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Cocoa seed multiplication: an assessment of seed gardens in
Cameroon, Ghana and Nigeria

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By:

Richard Asare¹, Victor Afari-Sefa², Isaac Gyamfi², Chris Okafor² and Jonas Mva Mva²

¹ Forest and Landscapes Denmark and International Institute of Tropical Agriculture (IITA) - Sustainable Tree Crops Program (STCP), Regional Office- P.O. Box 135 Accra, Ghana. Email:

gra@life.ku.dk; r.asare@cgiar.org

² International Institute of Tropical Agriculture (IITA) Email: v.afari-sefa@cgiar.org;
i.gyamfi@cgiar.org; c.okafor@cgiar.org; j.mva@cgiar.org



International Institute of Tropical Agriculture

The Sustainable Tree Crops Program (STCP) is a joint public-private research for development partnership that aims to promote the sustainable development of the small holder tree crop sector in West and Central Africa. Research is focused on the introduction of production, marketing, institutional and policy innovations to achieve growth in rural income among tree crops farmers in an environmentally and socially responsible manner. For details on the program, please consult the STCP website <<http://www.treecrops.org/>>.

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IITA-Ghana, Accra

P.M.B L 56, Legon, Ghana

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Preface

This study of cocoa seed gardens in Cameroon, Ghana and Nigeria was commissioned by IITA/STCP. The study aims at assessing the production capacities of the cocoa seed gardens to produce sufficient improved seeds that will help farmers improve their yield, output and income. The need for an improvement in the performance of the crop has become necessary in view of ageing of cocoa farms, poor average yield of cocoa trees across the sub region and the determined efforts of the respective governments to increase production through rehabilitation of all cocoa farms and the establishment of new ones.

The study was carried out in all existing seed gardens in the respective countries. The investigations have been in-depth, the study provided basic information on where cocoa seed gardens are located, when they were established and the different varieties planted. It also discussed pod production methods and gave the statistics of output and distribution by different seed gardens in the various countries. The critical challenges posed by labour and other inputs were highlighted, while the existing opportunities were equally discussed. The input and infrastructural requirements for maintaining 1 ha seed garden in the various countries were indicated. This study is particularly valuable in providing most basic information required for taking decisions on the way forward for successful and profitable farming operations by cocoa farmers in the respective countries.

Executive summary

In recent years, the viability of cocoa seed gardens and commercial cocoa farms has been of much concern to policy makers, farmers, and other stakeholders in the cocoa industry. This is as a result of low yield of cocoa trees, high maintenance costs of cocoa farms and ageing of some trees. To address the situation, the Sustainable Tree Crop Program (STCP) managed by the International Institute of Tropical Agriculture (IITA) commissioned this study to assess the production capacity of all seed gardens across West and Central Africa. This report discusses the results obtained from the study.

Study approach

The assessment was conducted in Cameroon, Ghana and Nigeria. Relevant information was gathered with the help of structured questionnaire, systematic observations and informal interactions with officers and other workers of the seed gardens across the various countries. The result of the analysis formed the basis of the discussions.

Findings

Seed Garden Location, Year Established, Area and Varieties Planted

Cameroon

There are only 3 state own cocoa seed gardens in the country. These are located in Nkoemvone (103 ha), Mengang (34.6 ha) and Barombi Kang (12 ha). Apart from the garden in Nkoemvone, which was established in 1960 the rest were established in 1981. There are about 17 different clones found across the 3 seed gardens.

Ghana

There are 26 state own seed gardens located in different agro-ecological zones across 6 cocoa growing regions in Ghana. Six seed gardens are located in the Ashanti region (106.5 ha) established between 1963 to 1980; 3 seed gardens are located in the Brong-Ahafo region (77.6 ha) established between 1953 to 1982; 2 seed gardens in Central region (22.4 ha) established between 1963 to 1974; 8 seed gardens in the Eastern region (201.43 ha) established between 1957 to 1982; 1 seed garden in the Volta region (11 ha) established in 1974, and 3 in the Western region (37 ha) established between 1954 to 1972. In all 16 different varieties of cocoa including clonal materials were found across the seed gardens.

Nigeria

Cocoa seed gardens in Nigeria are located in Ondo, Osun, Oyo States in the South-west zone; in Edo and Cross River State in the South-south zone and; in Abia State in the South-east zone. There are seven (7) cocoa seed gardens in Ondo State, out of which 5 belonged to the State and two to CRIN. These gardens were established between 1956 and 1978, and occupy a total nominal area of 106.46 ha. In Osun State, there are three (3) seed gardens, established between 1961 and 1979 and occupy a total of 16.2 ha. In Oyo State, there are five (5) seed gardens, four of which were established in 1964. The fifth plot containing improved clones was established in

1999. The 5 plots occupy a total area of 229.98 ha. The 2 seed gardens in Edo (31.5 ha established in 1967) and Cross River (4.4 ha established in 1975) States were established by CRIN as experimental plots and planted with improved planting materials. They were not established as seed gardens but nevertheless they have clonal materials which are made available to farmers. There is only one seed garden in the South-East Zone, which was established between 1971 and 1986, and occupies an area of 28.5 ha. There are 9 different cocoa varieties planted across the various seed gardens.

Cocoa pod production method, output and distribution

All the seed gardens in the respective countries use either the open or hand pollination method for hybrid pod production. The total annual production of pods for the 2008/2009 production season in Cameroon, Ghana and Nigeria are 177,767, 4,841,428 and 471,866 respectively. However, there was no systematic procedure for estimating farmer pod demand and quantity supplied in any of the seed gardens across the 3 countries.

Seed garden challenges and opportunities

The major challenges facing all the seed gardens include inadequate and untimely release of funds from government, old age of trees, depleted soils, inadequate number and poor condition of equipment and limited infrastructure. Despite these challenges, the seed gardens offer a lot of opportunities for the growth and development of the cocoa industry through the provision of high quality planting materials.

Costs of maintaining 1 ha seed garden in the respective countries

All the seed gardens lack adequate skilled and unskilled labour in addition to equipment and agrochemicals. Effort was made to estimate the labour, material and infrastructural costs to maintain 1 ha seed garden in the respective countries. This amounted to CFA 4,153,050 for Cameroon, GHC 11,041 for Ghana and NA 937,667 for Nigeria.

Conclusions and recommendations

In an effort to document the state of pod production in the sub-region a seed garden capacity assessment study was conducted across 3 countries namely Cameroon, Ghana, and Nigeria. Results indicate that none of the countries had a specific protocol and/or mechanism for estimating cocoa pod demand by farmers. As a result there is a deficit in production in all the countries. With the current efforts by the respective government to increase cocoa production, it will be necessary for the seed gardens to improve upon production to enhance rehabilitation of old cocoa farms and also establish new ones. In order to achieve such objectives, it is recommended that the following should be considered:

1. Government should provide funds for research into modern technologies in seed multiplication via somatic embryogenesis, grafting and budding and to also train more personnel in these technologies
2. There should be an aggressive rehabilitation regime in all the seed gardens to replace old cocoa trees with new improved planting materials. These new planting materials should be planted in a progressive expansion program taking advantage of the modest land availability that exist in the respective countries

3. There should be the establishment of private seed gardens with support from governments to augment the existing state own seed gardens
4. Novel and modern equipment should be used in the production process coupled with irrigation schemes to avoid over reliance on rainfall
5. A systematic procedure for estimating annual pod demand and supply should be promoted in all countries. This will help the seed gardens to make adequate planning of their planting material production activities
6. Public-private-partnership investment options in planting material multiplication and distribution should be considered.

