardwoods calculated using tropical hardwood equations.
3. Pod counts, yield estimates and nutrient exports by cocoa
4. Soil sampling (5 augers per plot, bulked) 6 depths (up to 552 samples) for exch. cations, N, P, organic carbon, pH, Al, texture, bulk density, once per year. Soil water content (0-20 cm only) using TDR, weekly.
5. Pests and diseases
  - scoring of *Phytophthora* spp. on pods (in July, the season of highest incidence)
  - scoring of lichen and bryophyte density on trees
  - scoring of capsid damage to trees
6. Litter sampling, litterfall monitoring and decomposition. Fine litter and dead wood collected from 1.25 x 1.25 m area in centre of plot. Litterfall traps (2 per plot) to be installed and collected once per week for a calendar year. Litter decomposition: the litter sampled initially can be incubated at specific times (two) to get an idea of the decomposition rate of fresh litter versus the litter already in place. It is assumed that there will be pronounced litter fall phases after which such litter should be incubated.
7. Soil faunal activity. Semi-quantitative assessment of termites, divided into functional groups. Monitoring of earthworm casting activity (once per week) and quantitative sampling of earthworms at conclusion of experiment. Identification or grouping by functional group - epigeic species should be specifically included.

### Expected results

Draft review article for international journal on shade effects

Technical report on the impact of shade on the agronomic performance of cocoa agroforests.  
Recommendations to farmers in the area on shade management

**Milestones:**

By June 2003. Visit and select potential sites for study.

By November 2003 Observation plots established

By December 2004 Completion of measurements

By January 2005, draft article

**Key findings to date:**

n.a. NEW

**Farmers' agronomic and ecological knowledge and management of cocoa multistrata systems in southern Cameroon.**

Activity no. ER1-3

<b>Project:</b>	Research and technology transfer
<b>Component:</b>	Research
<b>Executing Partners:</b>	N. Bidzanga, IRAD, F. Sinclair, University of Wales Bangor, UK., J.Gockowski & S.Weise, STCP
<b>Objective:</b>	Enhanced environmental services provided by tree crop based cropping systems

**BACKGROUND/JUSTIFICATION.**

The aim of this research is to acquire local knowledge about the agronomy and ecology of multistrata cocoa systems in Southern Cameroon, and then use this in combination with scientific knowledge, to improve and diversify systems productivity and provide ecosystem services. Understanding current knowledge and practice of farmers is vital to improving livelihoods of cocoa smallholders and sustainability in cocoa production (Sinclair, 2002). Farmers in Southern Cameroon have a long tradition of maintaining tree biodiversity in their cocoa farms, which is complementary to what we know scientifically. The diversity and complexity of those systems are also the basis for important ecological functions that drive and maintain the productivity of the systems. Acquiring this knowledge is a sensible first step in improving complex, multistrata cocoa systems in Southern Cameroon.

Developing knowledge based systems that incorporate local knowledge and scientific knowledge (Walker et al., 1995; Sinclair and Walker, 1998; 1999) underpins research and development in a number of ways that are set out below and discussed by Sinclair and Walker (1999).

*1) Productivity and livelihoods.*

Common understanding of local knowledge is a prerequisite for building effective partnerships with local producers. Increasing smallholder productivity requires interventions appropriate to their circumstances, building upon rather than changing what people already know and do (Thapa et al., 1995)

*2) Ecosystem services.*

Some farmers have used biodiversity for longer than agricultural and forest scientists have had an interest (Sinclair and Joshi, 1999), therefore, their knowledge is a potent resource.

**Study area.**

The farmers' agronomic and ecological knowledge and management of cocoa multistrata systems in Southern Cameroon were surveyed in 4 different locations distinguished by agroecological zone, land use intensity, population density and market access. These were:

- Akok, distinguished by low population density and poor market access in evergreen rain forest with low land use intensity.
- Awae (medium population density and some market access)
- Nkongmesse (high population density and good market access) in strongly degraded semi-deciduous forest with moderate to high land use intensity, and
- NdiKinimeki, distinguished by high population density and reasonable market access in the forest savannah transition zone with high land use intensity.

**Methodology.**

The approaches used for collection of farmer knowledge are drawn from the techniques of Participatory Rural Appraisal (PRA). The research involved the following steps:

- Participatory community and group level work were held with the existing Non Governmental Organisations (NGOs), Common Initiative Groups (CIGs), traditional leaders of the targeted locations and staffs of the Ministry of Agriculture.
- Semi-structured interviews guided by participant observations were conducted with a purposive sample of 15 knowledgeable cocoa growers per location drawn from strata where differences in knowledge are presupposed: i.e., age and gender. Interviews were complemented with field visits. Farmers' statements of knowledge were recorded with a tape recorder.
- A further sample of 60 informants per location were identified for the testing of validity of abstractions.
- Formal representation of knowledge in a computer-readable form that facilitates storage and flexible access of the knowledge.
- Comparative analysis of farmers' knowledge within and across study locations.
- Analysis of the implication of farmers' knowledge for research.

### **Key findings.**

Four knowledge bases from the study locations, completed with a knowledge base from scientists, documenting local and scientists agroecological knowledge of cocoa multistrata systems have been compiled. An initial investigation of distribution of local knowledge within and amongst the site has been conducted. Widespread shared local knowledge of the functional attributes of 65 upper and mid-canopy tree species, together with their implications for farmers' decision making have been documented. This was integrated with local knowledge about soil types, site selection and cocoa disease and pest occurrence and control.

The amount of knowledge was found to vary both across locations and was influenced by ecology and socio-economic inducements factors, and within locations according to age groups and gender. On the bases of the number of statements abstracted from farmers' knowledge and practices (745 in total), 100% of the amount of knowledge was held by men and 29% by women, whilst 99% were held by older men and 67% by younger men. The knowledge among the three groups of farmers is not exclusive. Detailed results have been presented at international fora in Indonesia and Ghana.

### **Expected outputs.**

Acquiring local agronomic and ecological knowledge is an efficient method of using available knowledge to formulate and target research, while facilitating effective communication amongst stakeholders. Immediate outputs are:

- documentation of local knowledge to reduce the risks of erosion of the amount of knowledge both across locations and within locations over times.
- Identification of gaps in knowledge and definition of research priorities based on analysis of these.
- Ultimate outputs are improvements in living standards of cocoa farmers and sustainability of cocoa production through well targeted research and extension.

### **2003/2004 Milestones**

1). Completion of field work in Cameroon and supervisory visit in Cameroon by Dr Fergus Sinclair, University of Wales, Bangor, UK, Co-ordinator of the activity. Anticipated timing 22 September 2003.

2). Review and consolidation of knowledge acquisition phase and detailed planning of remaining research. Anticipated timing 22 September 2003.

**3). Completion of writing up of research as a thesis for educational purposes. Sept. 2004.**

## Literature review of effects of shade on cacao and cocoa systems

Activity ER1-4

**Project:** Research and technology transfer

**Component:** Research

**Executing Partners:** Norgrove, L., and Hauser, S. IITA-HFC Cameroon, BP 2008 Yaounde Cameroon, l.norgrove@cgiar.org

**Project Output** Enhancing environmental services provided by tree crop based cropping systems

### Background

A recent review of shade management in cacao (Rice and Greenberg 2000) included the role of shade in pest and disease control, however, there was no reference to the impact of shade on *Phytophthora* diseases. Brown leaf spot of coffee *Cercospora coffeicola* is reduced in shaded coffee plantations, compared with unshaded ones (Nataraj and Subramanian 1975, quoted in Beer et al. 1998). However, in contrast, damage from tea blister blight, *Exobasidium vaxans* (Exobasidiaceae, Homobasidiomycetidae) was more severe under shade (Visser et al. 1961). It is thus important to summarise the available literature to assess the impact of shade on various fungal diseases of tree crops.

Furthermore, recent research here has not been able to establish the relationship between shade, growth and yield. It is thus required to conduct a review of the literature, particularly investigating and assessing the validity of the grey literature and older publications from the 18 and 19 th centuries. This work complements experimental work on shade effects.

### Methodology/Implementation Strategy:

Collection and evaluation of existing literature on the effects of shade on cocoa growth

### Expected results

Draft review article for international journal on shade effects

Technical report on the impact of shade on the agronomic performance of cocoa agroforests.

### Milestones:

By July 2003, literature collection completed.

By October 2003, literature collection documented and databased in Endnote

By April 2004, draft article

**An evaluation of genetic and geospatial factors associated with red powder of Cameroon bulk cocoa origins**

Activity no. PH1-1

**Project:** Research and technology transfer  
**Component:** Research  
**Executing Partners:** Nyasse, S. IRAD, Kolesnikova-Allen, Maria, IITA Ibadan,, J.Gockowski, STCP

**Objective:** Improving post harvest practices to ensure quality and improved livelihoods

**Background:**

Prior to the dissolution of the national marketing board, bulk cocoa with Cameroon origins in most years received a premium for the reddish color of cocoa powder from pressed Cameroon beans. Since liberalization with the backwards integration of multinational bulk processors into Cameroon origins this premium has disappeared. What once was approximately a \$5 million annual quality premium for Cameroon cocoa has now become a discount of between \$5-10 million relative to other West African origins. The first step in recapturing the quality premium for Cameroon origins is to better understand the origins of this reddish color. The country-wide IITA/USDA germplasm collection exercise about to begin in Cameroon provides an opportunity for piggy backing this activity and will hopefully provide information on the genetic origins as well as spatially explicit environmental factors. Geographical coordinates will be associated with the germplasm collection allowing for spatial mapping of reddish color. Both the genetic and spatial information will be useful for reestablishing the quality premium through the trade and information systems currently being developed in the STCP.

**Location:** Major cocoa producing sites in Cameroon (East, South, Central, and Southwest Provinces)

**Methodology:**

This activity will be included as part of the field gene bank and farmers' germplasm collection in Cameroon which will gather material (leaf tissue and pods) from 500 trees. An adequate quantity of cocoa pods will be gathered to enable testing for the reddish color of cocoa powder. Each accession will be geographically inputted using GPS.

**Expected results:**

- Understanding of the genetic versus environmental origins of the reddish color of Cameroon cocoa powder
- Spatial representation of red color.
- Trade strategy for marketing cooperatives to recapture price premiums once received for red color.

**Milestones:**

- Accessions collected and cocoa beans sent for color analysis by December 2003
- Technical report by June 2004

## **Analysis of major production and marketing constraints at the household level in current cocoa and cashew systems of West Africa**

Activity no. PR1-1

**Project:** Research, technology transfer and impact

**Component:** Research

**Executing Partners:** Nkamleu, B., Gockowski, J. (STCP), Jonas Mva-Mva (Odeco - Cameroon); Charles Akinola (EFDI - Nigeria), Olivia Agbenyega (UST – Kumassi, Ghana), Keho Yaya (ENSEA - Cote d'Ivoire), Moustapha Kane (SPCIA - Guinea).

**Objective:** Identification and analysis of policies and institutions for the increased competitiveness of the West African tree crops sector

### **Background/Justification:**

Beginning in 1998 a partnership emerged between the chocolate industry, development agencies, and concerned governments, focusing on the issue of sustainable rural development in cocoa-producing areas. In May 2000 in Accra, Ghana, the Sustainable Tree Crops Program (STCP) was launched to implement this partnership's activities. The goal of the STCP is to improve the well-being of smallholder farmers through the development of sustainable tree crop systems that increase productivity, raise smallholders' income, conserve biodiversity, use natural resources sustainably, and offer stable, socially responsible development prospects for farmers and their workers. Among the STCPs first activities was the conduct of baseline surveys in the major cocoa-producing regions of Cameroon, Côte d'Ivoire, Ghana, Nigeria and Guinea

This activity consists of writing country reports of this baseline survey.

**Location/Target Group:** Cocoa growing regions of Cameroon, Nigeria, Ghana, Cote d'Ivoire, and Cashew growing regions of Guinea

### **Methodology/Implementation Strategy:**

1. Conduct baseline surveys of tree crop producing households in Nigeria, Cameroon, Cote d'Ivoire, Ghana, and Guinea (n=1000 to 1350) to gather quantitative data on production systems, tree stock investment behavior, labor utilization, tree stock quality, agronomic practices, farm gate marketing channels, and rural service provision. Spatial coverage of minimum of 80 percent of production area with the exception of Nigeria (45%).
2. Conduct econometric and descriptive analyses.