Key Words: Seed gardens; Seed multiplication; Clonal varieties

Acronyms

CBO	Community Based Organization
CCSP	Coffee and Cocoa Seed Project
CGIAR	Consultative Group on International Agricultural Research
COCOBOD	Cocoa Marketing Board of Ghana
CRIG	Cocoa Research Institute of Ghana
CRIN	Cocoa Research Institute of Nigeria
CSSVD	Cocoa Swollen Shoot Virus Disease
FODECC	Fund for Cocoa and Coffee Development
IITA	International Institute of Tropical Agriculture
IRAD	Institut de Recherche Agronomique pour le Développement
MINADER	Ministry of Agriculture and Rural Development
MIDENO	Mission de Développement du Nord Ouest
NGO	Non-Governmental Organization
NWCA	North West Cooperatives Association
R4D	Research for Development
SODECOA	Société de Développement du Cocoa
SOWEFCU	South West Farmers Cooperative Union
SPU	Seed Production Unit
STCP	Sustainable Tree Crops Program
UCAL	Union des Coopératives du Littoral
UCCAO	Union Central des Coopératives Agricoles de l’Ouest

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Introduction

Background

Despite productivity gains of 50 per cent recorded amongst farmers that have fully adopted cocoa hybrids as planting materials in their cocoa cultivation, access to such improved planting materials still remains difficult and sometimes non-existent. In its cocoa household baseline studies conducted in 2001/2002, IITA/STCP identified that production inefficiencies has given rise to limited enterprise profitability among cocoa farmers. The study also noted that about one-third of cocoa farmers experience a negative return on their investment in cocoa production. What is more, it noted that yields per ha are low in West Africa compared to other regions of the world such as in Malaysia and Indonesia. Lack of access to improved planting materials for cocoa establishment is identified as being one of the main reasons for low yields in cocoa.

With production levels of between 200-700 kg of dry beans per ha across West and Central Africa, governments are determined to increase production over the coming years. For instance in Cameroon, the government in the year 2000 developed a 10-year plan with an objective of increasing cocoa production from 100,000 MT to 200,000 MT by the year 2010. In Ghana the national COCOBOD has set a target of 1,000,000 MT annual production by the year 2012. This current development is not different in Nigeria where federal government has increased intervention in the cocoa industry to boost production. The strategy for achieving success in the respective countries includes among others a common activity of rehabilitation of old cocoa farms using new and improved planting materials.

Cocoa like any other tree crop thrives well depending on its genetic qualities. This therefore calls for the presence of well established seed gardens¹ (seed sources) in the respective countries that will make improved hybrid materials readily available and a dynamic and efficient distribution mechanism, which will facilitate delivery of these materials to farmers to sustain the rehabilitation process.

Establishing reliable and sustainable seed sources and distribution systems for new cocoa farm establishment and rehabilitation of old cocoa farms require a public-private partnership approach in which there is a collective responsibility of possible stakeholders including donors, relevant government agencies, NGOs, CBOs, farmer organizations, and farmers. In this partnership, complimentary relationships between the different stakeholders for the establishment of a cost-effective and relatively self-sustaining system are required. This will then encourage farmers' to adopt and use improved planting materials for a sustained production.

In pursuit of its commitments to improve cocoa yields in West and Central Africa the IITA/STCP carried out an assessment of the pod production capacities of the cocoa seed gardens in

¹ A seed garden according to Aikpokpdion (2007) is a specialized tree orchard planted with known selected clones as parents to generate hybrids of good genetic qualities of known yield, disease and pest resistance potentials.

Cameroon, Ghana and Nigeria. The assessment is a critical initial step towards establishing a successful planting material production and distribution system for cocoa farmers. The aim of the assessment is to enable STCP to match the planting materials needs of the programs in the various countries against potential supplies over the period of the program and also to enable the STCP pursue measures that minimize the shortfall, if any of seed supply and demand in the sub region.

This report is a synthesis of the results of the assessment from the 3 countries. The report discusses findings from the various seed gardens investigated across the respective countries and also provides a set of recommendation for the way forward in the management and operations of the identified seed gardens. The objectives of the assessments were however, to investigate:

- When the various seed gardens were established and to determine their current operational sizes
- What design and set up exist on various plots on seed gardens indicating the different varieties (pod parents and pollen parents) in the design
- The method of production (open pollinated or hand pollinated)
- The most recent annual pod production capacity
- Pod delivery capacity (i.e., disease free and good quality pods delivered to farmers)
- Temporal (monthly) pod distribution and distribution schemes if any, i.e., quantities delivered, number of farmers reached and period of year, mode of transport)
- How pod demand is estimated by the respective seed gardens as well as the proportion of the demand that is per annum

In order to achieve the set objective, questionnaires tailored to the peculiarities in the various countries were designed and information collected from October to December 2009.

Overview of hybrid pod production in Cameroon, Ghana and Nigeria

A combination of a functioning seed garden and an efficient and dynamic seed distribution system is the engine that drives an effective and efficient agricultural production. In the West African sub-region very few institutions exist that facilitate the multiplication and distribution of planting materials to farmers. Where such institutions exist, they are predominantly run by the state and provide planting materials for especially food and tree crops at subsidized prices.

With over 400,000 ha under cocoa cultivation and the government's ambition of a 100% production increase by the end of 2010, Cameroon has only three state own seed gardens covering a total area of about 149.9 ha. Out of this only 79.9 ha is effectively under production at the moment planted with 17 different clonal varieties. These seed gardens have an estimated annual production of less than 300,000 pods. The seed multiplication method is mainly hand pollination. This according to official estimate represents one-fifth of the annual demand by farmers even though there is no properly laid down procedure for estimating farmer demand of hybrid pods. The shortfall in production has been attributed to old age of tree stocks in seed gardens, declining soil fertility, dwindling land area under seed gardens, the use of obsolete equipments and, the absence of methods to boost cocoa seed production. However, government has initiated a number of interventions to help bridge the production gap. One of such initiatives is the establishment of a cocoa and coffee development fund. This fund will be used through the Cocoa and Coffee Seed Project (CCSP) to establish a 25 ha cocoa seed garden by 2011. It is estimated that the new seed garden when completed and in full production capacity, will raise 500,000 pods to supplement what is currently being produced in the other seed gardens by the year 2015.

Ghana has 1,400,000 ha of land committed to cocoa production. The country has 26 state own seed gardens located in the 6 cocoa growing districts across the different agro-ecological zones of the cocoa belt. The seed gardens planted with 16 different clonal materials are managed by the Ghana COCOBOD through its Seed Production Unit. The average annual production capacity is about 4.5 million pods with an effective seed garden land area of about 495.57 ha (out of a total nominal area of about 2,732 ha). According to official estimates, this represents 66% of annual hybrid pod demand target from farmers even though there is no properly documented approach of estimating this target. Almost all the seed gardens use the hand pollination method for seed multiplication. Challenges facing these seed gardens include ageing tree stocks, (about 60% of trees are over 30 years), use of obsolete equipments over reliance on rainfall as a source of water for production, and a dwindling land area. According to discussions held with some key informants, the SPU has initiated a plan to rehabilitate and expand the seed gardens with new clonal materials even though the process is slow. This is to help realize government's target of increasing production from 700,000 to 1,000,000 MT by the year 2012.

Nigeria has about 700,000 ha of land planted under cocoa. With a production level of 360,000 MT in 2008 and a drive to improve the largest non-oil foreign exchange earner (cocoa) for the country, the federal and state governments are giving extensive support in policy direction, provision of inputs and funds for research. In terms of improved planting material production,

there are 18 state own seed gardens in the country, which cover an effective area of 279.31 ha out of the total available land area of 426.35 ha. Production in these seed gardens is by both hand and open pollination with annual pod production of over 600,000 in 2006 and 2007 but dropped to a little under 500,000 in 2008 with average annual production of 564,331. Challenges faced by these seed gardens include ageing tree stocks, inadequate and untimely release of government funds for operations, declining soil fertility and lack of skilled and unskilled labour. In a recent effort to support the cocoa industry through supply of improved hybrids to farmers, especially the recently selected highly precocious materials from CRIN, the Federal Government of Nigeria mandated CRIN to establish a two-hectare seed garden plot in each of the 14 cocoa growing states of Nigeria. This project began in 2007 and is expected to be completed by 2011. Once successfully completed, cocoa farmers would have access to cocoa varieties with yield potentials in excess of 2.5 to 3.5 tons/ha. Some of the selections are also highly resistant to the black pod disease of cocoa. It is expected that, a well maintenance regime of the seed gardens by the states coupled with carefully managed hand pollination would have a tremendous impact on the Nigerian cocoa industry in terms of increased volume, higher family earnings and increased foreign exchange from exports.

Table 1: State of seed gardens in Cameroon, Ghana and Nigeria

Seed garden characteristics	Countries		
	Cameroon	Ghana	Nigeria
Land area (ha)	79.9 (149.6)	495.57 (2,732)	279.31 (426.35)
Number of seed gardens	3	26	18
Average age of tree stock	>40	>35	>40
Pollination method	Mainly hand pollination	Mainly hand pollination	Both open and hand pollination

*figure in parenthesis indicates the nominal land area for seed garden

Table 2: Annual production of hybrid pods in Cameroon, Ghana and Nigeria

Year	Country	Number of pods produced
2005/2006	Cameroon	137,671
	Ghana	NA
	Nigeria	NA
2006/2007	Cameroon	189,197
	Ghana	NA
	Nigeria	617,839
2007/2008	Cameroon	254,814
	Ghana	4,497,739
	Nigeria	603,288
2008/2009	Cameroon	177,767
	Ghana	4,841,428
	Nigeria	471,866

Cocoa seed multiplication in Cameroon

Cocoa is an important crop for Cameroon. The national dry bean cocoa production remains stable, around 120,000 MT per year, but has recently increased to 200,000 MT. However, cocoa cultivation is actually subjected to several constraints such as the ageing of the trees mainly in Southern Cameroon where 40% of cocoa trees were planted before 1960.

In a bid to improve production the government invested in the establishment of cocoa seed gardens in a co-financed project between Cameroon and Belgium. The seed gardens were created to multiply high yielding hybrid varieties of cocoa and coffee, which were developed by Institut de Recherche Agronomique pour le Développement (IRAD) and supplied to farmers through extension agents at a highly subsidized price. The main objectives of the initiative were to promote the production of tree crops in the six regions of Cameroon: South West, North West, West, South, Center and Littoral respectively and; to train extension agents and farmers practically on the establishment and management of cocoa and coffee farms in the country.

In recent times, the government is making frantic efforts to boost the cocoa industry in the country. In line with this, the government has launched a campaign to stimulate the cocoa sector by rehabilitating old and abandoned farms and to establish new ones as well. In order to do this the seed gardens in the country are expected to produce the needed improved planting materials for planting. However, according to the Coordinator of the cocoa and coffee seed project (CCSP) in the Ministry of Agriculture and Rural Development, the official demand for cocoa pods in the country is five times higher than production from the seed gardens. This has come about as a result of pests, diseases and ageing of cocoa trees in the seed gardens.

Seed garden location, year established, area and varieties planted

There are three state own cocoa seed gardens in Cameroon. These cover a total land area of about 149.6 ha, and they are located and distributed as follows:

- One hundred and three (103) hectares located in Nkoemvone and established in 1960;
- In Mengang there is 34.6 ha of seed garden that were established in 1981;
- In Barombi Kang 12 hectares of seed gardens was established in 1981.

Table 3: Seed garden location, year established, area and varieties planted

Location	Year established	Nominal area (Ha)	Effective area (Ha)	Cocoa varieties planted
Nkoemvone (Ebolowa)	1960	103	50	SNK 13, SNK 64, SNK 10, SNK 16, SNK 109, ICS 40, ICS 46, ICS 95, IMC 67, UPA 134, UPA 143, SCA 6, SCA 12, T79/467, T79/501
Mengang	1981	34.6	23.9	SNK 13, T79/467, UPA 13, ICS 40, T79/501, SNK 16, SCA 12, SNK 413
Marombi Kang	1981	12	6	NA
Total		149.9	79.9	

It is worth noting that these cocoa seed gardens have reduced in size over the course of the years.

Nkoemvona (Ebolowa)

The seed garden in Nkoemvona has reduced in size to half its original land area. Almost all the trees on this seed garden are in full production. There are fifteen (15) different varieties planted at this seed garden. Table 4 below shows the different varieties and the year of establishment.

Table 4: Clones in Nkoemvone by year of establishment

Type of clone	Year planted
SNK 13	1972
SNK 13	1973
SNK 64	1960
SNK 10	1972
SNK 10	1975
SNK 16	1983
SNK 16	2002
SNK 109	1989
SNK 109	2009
ICS 40	2002
ICS 46	1982
ICS 95	1983
IMC 67	1989
IMC 67	2009
UPA 134	2002
UPA 143	1970
UPA 143	1960
SCA 6	1983
SCA 12	1983
T79/467	1983
T79/501	2002

Mengang

The Mengang and the Barombi Kang gardens have a few cocoa trees that do not produce unlike the Ebolowa gardens with all cocoa pod producing trees. There are eight (8) different varieties planted at this seed garden with their dates of planting indicating the table below.

Table 5: Clones in Mengang by year planted

Type of clone	Year planted
SNK 13 and T79/467	1981
UPA 13 and ICS 40	1981
T79/501	1982
SNK 16 and SCA 12	1982
SNK 413	2005

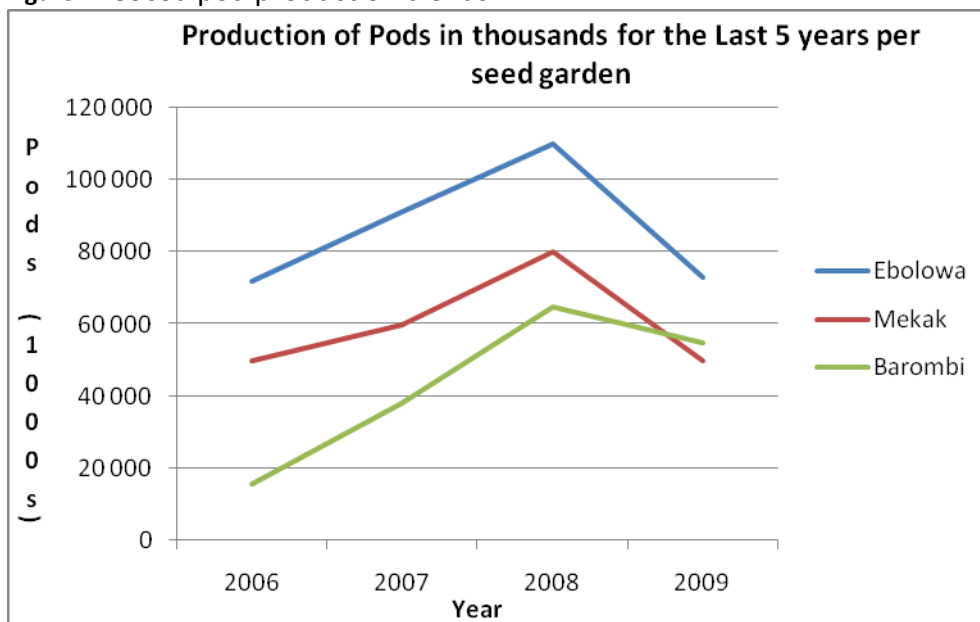
Barombi Kang

There are no records of the varieties planted at this seed garden.