### **Expected Results/Deliverables in 2003/2004:**

Country specific recommendations for improving the productivity and competitiveness of West African cocoa and cashew production and marketing based on report findings.

### **Milestones:**

Analysis for all countries will be complete by September 2003

Draft reports by November 2003

### **Key Findings to date**

Tabular analysis for Cameroon, Nigeria, Cote d'Ivoire and Guinea completed.

Report writing for Guinea completed.

**Analysis of the role of child labor in West Africa tree crops sector**

Activity no. PR1-3

**Project:** Research, technology transfer and impact  
**Component:** Research  
**Executing Partners:** Gockowski, J. and Nkamleu, B., (STCP), Bazzi-Veil, L. and Jean-Baptiste, E. (CEPRASS Cote d'Ivoire), Jonas Mva-Mva (Odeco - Cameroon); Charles Akinola (EFDI - Nigeria), Olivia Agbenyega (UST – Kumassi, Ghana), Moustapha Kane (SPCIA - Guinea).  
**Objective:** Identification and analysis of policies and institutions for the increased competitiveness of the West African tree crops sector

**Background:**

An increased labour demand in the cocoa sector of West Africa has placed pressure on existing labour institutions that in conjunction with historically low world cocoa prices from the late 1980s through the late 1990s may have contributed to abusive child labour practices on the part of some cocoa producers. Beginning in September 2000, media allegations of child labour trafficking and child slavery on cocoa farms in Cote d'Ivoire were made. These reports led to threats of consumer boycott and legal action, which threaten the livelihoods of millions of West African producers. Producer and worker surveys conducted under the auspices of the Sustainable Tree Crops Program and ILO's International Program for the Elimination of Child Labour in 2001 and 2002 examined labour relations. The survey analysis of labor demand and supply relations with a special focus on the role of children is the chief focus of this activity.

**Location:** Cocoa sectors of Cameroon, Ghana, Nigeria, and Cote d'Ivoire

**Methodology:**

Descriptive and econometric analyses of survey data focused on the extent and role of child labor in the cocoa sectors of Nigeria, Cameroon, Cote d'Ivoire, and Ghana.

**Expected results:**

Policy recommendations for addressing the developmental issues surrounding child labor in the cocoa sector of West Africa

**Milestones:**

- Three STCP baseline survey monographs on labor with special focus on child labor for Nigeria, Cameroon & Ghana currently in press at IITA since July 2003.
- Qualitative study of child labor in the cocoa sector of Cote d'Ivoire by CEPRASS translated into English and currently under editorial review for publication by IITA—STCP.
- Synthesis report on child labor findings for RCI, Nigeria, Cameroon, & Ghana on IITA website.
- Draft report on producer/worker survey of child labor in Cote d'Ivoire translated into English (October 2002).
- Abridged report on producer/worker survey of child labor in Cote d'Ivoire by December 2003.

**Spatial analysis of baseline survey**

Activity no. PR1-4

**Project:** Research, technology transfer and impact  
**Component:** Research  
**Executing Partners:** Nkamleu, G., Gockowski, J. (STCP), Eric Wood, (USGS - USA)

**Objective:** Identification and analysis of policies and institutions for the increased competitiveness of the West African tree crops sector

**Background/Justification:**

In May 2000 in Accra, Ghana, the Sustainable Tree Crops Program (STCP) was launched to implement the partnership emerged between the chocolate industry, development agencies, and concerned governments, focusing on the issue of sustainable rural development in tree crops - producing areas. Among the STCPs first activities was the conduct of baseline surveys in the major cocoa-producing regions of Cameroon, Côte d'Ivoire, Ghana, Nigeria and Guinea.

This activity will make use of data collected during this survey to spatially represent production and marketing parameters.

**Location/Target Group:**

Cocoa sectors of Cameroon, Nigeria, Ghana, Cote d'Ivoire; and cashew sector of Guinea

**Methodology/Implementation Strategy:**

The method consists of matching administrative divisions in the baseline data base with those available in existing GIS layers and calculating descriptive statistics for selected variables.

**Expected Results/Deliverables in 2003/2004:**

Spatial differentiation of major production and marketing parameters in the cocoa sector of West Africa for informing spatially explicit policies and rural development efforts.

**Milestones:**

Cote d'Ivoire spatial representation developed July 2003  
Complete descriptive means analysis by September 2003  
Draft report by Nov 2003

**Investigating the determinants of child labor and schooling in the cocoa sector**

Activity no. PR1-5

**Project:** Research, technology transfer and impact  
**Component:** Research

**Executing Partners:** B. Nkamleu and J. Gockowski (STCP), Anne Kielland (World Bank – Washington), Jean-Baptiste, E. (CEPRASS Cote d'Ivoire).

**Objective:** Identification and analysis of policies and institutions for the increased competitiveness of the West African tree crops sector

**Background/Justification:**

There is a growing concern that some agricultural goods in developed country markets are being produced under “exploited” forms of labor practices. In particular, since 2001, there has been persistent report that children are being used in cocoa production in Côte d'Ivoire.

In response to those anecdotal reports of slavery on cocoa plantations in Ivory Coast, International Institute of Tropical Agriculture (IITA) and in close consultation with the Program for the Elimination of Child Labor of the International Labor Organization (ILO/IPEC) undertook investigative surveys of child labor practices on cocoa plantations, to establish the extent of such practices.

The challenge for child labor policy is to remove children away from work and toward schooling. To this end, there is a need to better understand the interplay between work and schooling as well as household decision making behavior with respect to child's time allocation. This activity investigates child labor and child schooling issues in the cocoa sector of Cote d'Ivoire, with the aim to identify determinant factors that can help to design a multi-angle policy approach towards the elimination of child labor.

**Location/Target Group:** Cocoa farmers of d'Ivoire Cocoa.

**Methodology/Implementation Strategy:**

To capture information on the status of abusive forms of child labor in Cote d'Ivoire, an extensive national survey was conducted in 2002. The survey was the first effort towards building a knowledge base on cocoa producing household and its workforce.