Cocoa pod production Method, Output and Distribution

The common pollination method across the different seed gardens is hand pollination, which is mostly done by women. The Barombi Kang garden carries out budding as another production technique. The seed garden in Nkoemvone is the only one that carries out grafting. In terms Figure 1 below shows the production of pods in the seed garden for the past 4 years.

Figure 1: Cocoa pod production trends



As could be noted in Figure 1 above and Table 3 below, production increased from 2005 to its peak in 2008. There was a drop in production in 2009. This drop, according to officials was due to drought conditions.

Table 6: Cocoa pod production trends

Year	Nkoemvone	Mekak	Barombi
2006	72 000	50 000	15 671
2007	91 000	60 000	38 197
2008	110 000	80 000	64 814
2009	73 000	50 000	54 767

Pod distribution mechanism

It is the policy of the Cameroonian government to distribute cocoa pods at no cost to farmers. This is to boost the cocoa sector but it also seems to be a major hindrance to seed production. The policy drives demand at high levels that are not matched by the production of seed pods in the various seed gardens. As of now there is no properly designed mechanism for estimating demand and distribution of pods since the CCSP stopped its activities on seed distribution. However, the seed gardens sell improve planting materials to large scale farmers, small and medium scale farmers and cooperatives upon request.

Cost of labour, materials and infrastructure for maintaining 1 ha seed garden

The average cost of production per pod is 284 francs CFA. Table 7 below shows details of the cost of production of hybrid cocoa pod in the Barombi seed garden. The first assumption is that the seed garden already exists and we are considering 1 ha as the unit of analysis for this report.

Table 7: Cost of production of hybrid pods

Description of item	Qty	Unit cost	Total
Maintenance			
Clearing in the course of year	4	30 000	120 000
Pruning in the course of year	1	40 000	40 000
Side shoot removal in the course of year	6	20 000	120 000
Removal of parasites, epiphytes, mosses	2	40 000	80 000
Creation of fire band round farm	1	50 000	50 000
Insecticide to fight against capsid (liters)	45	10 000	450 000
Labor to fight against capsid for 9 sessions	9	30 000	270 000
Fungicide to fight against black pod (sachets)	100	750	75 000
Labor to fight against black pod for 9 sessions	9	30 000	270 000
Fertilizer in bags	11	20 000	220 000
Labor to apply fertilizer in 2 sessions	2	30 000	60 000
Sanitary harvest			
Labor for main harvest	1	40 000	40 000
Routine harvest for 8 months	8	20 000	160 000
Manual pollination			
We assume that there are 10 pods/tree multiplied by 1100 trees = 11 000 pods expected			
We assume a success rate of 15% = 73,333 flowers to be pollinated and that 489 man days would be required pollinate the 73,333 flowers.	489	1 500	733 500
Pollination materials			
Forceps	4	2 500	10 000
Alcohol in liters	4	1 000	4 000
Cotton in rolls	4	1 500	6 000
Buckets	4	1 000	4 000
Others			0
Ladder	4	1 500	6 000
Cutlasses (depreciation) 4 x 3500/2 years	1	7 000	7 000
Sprayers (depreciation) 40000/4 years	1	10 000	10 000
Nose covers 4x5000/2 years	1	10 000	10 000
Overalls 4x 4x5000/2 years	1	10 000	10 000
Boots 4x 4x5000/2 years	1	10 000	10 000
Gloves 4x2500/2 years	1	5 000	5 000
Glasses (to protect eyes) 4x2500/2 years	1	5 000	5 000
Supervision (monthly)	12	40 000	480 000
Fuel per month for motorcycle	12	10 000	120 000
Depreciation of motorcycle	1	400 000	400 000
Sub total			3 775 500
Miscellaneous expenditure 10%			377 550
Total			4 153 050
Unit cost of 11000 pods			378

Table 8: Cost of production and sale of hybrid pod in the different seed gardens

Farm	Production cost per cocoa pod	Selling cost per cocoa pod
Ebolowa	275 F CFA	50 F CFA
Mekak	200 F CFA	50 F CFA
Barombi	378 F CFA	100 F CFA

The various seed gardens vary considerably in the availability of working tools. All the seed gardens have at least 3 sprayers with the seed garden at Mengang having the highest number (15). The seed gardens in Nkoemvone and Barombi seed gardens have a Pick-up truck each as shown on table below.

Table 9: equipment in the various seed gardens

Equipment	Seed garden location		
	Nkoemvone	Mengang	Barombi Kang
Sprayer	10	15	3
Chain saw	1	3	0
Water pump	1	0	0
Wheel barrow	8	30	5
Dryer	0	1	0
Truck	1	2	0
Pick-up truck	0	1	1
Lorry	0	0	0
Motor cycle	1	1	1
Tractor	0	0	0
Cutlasses/Scissors	5	20	20
Harvesting knives	10	3	10

Challenges and opportunities of seed gardens

The official average production of cocoa pods is estimated at less than 300,000 pods per annum while the unofficial demand of cocoa pod is estimated at almost 1 000 000 pods. According to the coordinator of the CCSP, the effective demand is about five times the production. A number of constraints hinder the production of high quality cocoa seeds in the different seed gardens. In all the seed gardens surveyed, it was mentioned that diseases and pests reduce the quantity of cocoa pods that are produced every year. The major diseases and pests include black pod and capsids respectively. As a control measure, pesticides and fungicides are used as treatment in all the three cocoa seed gardens. All the managers of the three gardens testified that there has been a decline in yield due to a decline in soil fertility. This was confirmed by findings from a research activity carried out at Mengang to assess the soil fertility levels in the seed garden, which showed a decline in soil fertility. This was attributed to soil erosion and inadequate fertilizer application. Other challenges include but not limited to the following:

- Ageing tree stocks
- Dwindling land area of seed gardens
- Destruction of trees by bush fires
- Lack of trained personnel

National seed garden programs

The existing seed gardens are very old and need to be rehabilitated to meet the demand for seeds by farmers. A number of initiatives have been put in place to boost the production of cocoa and coffee planting materials in the country. These include:

- a) The rural development program of the Mungo-Nkam basin
- b) The IITA support project for tree crops in the Center and South West Regions
- c) The MINADER investment budget projects
- d) The Cocoa and Coffee Development Fund.

The government has put in place the Cocoa and Coffee Development Fund, better known by the acronym, FODECC. To signify the importance of cocoa and coffee in the economy of the country, the president of the Republic signed an act creating the fund. The major objective is to refurbish existing seed gardens and create new ones. The budget for this project is 5,627,648,000 francs CFA (US\$.11 724 267²) and spans from 2008 – 2010.

The sum of 1,116,625,000 CFA (US\$2,326,302) was budgeted for 2010. Out of this amount, 495,574,000 francs CFA (US\$ 1,032,446) was allocated to some cooperatives including SOWEFCU, NWCA, UCAL and UCCAO with SODECOA and the CCSP who are the coordinators of the project.

The project also has set aside the sum of 1,408,000,000 francs CFA (US\$ 2,933,333) to IRAD for the period of 2008-2012. However, the fund does not take into account certain key factors like:

- a) The production of seriously needed clones
- b) The massive production of seeds using biotechnology techniques
- c) The refurbishment and construction of propagators
- d) The production of root stock
- e) The provision of facilities like transportation.