A total of 1501 households and over 250 villages, hamlets and cocoa “camps” across the cocoa belt of Cote d'Ivoire were visited. More than 11600 persons were enumerated in the survey.

Econometric analysis is being conducted of the determinants of child labor and schooling in the cocoa sector of Cote d'Ivoire.

**Expected Results/Deliverables in 2003/2004:**

Policy recommendations for increasing children's schooling in rural cocoa producing areas relative to work.

**Milestones:**

- Analysis completed in Juillet 2003
- Draft article completed in August 2003
- Expected publication date March 2004

**Review of regional agricultural labor markets and agricultural labor migrations.**

Activity no. PR1-6

**Project:** Research, technology transfer and impact

**Component:** Research

**Executing Partners:** G. B. Nkamleu (STCP)

**Objective:** Identification and analysis of policies and institutions for the increased competitiveness of the West African tree crops sector

**Background/Justification:**

This activity consists of a review of the literature on agricultural labor in West and Central Africa. The general objectives of this research are to collate and facilitate access to information on research work covered a wide array of topics related to rural employment and unemployment in West and Central Africa. This review is part of the background work of the child labor component of the Sustainable Tree Crop Program (STCP).

The main objective is to understand labor practices and history in the region and to broaden the understanding beyond child labor issues.

**Location/Target Group:** Labor institutions of West and Central Africa.

**Methodology/Implementation Strategy:**

Conducted literature review in various locations on issues connected to agricultural labor and rural migration in West Africa.

**Expected Results/Deliverables in 2003/2004:**

Compilation of knowledge on labor markets, institutions, and migration in West Africa in order to better inform agricultural labor policies.

**Milestones:**

Draft report submitted in June 2003

Annotated bibliography

**Key Findings**

- The impact of colonial inheritance on agricultural labor is highlighted.
- Literature and research on rural migration in West and Central Africa are synthesized.
- An overview of population trend and agricultural labor dynamic in the region is presented.
- The historical roles of policy and institutions on agricultural labor are explored.
- Literature on child labor, gender, impact of diseases on labor productivity particularly HIV and malaria is synthesized.

**Coordinating FFS curriculum development** (Cabi Bioscience collaborative activity with co-funding from DFID)

Activity no. FS1-2

**Project:** Research, technology transfer and impact  
**Component:** Technology transfer  
**Executing Partners:** Vos, J. (CABI Bioscience), S. David and J. Gockowski (STCP), resource persons from IRAD, CRIN, CRIG, CNRA, and IRAG

**Objective:** Strengthen farmers' decision-making capacity for sustainable production of tree crops through the implementation of FFS

**Background/justification:**

Experiences from Asia and elsewhere have shown that farmer field schools are an effective way to introduce farmers to knowledge intensive practices such as IPM and ICM. Farmer field schools (FFS) is a discovery based learning approach which seeks to strengthen farmers' knowledge of integrated crop management and improve their decision making capacity. The FFS approach was initiated with Asia with a focus on IPM in annual crops such as rice and vegetables. Innovations in FFS curricula include gender advocacy, public health issues and livestock. There is relatively little experience world wide with conducting FFS on perennial crops, hence the need to adapt the approach, training of trainers and curricula to longer season crops such as cocoa and cashew. For cocoa, work is needed on how to integrate social messaging on child labour into the FFS curriculum.

**Location/target group:**

STCP pilot projects; other projects in West Africa and worldwide

**Methodology**

Protocols are developed during curriculum development and TOT workshops attended by STCP teams and resource persons. Protocols are validated by facilitators/master trainers prior to use in FFS.

**Activity objectives:**

- Develop a curriculum for use in farmer field schools on cocoa and cashew in West and Central Africa
- Integrate social messaging on child labour into FFS curriculum

**Expected results/deliverables:**

- Validated curriculum for integrated FFS on cocoa and cashew
- STCP cocoa IPM manual
- Protocols on child labour

**Milestones:**

- Curriculum development workshop for cocoa (March 2003) and cashew (2004)
- Cocoa FFS curriculum tested in pilot field schools (May-December 2003)
- Further cocoa curriculum development during TOT workshops (August-September 2003, 2004)
- Publication of STCP cocoa IPM manual (early 2004)

**Status:**

- A five day workshop was held in March 2003 to initiate the process of developing a curriculum for FFS on cocoa. The workshop was attended by pilot project managers, master trainers, resource persons from cocoa research institutes in the region and facilitators from

IITA, CABI and a cocoa IPM project in Indonesia supported by ACDI-VOCA. Workshop participants developed 24 discovery learning exercises which will be compiled into an STCP IPM training manual for FFS. Three protocols were developed on the use of child labour in tree crop production. Protocols developed at the workshop were validated during the workshop or during pilot FFS in the four STCP countries.

- Follow-up training of trainers workshops are also being used to develop/validate new protocols. The second round of TOTs (August-September 2003) will introduce new protocols on fermentation, use of the ballot box test and disease zoos.
- In July-August 2003, CABI Participatory IPM Specialist completed a six week consultancy to provide feedback on the FFS curriculum and work on the STCP cocoa IMP manual.

**Technical backstopping and monitoring of FFS** (Cabi Bioscience and WCF collaborative activity with co-funding from DFID and WCF)

(Sept 5 version)

Activity no. FS1-3

- Project:** Research, technology transfer and impact  
**Component:** Technology transfer  
**Executing Partners:** S. David (STCP), Vos, J. (CABI Bioscience), BK Matlick (consultant WCF), Brice Gbaguidi (IITA Cotonou), resource persons from IRAD, CRIN, CRIG, CNRA, and IRAG
- Objective:** Strengthen farmers' decision-making capacity for sustainable production of tree crops through the implementation of FFS

**Background/justification:**

Tree crop farmers in West Africa have limited access to new information and technologies. Most rely on radio for technical information. Experiences from Asia and elsewhere have shown that the farmer field school approach is an effective way to introduce farmers to knowledge intensive practices such as integrated pest management (IPM) and integrated crop management (ICM). Farmer field schools (FFS) encourage discovery learning to strengthen farmers' knowledge of integrated crop management and improve their decision making capacity on a broad range of technical issues, including marketing. FFS also provide a platform for empowerment and may incorporate an advocacy agenda on social issues such as gender equality and the use of child labour in agriculture. In line with STCP's goal to take an integrated approach to developing sustainable tree crop production systems, the program seeks to institutionalize the FFS approach within farmer organizations and, to a lesser extent, national extension systems.