² At the exchange rate of 480 CFA = USA\$ 1

CCSP has started new seed gardens of one hectare each in Kumba, Mamfe (Obang) and Menchum (Modele). By March 2010, another seed garden will be established at the old MINENO site at Modele. Ten hectares will be established in Kumba, another 10 ha in Obang with 5 ha in Modele. This implies that a total of 25 ha of new cocoa seed gardens will be in place by 2011. Officials estimate that 20,000 pods can be provided per ha from these seed gardens. As a result it is expected that 500,000 pods will be made available to farmers starting from 2015.

Cocoa seed multiplication in Ghana

The commercial cultivation of cocoa in Ghana began after the introduction of cocoa beans into the country by Tetteh Quarshie in 1879. Knapp³ (1920) described the seriousness with which the people of the then Gold Coast took to cocoa farming as phenomenal. Cocoa farms were established from the seeds in the cocoa pods procured from Tetteh Quarshie's farm. The use of seeds from farmers' fields to establish new cocoa farms is still practiced in recent times. This according to experts has partially affected yields due to the following reasons:

- Poor genetic and physical qualities of the seeds
- Susceptibility of old planting materials to most pests and diseases
- The unavailability of sufficient quantities of certified⁴ seeds to rehabilitate old farms and to establish new ones

To address the situation the Cocoa Research Institute of Ghana (CRIG)⁵ was mandated by Ghana COCOBOD to research into developing quality cocoa varieties which do not only give high yield, but also are resistant or at least tolerant to the major pests and diseases. This is because the use of certified seed in the production of any crop is found to be critical as the potential yield depends largely on the inherent potential of the seed.

To improve on the genetic and physical qualities of the seeds in the country, the Amazonia type of cocoa was brought in from Trinidad in 1945 to serve as additional genetic materials for breeding program in the country. A cross was then made between the existing Amelonado and the Amazonia to give the early-bearing, high-yielding hybrid cocoa, which has been the main planting material for cocoa farmers since its development in 1964. In the early 1970s, CRIG released the 'Tafo series'. With this release there was the urgent need to multiply these varieties for distribution to farmers. As a result the activities of seed gardens (as part of the cocoa stations) became significantly important in the multiplication and distribution of hybrid cocoa seeds in the country.

In the early 1950s cocoa stations⁶ were established in different agro-ecological zones in six (6) cocoa growing regions in Ghana namely, Eastern, Ashanti, Brong-Ahafo, Western, Central, and Volta Regions. As part of the general operations of the cocoa stations, cocoa seed gardens were established at the stations to serve as sources of recommended hybrid cocoa pods for farmers. Farmers were to use these seeds to rehabilitate their cocoa swollen short virus disease (CSSVD) infested farms and/or establish new farms. The cocoa stations also served as centers for research work.

³ Knapp, A.W. (1920). Cocoa and Chocolate: Their History from Plantation to Consumer. London

⁴ Certified seed is seed of a consistently high and known quality (genetic and physical quality) that has been produced according to the rules and regulations of an official seed certification scheme and for which proof of certification is available

⁵ An institution which emerged from the West Africa Cocoa Research Institute (WACRI)

⁶ Cocoa station refers to the seed gardens and the residential training facilities for farmers within its precincts

To operate the cocoa stations, the Seed Production Unit (SPU) was established by the Ghana COCOBOD to take charge of the activities of the seed gardens. The responsibilities of the SPU were to multiply and distribute certified cocoa and coffee planting materials to farmers. At the moment there are twenty three (23) active seeds gardens out of the twenty six (26) seed gardens in the country.

The high-yielding early bearing hybrid cocoa types developed by CRIG have been multiplied and supplied to farmers as pods. Annual estimation by the SPU indicates that it produces an average of 4.5 million hybrid pods per annum with the potential of producing about 6.8 million hybrid pods and raising about 2 million cocoa seedlings per annum. In spite of such a relatively higher potential to produce adequate seeds, accessing hybrid planting material is still increasingly difficult due to the spatial gap between the SPUs and farmers location in various communities. Consequently, a significant number of farmers raise seedlings from seeds harvested from their farms resulting in declined yield.

Seed garden location, year established, area and varieties planted

Table 10 shows the geographic locations of the active seed gardens, year of establishment, and type of plot designs as well as varieties of cocoa planted. The seed gardens are located in different agro-ecological zones across six regions in the country namely Ashanti, Brong-Ahafo, Central, Eastern, Volta, and Western Regions..

Ashanti region

It has six seed (6) gardens situated in Akumadan, Kwadaso, Poano, Jamasi, Fumso, and Jauso. These gardens were established between 1963 and 1980. With the exception of Akumadan which did not have any pod parent in its plot design all the other seed gardens had both pod parents and pollen parents in their field designs.

Brong-Ahafo region

It has four (4) seed gardens located at Sankore, Goaso, Beachem, and Wamfie. They were established between 1958 and 1982. There was no data available at Wamfie. The seed garden at Sankore is the only one in the region that has Amazon, F2, and F3 varieties on the plots.

Central region

It has three (3) seed gardens situated in Breman Asikuma, Breman Baako and Assin Fosu. They were established between 1959 and 1974. There was no data available for the Breman Baako seed garden. The seed garden at Breman Asikuma had a plot design with only pollen parents while the one in Assin Fosu had a plot design with only pod parents.

Eastern region

This region has the highest number of seed gardens numbering 8 in all and located at Akoase, Akwadum, Apedwa, Asamankese, Bieni, Bunso, Pankese, and Oyoko. They were established

between 1957 and 1982. Apedwa and Akoase seed gardens had only pollen parent on the plot designs.

Volta region

This region has two (2) seed gardens located at Akaa and Ampeyo. There was no data available for the Akaa seed garden, but Ampeyo seed garden, which was established in 1988 have only pollen parent in its plot design.

Western region

It has 3 seed gardens, which are sited in Achichere, Boako and Saamang. They were established in 1972, 1962 and 1990 respectively.

Table 10: Seed garden location, year established, area and varieties planted

Region/Location	Year established	Type of design		Varieties planted
		Pod Parent	Pollen Parent	
Ashanti				
Akumadan	1963		√	C85, C77, C42, C67
Kwadaso	1965	√	√	C77,C75,C42,C67
Poano	1967	√	√	C75,C85,C77,C42,C27
Jamasi	1967	√	√	C85,PD150,PA7,C67,C42
Fumso	1972	√	√	C75,C42,C85,C67,C74
Juaso	1980	√	√	C75,C42
Brong-Ahafo				
Sankore	1977	√	√	AMAZON,F2,C85,C42,F3,C67,C77
Goaso	1962	√	√	C85,C42,CCM,C67,C77
Beachem	1982	√	√	C67,C84,C74
Wamfie	1958	NA	NA	NA
Central				
Breman Asikuma	1963		√	C42,C77,C69
Assin Fosu	1974	√		C85,C77,C74,C75
Breman Baako	1959	NA	NA	NA
Eastern				
Pankese	1957	√	√	C42,C74,C67
Oyoko	1958	√	√	C42,C85,C77
Apedwa	1961		√	C67,C77,C74
Asamankese	1961	√	√	C42,C85,C67
Bieni	1961	√	√	
Bunso	1962	√	√	C20,C77,C75,C42,C85,C67,C69
Akwadum	1981	√	√	C77,C20,C85,C42,C67

Akoase	1982		√	C85,C77,C42,C67
Volta				
Ampeyo	1988		√	C85,C77,C42,C67
Akaa	1958	NA	NA	NA
Western				
Achichere	1972	√	√	C77,C67
Boako	1962	√	√	C75,C85,C77,C67,C42
Saamang	1990		√	C85,C42,PA7,C67,C77

Land use on cocoa stations in the six regions

Only 18% (495 ha) of the total land (2,732 ha) dedicated to the cocoa stations are used for hybrid seed production. The rest are used for cocoa production, other crops and the remaining is left as fallow land as indicated on Figure 4. Table 11 shows a regional representation of the land use on cocoa stations across the country.

Figure 2: Land coverage on cocoa stations across the six regions

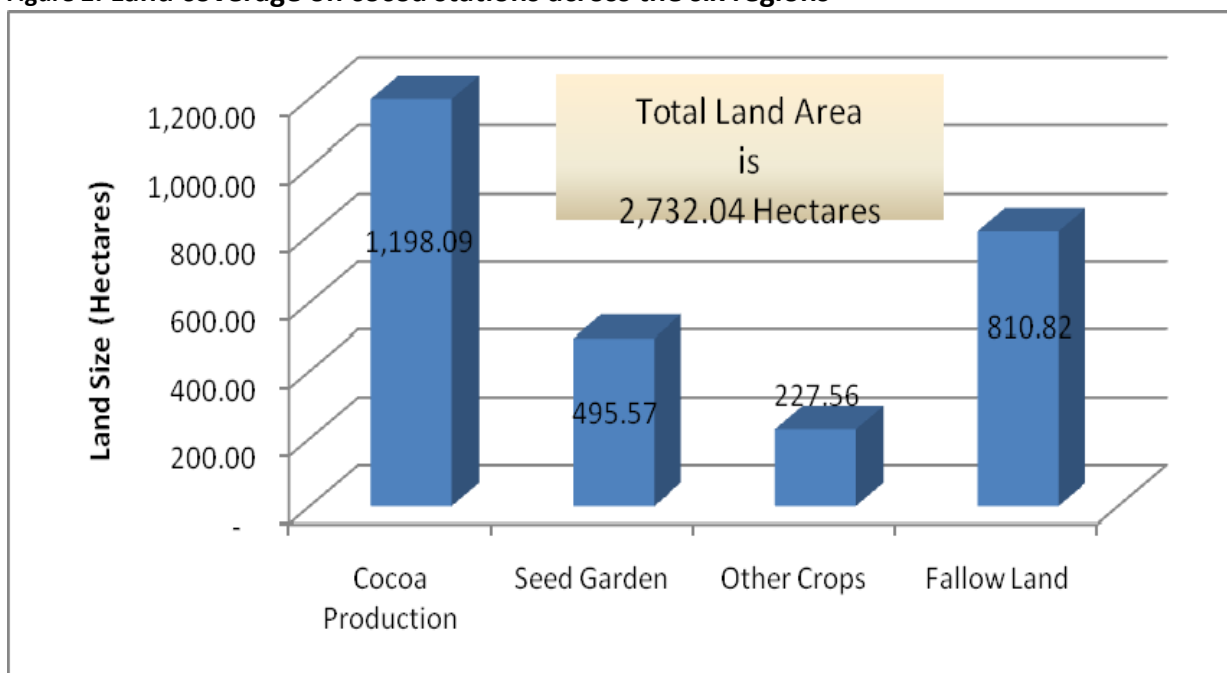


Table 11: Land use on cocoa stations by regions

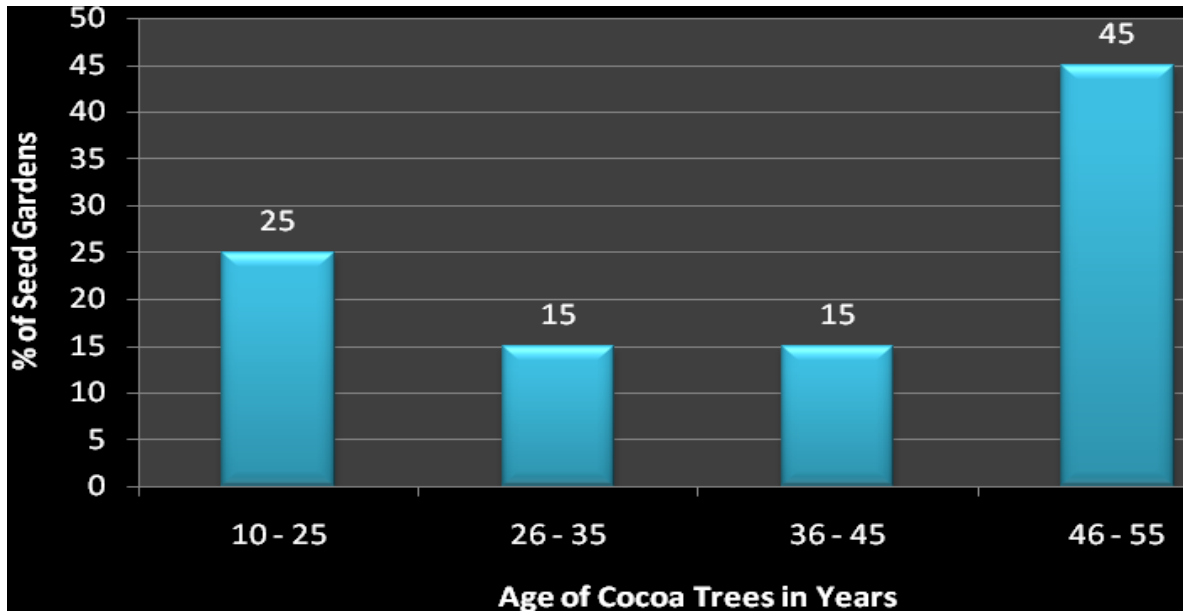
Region	Available land	Crop production	Cocoa production	Other crops	Seed garden	Fallow land
Ashanti	700.30	375.66	283.67	91.99	106.50	218.14
Brong-Ahafo	466.20	295.95	265.97	29.98	77.60	92.65
Central	237.32	157.03	139.12	17.91	22.40	57.89
Eastern	898.32	506.01	425.83	80.18	201.43	190.89
Volta	27.50	17.00	16.50	0.50	11.00	NA
Western	402.40	74.00	67.00	7.00	76.64	251.76
Grand Total	2,732.04	1,425.65	1,198.09	227.56	495.57	810.82

Age of cocoa trees in the seed gardens

Seventy five percent (75%) of all trees in the seed gardens across the country are more than 25 years of age as represented in Figure 3 below. Interviews with respondents show that 83% of station officers stated that productive trees produce 60 pods per tree per annum. This occurs predominantly when trees are less than 30 years old. And with about 60% of trees over 30 years

they cannot produce the required number of pods; hence the failure of most seed gardens to achieve their set targets.

Figure 3: Age of cocoa trees on seed gardens



Cocoa pod production method, output and distribution

With the exception of the seed garden at Akoase in Eastern region that uses open pollination, all the cocoa seed gardens surveyed used hand pollination for pod production. There was lack of pollinators in about 50% of the seed gardens. A compilation of production trends from previous years on the various seed gardens indicate that actual annual production is about 4.5 million pods, while potential annual capacity is pegged at 6.8 million pods (Table 12).

Table 12: Production capacity of the seed gardens

Region/Cocoa station	Potential Production Capacity	Actual Production Capacity	% of Target Achieved
Ashanti	1,445,714	1,031,934	71
Akumadan	70,754	62,886	89
Fumso	525,060	304,595	58
Jamasi	153,888	161,914	105
Juaso	175,560	176,158	100
Kwadaso	215,452	210,515	98
Poano	305,000	115,866	38
Brong-Ahafo	1,111,180	1,010,581	91
Beachem	328,980	278,402	85
Goaso	428,200	378,010	88
Sankore	354,000	354,169	100
Central	467,000	287,068	61
Assin Fosu	208,440	125,992	60
Breman Asikuma	258,560	161,076	62
Eastern	1,707,189	1,040,693	61
Akoase	537,600	215,013	40
Akwadum	130,800	68,578	52
Apedwa	160,000	116,667	73
Asamankese	228,120	125,922	55
Bieni	421,260	194,575	46

Bunso	NA	NA	NA
Oyoko	NA	NA	NA
Pankese	229,349	319,888	139
Volta	228,880	101,770	44
Ampeyo	228,880	101,770	44
Western	1,878,780	1,025,743	55
Achichere	820,200	515,443	63
Boako	678,240	175,300	26
Saamang	380,340	335,000	88
Grand Total	6,838,683	4,497,739	66

Pod production on seed gardens during 2008/2009 planting season

There were three categories of pod produced from the seed gardens. These include good pods, fermentable discards and non-fermentable discards. Seeds from both the good pods and the fermentable discards are used for planting, while the non-fermentable discards are processed and sold.