**Location/target groups:**

STCP pilot sites in Cameroon, Nigeria, Ghana, Cote d'Ivoire

**Methodology/implementation strategy:**

- Field visits by participatory extension specialist and email communication with master trainers and pilot project managers to provide informal training, technical guidance and feedback;
- Field visits by CABI's Participatory IPM specialist to provide informal training, technical guidance and feedback;
- Structured training of master trainers and facilitators.

**Activity Objectives:**

- Test and adapt the farmer field school methodology to tree crops;
- Assess the feasibility of implementing FFS with tree crops in the West/central African context;
- Develop capacity among farmer organizations and national extensions systems to implement farmer field schools and institutionalize the approach within farmer organizations

**Expected results/deliverables:**

- Manual on how to implement FFS for tree crops
- M&E framework for FFS
- Well trained facilitators and master trainers

**Milestones (for technical backstopping):**

- Initial monitoring to provide feedback on quality of FFS (August-October 2003)

- Develop 3 year pilot FFS program (August-October 2003)
- Develop M&E framework for FFS and initiate implementation (end of 2003)
- Training/review workshop for master trainers (November 2003)
- Publication on the process of initiating FFS for tree crops (2004)
- Manual on how to implement FFS for tree crops completed (2005)

**Status:**

- CABI Participatory IPM Specialist completed a six week consultancy to provide feedback on the quality of FFS in July-August 2003
- Three year pilot program for testing and adapting FFS methodology drafted based on observations from monitoring activities in Cameroon. Three phases are envisaged, with the following activities:

**Phase 1 (training and validation).** Curriculum development workshop; initial training of trainers for FFS facilitators and master trainers; follow-up TOTs; protocols validated during pilot FFS; facilitators graduate after completing several TOTs; awareness raising among farmer organizations on the FFS approach to encourage buy in and ownership. (2003)

**Phase 2 (implementation and monitoring):** Implementation of year-long field schools by certified facilitators monitored by master trainers; some FFS supported by farmer organizations (2004)

**Phase 3 (Institutionalization):** New FFS, some self financed, are initiated by experienced facilitators working in pairs with new farmer facilitators, most or all supported by farmer organizations (2005)

- M&E framework for FFS activities drafted and circulated among STCP team members

**INSTITUTIONALIZATION OF FARMER FIELD SCHOOLS**

(Sept 5 version)

Activity no. FS1-4

- Project:** Regional Project on Research and Technology and Knowledge Dissemination  
**Component:** Technology/knowledge dissemination  
**Executing partners:** Pilot projects in Cameroon, Nigeria, Ghana and Cote d'Ivoire, collaborating farmer organizations, national extension systems  
**Collaborators:** CABI Bioscience, SOCODEVI
- Objective:** Strengthen farmers' decision-making capacity for sustainable production of tree crops through the implementation of FFS

**Background/justification:**

STCP will explore how to modify the FFS approach, originally designed to be community based, to fit into a new institutional context: farmer organizations. Institutionalizing FFS within farmer organizations allows for a more integrated approach to tackling the full range of constraints farmers face, including marketing and weak organizational capacity. While STCP will focus on farmer organizations as the principle means of ensuring the sustainability of FFS, the program will also explore ways to better integrate FFS programs into national extension systems.

**Methodology/implementation strategy:**

- Train master trainers from farmer organizations and national extension systems
- Raise awareness among farmer organizations about the FFS approach through field visits, discussion etc.
- Develop guidelines and procedures for recruiting master trainers and facilitators from farmer organizations and extension and supported by them

**Activity Objectives:**

- Develop a sustainable strategy for implementing and scaling-up FFS in an integrated manner
- Adapt FFS approach to the farmer organization institutional context

**Expected results/deliverables:**

Farmer organizations have a better understanding and appreciation of the FFS approach and start to implement FFS under their own management

**Milestone:**

- Monitoring tour of FFS by farmer organization officers; based on negotiations with pilot projects, farmer organizations agree to provide financial support to FFS (early 2004)
- Farmer organizations use transparent procedures to recruit new master trainers (early 2004)
- Some farmer organizations remunerate FFS facilitators and master trainers (mid 2004)
- All farmer organizations remunerate FFS facilitators and master trainers (2005)
- Self-financing FFS initiated on a pilot scale (2005)
- Farmer organizations develop plan of action for scaling up FFS under their management (early 2005)

**Status:**

Activity to start in 2003-4

**INTEGRATE SOCIAL MESSAGING ON CHILD LABOUR IN THE FARMER FIELD SCHOOL (FFS) CURRICULUM AND INNOVATIVE EXTENSION APPROACHES**

(Sept 5 version)

Activity no. FS1-5

- Project:** Regional Project on Research and Technology and Knowledge Dissemination
- Component:** Technology/knowledge dissemination
- Executing partners:** Pilot projects in Cameroon, Nigeria, Ghana and Cote d'Ivoire, collaborating farmer organizations
- Collaborators:** ILO-IPEC West Africa Cocoa/Agriculture Project (WACAP)
- Objective:** Strengthen farmers' decision-making capacity for sustainable production of tree crops through the implementation of FFS

**Background/justification:**

WACAP is a comprehensive programme aimed at the systematic elimination of hazardous and exploitative child labour in the cocoa/agriculture sector. One of its five components is raising awareness of child labour issues among children, communities and private and public agencies. The inclusion of social messaging on child labour issues in the FFS curriculum and innovative extension methods is a key strategy for awareness raising among cocoa farmers and communities.

**Methodology/implementation strategy:**

- Develop and validate protocols on child labour for use in FFS
- Develop and test, within the context of the FFS approach, other approaches for raising awareness on child labour issues e.g. farmer life schools focusing on child labour issues
- Include both technical and social messages in innovative extension approaches based on a social marketing approach

**Activity Objectives:**

- Effectively integrate social messaging on child labour issues in the curriculum for FFS and in innovative extension approaches
- Explore FFS as an advocacy platform on child labour issues

**Expected results/deliverables:**

- Validated protocols
- Extension materials integrating both technical and social content
- New approaches to advocacy within FFS

**Milestones:**

- Protocols validated and included in FFS curriculum (end of 2003)
- WACAP staff train master trainers and FFS facilitators on child labour issues and use of child labour protocols (end of 2003 and continuous in 2004)
- Extension materials containing social messages developed (mid 2004) and in use (end of 2004)
- WACAP staff, FFS facilitators and master trainers develop approaches to promote the advocacy role of FFS on child labour issues (end of 2004)
- Advocacy approaches tested on a pilot scale (2005)

**Status:**

- Four protocols were developed on the use of child labour in tree crop production during

the March 2003 curriculum development workshop held in Cameroon. They covered an introduction to child labour issues (2 protocols), use of pesticides/chemicals by children and carrying loads.

- Protocols introduced to FFS facilitators during training workshops (August-September 2003).

## **BACKSTOPPING PARTICIPATORY TECHNOLOGY DEVELOPMENT IN STCP PILOT PROJECTS**

(Sept 5 version)

Activity no. TD1-1

**Project:** Regional Project on Research and Technology and Knowledge/Dissemination  
**Component:** Technology/knowledge dissemination  
**Executing partners:** Pilot projects in Cameroon, Nigeria, Ghana and Cote d'Ivoire, farmer organizations, national extension systems  
**Collaborators:** CABI Bioscience

**Objective:** Increase farmer involvement in tree crops research through participatory technology development (PTD)

### **Background/justification:**

Participatory technology development (PTD) (also known as farmer participatory research or FPR) is an approach for involving farmers in developing technologies that are appropriate for their particular situation. PTD involves bringing farmers together with researchers to pool the expertise of each group: farmers' knowledge and practical abilities and researchers' scientific knowledge and expertise, in testing and developing technologies. "PTD seeks to reinforce the existing creativity and experimental capacity of farmers, and to help them keep control over the process of generating innovation" (IIRR sustainable agricultural extension manual). The major reasons for conducting PTD are: to obtain realistic assessments under farmer conditions, obtain rapid feedback from farmers to avoid costly research dead-ends, identify new researchable problems and opportunities and improve the sustainability of the innovation process. Because PTD involves conducting research in the field, researchers working together with farmers, on issues identified by farmers themselves, technological adoption is likely to be higher.

### **Methodology/implementation strategy:**

Farmer research groups (FRGs), consisting of selected FFS graduates, will be established on a pilot basis, facilitated by FFS facilitators and supervised by master trainers. The stages involved in PTD are:

- Problem identification/setting priorities
- Planning, designing and implementing experiments
- Monitoring experiment
- Evaluation of technologies
- Analysis experimental results
- Provide feedback of results to the community
- Scaling up/diffusion

### **Activity Objectives:**

- Strengthen farmers' involvement in tree crops research
- Validate new technologies for inclusion in FFS curriculum

### **Expected results/deliverables:**

- Methods adapted for organizing and implementing PTD with tree crops
- FRG results feed into FFS curriculum
- Farmer organization and extension staff trained in PTD
- Training materials for PTD with tree crops

**Milestones:**

- Strategy developed for implementing PTD within STCP (end of 2003)
- Master trainers and selected FFS facilitators trained in PTD (early 2004)
- Pilot FRGs set up in Cameroon, Nigeria, Ghana, Cote d'Ivoire (early 2004)
- Training materials for PTD with tree crops developed (2005)
- Monitoring tour of FRGs by farmer organization officials; action plans developed by farmer organizations to support and scale up FRGs (2005)

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**Status:**

Activity to start in 2003-04

**BACKSTOPPING INFORMATION/TECHNOLOGY DISSEMINATION THROUGH INNOVATIVE EXTENSION APPROACHES**

(Sept 5 version)

Activity no. IE1-1

**Project:** Regional Project on Research and Technology and Knowledge/Dissemination  
**Component:** Technology/knowledge dissemination  
**Executing partners:** NGOs, farmer organizations, national extension systems and other rural service providers in pilot project areas

**Objective:** Disseminate information on sustainable tree crop management practices through innovative extension approaches

**Background/justification:**

Farmer field schools develop farmer skills and decision making ability and are therefore more appropriate for imparting knowledge and information on complex, knowledge based issues such as IPM and ICM. Component or input technologies are more suitable for dissemination through other channels or approaches. Such approaches include mass media (radio, newspapers), traditional media (folk or development theater), rural information centers, traditional extension materials (posters, brochures, decision guides) and support to input suppliers (nurseries run by individual farmers or farmer organizations, farmer seed enterprises). There is need to complement discovery learning through FFS with other dissemination approaches that are innovative and involve farmers.

**Methodology/implementation strategy:**

Suitable rural service providers (RSP) will be identified to collaborate on this activity. Working sessions involving cocoa researchers, RSP staff and a communications/extension specialist will be held to review the technology "toolbox" used in FFS and select those appropriate for dissemination through other extension approaches. Extension approaches and materials will be developed and tested on a pilot scale. RSP will monitor the reach of the approaches used.

**Activity Objectives:**

- Disseminate technical information to improve sustainable production of tree crops
- Test the appropriateness of different extension approaches
- Integrate social and technical messages in extension approaches
- Develop capacity of farmer organizations and other rural service providers to develop extension messages and materials

**Expected results/deliverables:**

- Extension materials
- Methods developed and tested for innovative dissemination approaches

**Milestones:**

- Suitable rural service providers identified and agree to collaborate (end of 2003)
- Working sessions held to identify messages/technologies and develop approaches and messages (April 2004)
- Preparation of messages/materials and implementation of methods (mid 2004)
- Continued implementation of methods (2005)
- Monitor reach of extension approaches (continuous, final survey in 2005)

**Status:**

Activity to start in 2004

**Development of a monitoring, evaluation and impact assessment framework for project interventions.**

Activity no. IA1-2

**Project:** Research, technology transfer and impact

**Component:** Impact

**Executing Partners:** Gockowski, J. (STCP/IITA)

**Objective:** Measure economic, environmental and social impacts of tree crop systems & interventions.

**Background:**

As the initial phase of the STCP is meant to test new innovations and approaches for trading systems, information and knowledge dissemination, and capacity development of farmer organizations it is important that the program monitor and evaluate interventions with great attention. The ultimate objective is to measure the impact (economic, social, and environmental) of these interventions. As the first step in the process a workshop was held in Ibadan Nigeria to begin to explore ME&I and to discuss the processes for accomplishing the impact objective. The output from this workshop is to serve as an input in the ME&I framework. This framework is to assist in the monitoring and evaluation of interventions in the tree crop sector in West Africa, development agents require an assessment framework illustrated with practical examples of the peculiarities of the West African tree crop sector.