Ashanti region

Within the period under review for this study, Ashanti region produced 1,044,118 pods with staff strength of 392 people. The total production per unit labour was 2,393.25 with 8,808.95 of production per hectare.

Table 13: Ashanti region-Pod production available, labour and land resource for seed gardens (2008/2009)

Area	Total pods produced	Good pods produced	Permanent labour	Casual labour	Land Size	Production/Unit Labour	Production /Ha
Total	1,044,118	938,153.00	141	251	106.5	2,393.25	8,808.95
AKUMADAN	70,754	62,886	13	26	5.14	1,612.46	12,234.63
FUMSO	304,595	304,319	35	49	36.44	3,622.85	8,351.23
JAMASI	153,714	110,700	19	39	10.52	1,908.62	10,522.81
JUASO	176,758	133,867	24	60	12.00	1,593.65	11,155.58
KWADASO	215,452	210,515	34	46	28.40	2,631.44	7,412.50
POANO	122,845	115,866	16	31	14.00	2,465.23	8,276.14

Brong-Ahafo region

Seed gardens in Brong-Ahafo region produced a total of 943,906 pods with staff a strength of 251 people. The region produced 3,511.88 per unit labour of production and 11,359.29 of production per hectare.

Table 14: Brong Ahafo region-Pod production available labour and land resource for seed garden (2008/2009)

Area	Total Pods Produced	Good Pods Produced	Permanent labour	Casual labour	Land Size	Production/Unit Labour	Production /Ha
Total	943,906	881,481	69	182	77.6	3,511.88	11,359
BEACHEM	271,401	249,117	22	37	42	4,222.32	5,931
GOASO	378,010	367,819	22	41	18.4	5,838.40	19,990
SANKORE	294,495	264,545	25	104	17.2	2,050	15,380

Central region

Central region produced a total of 287,068 pods with a staff strength 192 people.

Table 15: Central region- Pod production available labour and land resource for seed gardens (2008/2009)

Area	Total pods produced	Good pods produced	Permanent labour	Casual labour	Land Size	Production/ unit labour	Production /Ha
Total	287,068	262,913	114	78	22.4	1,369.34	11,737.19
ASSIN FOSU	125,992	112,024	55	38	9.6	1,204.56	11,669.17
BREMAN ASIKUMA	161,076	150,889	59	40	12.8	1,524	11,788

Eastern region

Eastern region with its eight (8) seed gardens produced a total of 1,425,938 pods with a staff strength of 552 people.

Table 16: Eastern region-Pod production available labour and land on seed gardens(2008/2009)

Area	Total Pods Produced	Good Pods Produced	Perma-nent labour	Casual labour	Land Size	Production/ Unit labour	Production /Ha
Total	1,425,938	1,166,231	190	362	201.426	2,112.74	5,789
AKOASE	70,060	69,524	11	17	2.72	2,483.00	25,560
AKWADUM	65,304.00	59,957.00	13	15	9.03	2,141.32	6,639.76
APEDWA	116,667.00	86,891.00	26	47	52.00	1,190.29	1,670.98
ASAMANKESE	125,922.00	120,224.00	21	47	9.00	1,768.00	13,358.22
BIENI	194,575.00	193,645.00	23	59	4.00	2,361.52	48,411.25
BUNSO	533,522.00	406,641.00	60	97	91.08	2,590.07	4,464.85
OYOKO	NA	NA	12	20	5.60	-	-
PANKESE	319,888	229,349	24	60	28.00	2,730.35	8,191

Volta and Western regions

Volta region with one seed garden produced a total of 114,142 pods with staff strength of 31 people. Western region with staff strength of 165 people produced 1,026,256 pods, which is the second highest after the Eastern region.

Table 17: Volta region-Pod production available labour and land on seed gardens (2008/2009)

Area	Total Pods Produced	Good Pods Produced	Perma- nent labour	Casual labour	Land Size	Production/ Unit Labour	Production/ Ha
VOLTA total	114,142	101,770	14	17	11	3,282.90	9,251.82
AMPEYO	114,142	101,770	14	17	11	3,282.90	9,251.82
WESTERN total	1,026,256	862,014	87	78	37	5,224.33	11,247.57
ACHICHERE	515,443	417,402	32	42	19.82	5,633.95	21,059.64
BOAKO	175,300	174,090	36	46	37	2,123.05	4,705.14
SAAMANG	335,513	270,522	19	32	19.82	5,304.35	13,648.94

Although all the respondents agreed that it was important to estimate annual pod demands by farmers, none of them had any mechanism in place to assess farmer pod demand. However, respondents indicated that this can easily be done by estimating the total area to be planted under cocoa and the number of farmers requiring pods.

Table 18: Total pod production and available labour and land size at the seed gardens in all six regions for (2008/2009 season)

REGION	Total Pods produced	Good pods produced	Perma- nent labour	Casual labour	Land Size	Production/U nit Labour	Production/Ha
ASHANTI	1,044,118.	938,153	141	251	106.5	2,393.25	8,808.95
BRONG AHAFO	943,906	881,481	69	182	77.6	3,511.88	11,359.29
CENTRAL	287,068	262,913	114	78	22.4	1,369.34	11,737.19
EASTERN	1,425,938	1,166,231	190	362	201.43	2,112.74	5,789.87
VOLTA	114,142	101,770	14	17	11.00	3,282.90	9,251.82
WESTERN	1,026,256	862,014	87	78	76.64	4,162.57	11,247.57
Grand Total	4,841,428	4,212,562	615	1010	495.57	2,592.35	8,500.44