**Location:** Cameroon

**Outline of framework:**

1. Develop theory of market failures,
2. Economic measurement issues ,
3. Normative prescriptions (e.g. child labor) and
4. Measurements issues specific to perennial tree crops.
5. Participatory monitoring and evaluation
6. Ex ante impact assessment for prioritising potential interventions
7. Ex poste impact assessment for prioritising future interventions and scaling out
8. Use input from IA1-1 report to illustrate approaches to different categories of problems

**Expected results:**

Methodology for monitoring and evaluating tree crop interventions and measuring their impacts (both potential and actual) developed and disseminated among STCP partners and other stakeholders.

**Milestones:**

- Draft framework developed Sept 2003
- Finalized framework to be distributed to pilot project managers in Oct 2003
- Continued updating and illustration with practical examples through 2005.

**Estimated economic value of secondary products and environmental services provided by cocoa agroforests in Nigeria and Cameroon.**

Activity no. IA1-4

**Project:** Research, technology transfer and impact  
**Component:** Impact  
**Executing Partners:** Gockowski, J. (STCP/IITA), forestry research institutes, ecology research institutes in Cameroon and Nigeria

**Objective:** Measure economic, environmental and social impacts of tree crop systems & interventions.

**Background**

Cocoa farms are one of the best examples of permanent agriculture in the humid tropics and in some of the degraded forest landscapes of Nigeria and Cameroon serve as mini refuges for biodiversity and wildlife. Unlike food crop production which involves crop-fallow rotations with regular human disturbance of the agroecosystem. Cocoa agroforests are a variant of cocoa production in which the farmer selectively (and sometimes non selectively) maintains an array of other tree and plant species for various reasons. Studies in Cameroon have characterized this biodiversity in terms of species and plant functional attributes from which we know there is a wide variety of useful indigenous species maintained in these mini-refuges. The cocoa farms of southwest Nigeria are remarkably similar in structure and function to those in Cameroon, producing a wide array of secondary products including fruits, medicines and timber. In addition to these significant “secondary products” these systems also contribute a number of environmental services including nesting sites for bird, bat and reptilian insectivores, watershed services, maintenance of forest biodiversity, and carbon stocks.

The relative value of these services is often overlooked when discussion turns to the cocoa system innovations, extension, and adoption by farmers. For example, farmers may be perceived as acting irrationally when they don't cut down their kolanut trees at the behest of extension officers when in fact they are often pursuing very sound strategies of income diversification. As environmental services are generally considered public goods whose benefits accrue to society at large, whereas farmers are concerned with private returns, the socially optimal level of these services is often not attained. To counter this situation governments should develop policies to encourage the greater provision of such services to the point where the marginal social cost of provision is equal to the marginal social benefit. To begin to devise such policies informed decision making needs to know what is the value of those commodities and services. The objective of this activity is to develop estimates of these benefits.

**Location**

Cocoa agroforests of Lekie Division in Cameroon and Owena LGA in Ondo State Nigeria.

**Methodology:**

Focused group discussion with cocoa producers of the various secondary commodities produced in their systems; ranking exercises; seasonal calendar of production;  
Estimation of production potential for commercially exploited secondary products  
Stand densities of various secondary commodities.  
Collection of market prices for commercially exploited products  
Estimation of use value for commodities and goods consumed by household (e.g. medicines)  
Estimation of standing timber value and annual productivity using allometric equations.  
Estimation of carbon stocks using allometric equations.  
Estimation of environmental services provided

Valuation of env. services using contingent valuation methods

**Expected result:**

Estimation of the value of secondary products, non-market goods & services produced by cocoa agroforests.

**Milestones:**

Inventory and classification by use of plant species and densities in cocoa agroforests in both Cameroon and Nigeria by January 2004.

Initial draft technical report by September 2004

**Key findings:** new activity

**Social determinants of chronic poverty thresholds and poverty traps among cocoa sharecropper tenants in Nigeria and Cote d'Ivoire.**

Activity no. IA1-5

**Project:** Research, technology transfer and impact  
**Component:** Impact  
**Executing Partners:** Gockowski, J. (STCP/IITA), rural sociology research institutes/consultants in Cote d'Ivoire and Nigeria

**Objective:** Measure economic, environmental and social impacts of tree crop systems & interventions.

**Background:**

The STCP baseline surveys revealed that the most common type of permanent cocoa worker was employed under a sharecrop leasehold arrangement. The most common share arrangement was one-third of gross proceeds to the tenant and two-thirds to the producer. These workers represent an agricultural underclass that appears to be trapped in chronic poverty. The objective of this study is to determine whether or not these workers are in transitory or chronic poverty and if the latter the threshold of assets needed to escape and worker strategies for accumulating these assets. The expected result of this effort will be a set of policy recommendations for lifting these workers and their dependents out of chronic poverty.

**Location:**

Ondo State, Nigeria and eastern Cote d'Ivoire (Aboisso, Abengourou regions).

**Methodology:**

Use of qualitative and quantitative rural sociology research methods to describe dynamic chronic poverty thresholds among sharecropper population of Nigeria and their coping strategies

**Expected result:**

Relationship between tenant household characteristics, farm productivity, farm size and poverty thresholds and livelihood strategies described and used to formulate policy recommendations for lifting the poor out of chronic poverty.

**Milestones:**

- January 2004 first round of scoping interviews conducted.
- April 2004 quantitative survey of sharecroppers completed.
- May 2004 data base created
- July 2004 technical report
- Sept 2004 draft article for referred journal

**Needs assessment of producer marketing organizations for enhanced supply chain management**

Activity no. IA1-6

**Project:** Research, technology transfer and impact  
**Component:** Impact  
**Executing Partners:** Gockowski, J. (STCP/IITA), TISP regional specialist (to be hired), consultants in Nigeria, Cameroon, and Cote d'Ivoire.  
**Objective:** Measure economic, environmental and social impacts of tree crop systems & interventions.

**Background:**

The gains from the liberalization of cocoa marketing in West Africa has been hindered in part from coordination failures between the demands of processors/manufacturers in the north and the newly liberalized private sector. IITA has recently submitted a proposal to the USAID West African Regional Program for regional trade enhancement in response to a recently issued RFA which includes a component dealing with enhanced supply chain management (ESCM). The objective of ESCM is to assist producer marketing cooperatives innovate and develop new information systems and tools for trading directly in today's global markets. The objective of this activity is to assess current trading capacity in producer cooperatives and in a consultative process develop a proposal for new innovative approaches for tackling the coordination problem which exists in today's markets in a fashion in which producers benefit.

**Methodology:**

Needs assessment methodologies applied to the issue of information systems and new trading systems required to ensure quality and maintain product identity in supply chain

**Expected result:**

Development of a project proposal for supporting enhanced supply chain management in key export commodity sectors of coastal West Africa

**Milestones:**

- Initiate assessment in October 2003
- Report findings at proposal design workshop in February 2004
- Present proposal to USAID and private investors by March 2004 for funding

**Evaluation of credit impacts on intensification of cocoa production systems.**

Activity no. IA1-7

**Project:** Research, technology transfer and impact

**Component:** Impact

**Executing Partners:** Gockowski, J. (STCP/IITA)

**Objective:** Measure economic, environmental and social impacts of tree crop systems & interventions.

**Background:**

Access to rural credit is often cited as a critical need for agricultural development. In the baseline survey, the lack of rural credit was ranked in all the countries as farmers' number one economic concern. Farmers indicated that due to a lack of credit they were forced into applying less than optimal quantities of purchased inputs. The objective of this study is to quantify the impact of this market failure on the technical and allocative efficiency of cocoa producers and quantify for policy makers the costs of failing to address rural credit market failures.

**Location/target group** The analysis will be conducted in Yaounde using the baseline survey databases from Nigeria and Cameroon, which are the two countries where fungicides were found to be essential to production. (See also the findings described in Activity no. ER1-1 above)

**Methodology**

Econometric (stochastic production frontier) and descriptive analysis of STCP baseline data to examine the effects of rural credit on the intensification of cocoa production.

**Expected Result**

Understanding of the role of rural credit in cocoa production and its potential for increasing the competitiveness of West African cocoa sector

**Milestones:**

- Produce initial descriptive analysis of data sets by Dec 2003
- Econometric analyses completed by February.
- Final report by March 2004
- Referred Publication by May 2004

**Ex ante economic evaluation of the costs of alternative methods of delivering improved planting materials to farmers**

Activity no. IA2-1 and GP1-2

**Project:** Research and technology transfer  
**Component:** Impact  
**Executing Partners:** Gockowski, J., and David, S., STCP, Master trainers in Ghana, Cameroon, Nigeria, RCI.

**Objective:** Exante evaluations of potential innovations, institutional change and policy change on net social welfare

**Background:**

One of the findings of the baseline surveys was that in general farmers lack access to improved planting materials. A majority of farmers (67% to 90% depending on country) reported using seedling material from their existing tree stocks as their chief source of planting material. Although improved materials exist with research, it appears that market failures associated with the dissemination of these materials are a constraint on West African competitiveness vis a vis other producing regions. As part of the strategy to address this issue, an economic evaluation of the various alternative approaches for bringing these materials to farmers is needed.

**Location:** Four cocoa producing sites and one cashew producing site of STCP

**Methodology:**

- Site visits to existing dissemination centers of cocoa planting materials to collect information on technologies and costs.
- Calculation of economic costs and returns of seedgardens, tissue culture, budwood gardens & grafting, hand pollination, cooperative nurseries vs. individual nurseries, bareroot seedlings versus polybag, etc using net present discounted value and economic and social prices.

**Expected results:**

Recommendations for low cost effective dissemination of improved planting material

**Milestones:**

- Research protocol and workplan by Sept. 2003
- Site visits to Ghana, Nigeria, Cameroon, RCI completed by January 2004
- Country trip reports
- Technical report by March 2004
- Journal article by June 2004

## **Structure, conduct, and performance studies of liberalized cocoa markets in Nigeria, Cameroon and Cote d'Ivoire**

Activity no. IA2-2

**Project:** Research and technology transfer  
**Component:** Impact  
**Executing Partners:** Gockowski, J. (STCP/IITA), TISP regional specialist (to be hired), consultants in Nigeria, Cameroon, and Cote d'Ivoire.

**Objective:** Ex ante evaluations of potential innovations, institutional change and policy change on net social welfare

### **Background:**

The recent liberalizations of cocoa marketing in West Africa offer an opportunity for producer marketing cooperatives to increase their market share and generate important benefits for their members. In order to develop business plans, trading innovations, and effective marketing strategies, information on the current marketing system is urgently needed. The objective of this activity is to provide strategic information to the benefit of producer marketing cooperatives on cocoa marketing in the newly liberalized contexts of Cameroon, Nigeria, and Cote d'Ivoire using the "structure, conduct, performance paradigm of marketing research.

### **Location**

Marketing systems from farmgate to CIF Europe in Cameroon, Cote d'Ivoire and Nigeria.

### **Methodology:**

Through key informant interviews and secondary data sources (e.g. Chamber of Commerce, Interprofessional groups) gather information necessary for relating market structure and conduct to performance.

This will include analysis of :

- Structure (no. of buyers, grades and standards, brands, vertical and backwards integration, barriers to entry, market share concentration)
- Conduct (price discovery mechanisms, buying strategy) and
- Performance (innovations, efficiency, price-cost margins at various levels in system).

### **Expected results:**

Identification & prioritization of interventions (policies, institutional or trading) to improve efficiency of supply chain management thru producer marketing cooperatives.

### **Milestones:**

- Initiate assessment in October 2003
- Report findings at proposal design workshop in February 2004
- Present proposal to USAID and private investors by March 2004 for funding