Figure 4: Regional distribution of pod production

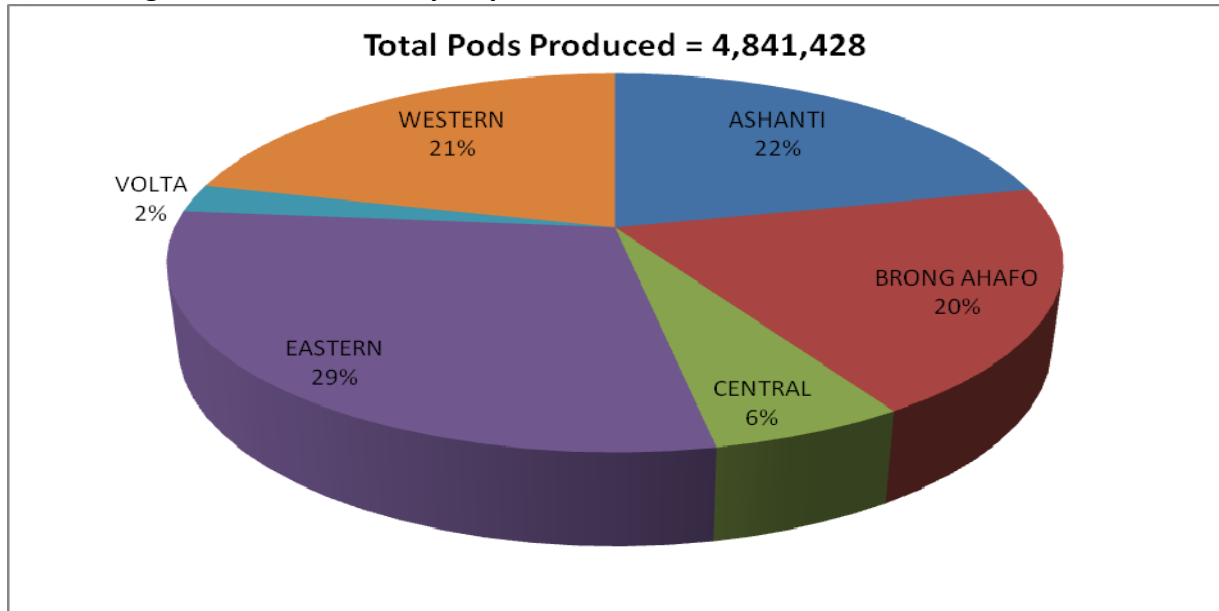
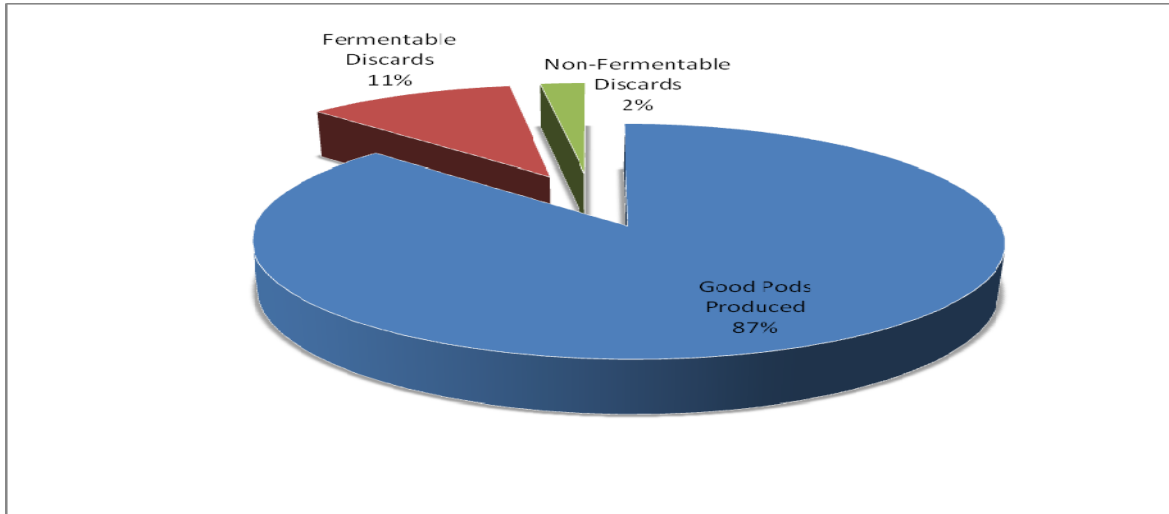


Table 19: Total pod production in the season including fermentable and non-fermentable discards (2008/09)

Region	Total Pods Produced	Good Pods Produced	Fermentable Discards	Non-Fermentable Discards
Ashanti	1,044,118	938,153	87,023	18,942
Brong- Ahafo	943,906	881,481	50,778	11,647
Central	287,068	262,913	18,335	5,820
Eastern	1,425,938	1,166,231	198,922	60,785
Volta	114,142	101,770	12,372	0
Western	1,026,256	862,014	150,228	14,014
Grand Total	4,841,428	4,212,562	517,658	111,208

Figure 5: Pod types available at seed gardens



Cost of labour, materials and infrastructure for expanding output of seed gardens by 15%

Inventory of equipment used by the seed gardens at the various locations is shown on Table 20 below. An estimate of the cost involved to plant one (1) hectare of a seed garden to produce improved hybrid pods is also indicated in table 21 below.

Table 20: Equipment used in the various seed gardens

Motorized mist blower
Knapsack sprayer
Chain saw machine
Harvesting hook
Water pump
Vehicles
Forceps
Pruning knives
Cutlasses

Table 21: Estimate of labour and materials required per annum of 1 ha cocoa seed garden

Item	Quantity	Unit Cost (GHC)	Total Value (GHC)
Labour			
Farm hands	6	1,200.00	7,200.00
Pollinators	3	840.00	2,520.00
Security guards	1	170.00	170.00
Sub-Total			9,890.00
Materials			
Assorted Agrochemicals	22	11.00	242.00
Knapsak sprayer	3	35.00	105.00
Prunning knife	15	10.00	150.00
Harvesting hook	4	29.00	116.00
Cutlass	8	5.00	40.00
Fertilizer	3	16.00	48.00
Motorised sprayer	1	450.00	450.00
Sub-Total			1,151.00
Grand Total			11,041.00

Challenges and opportunities encountered in the operation of seed gardens

Cocoa seed gardens in the country are confronted with numerous challenges, which have affected the operations in recent times. Some of the challenges indicated by respondents include the following;

- Old age of cocoa trees
- Dwindling land area for seed gardens
- Poor staff incentives
- Encroachment of acquired land by communities
- Incidence of pests and diseases

- Inadequate funding from government
- Lack of basic equipment
- Over-reliance on rainfall for production
- Land litigation

In spite of these challenges, there exist some opportunities for the seed gardens in the country to address the challenges. These include:

- Large pool of educated staff
- Large tracts of land for seed garden expansion
- Strong linkage with CRIG
- Existence of huge demand for pods and seedlings
- Availability of technical knowhow from CRIG
- Substantial support from COCOBOD

National seed garden expansion program

The SPU has been undertaking a long term rehabilitation and expansion program in the seed gardens in order to improve production. The aim is to rejuvenate or replace completely old and moribund trees with dead and/or moss covered cushions as well as swollen shoot infected trees. The program involves three methods namely

- Coppicing and filling gaps,
- Under-planting before uprooting/cutting down old trees and
- Complete uprooting or cutting of old trees with total replanting

According to the SPU the program is designed to rehabilitate over 208 ha of seed gardens and it will cover a period of five years. In order to see this through in 2009 for instance, 4 ha of the seed garden in Pankese, and 2.4 ha of seed garden in Boako were coppiced and gaps filled. In 2010, 2 ha of the seed garden in Kwadaso and 1.6 ha of seed garden in Boako have been coppiced and filling of gabs is underway. Table 22 below shows the SPU's plan for rehabilitation in some selected seed gardens in the country.

Table 22: Plan for rehabilitating seed gardens that are over 30 years of age

Station	Hectarage over 30 years	Method for rehabilitation	Program for rehabilitation				
			Year 1	Year 2	Year 3	Year 4	Year 5
Bumso	61.51	Complete tree removal	6.06	4.04	8.08	4.04	4.04
Pankese	24.24	Coppicing	4.04	4.04	4.04	4.04	8.08
Apedwa	16.16	Complete tree removal	4.04	4.04	4.04	4.04	-
Bieni	9.05	Complete tree removal	2.02	2.02	2.02	2.99	-
Asamankese	5.28	Complete tree removal	1.62	1.62	1.62	0.42	-
Kwadaso	5.67	Coppicing	1.62	1.62	1.62	0.81	-
Jamasi	4.00	Coppicing	2.00	2.00	-	-	-
Akomadan	4.04	Coppicing	1.01	1.01	1.01	1.01	-
Juaso	8.08	Coppicing	2.02	2.02	2.02	2.02	-
Poano	6.48	Coppicing	1.62	1.62	1.62	1.62	-
Fumso	14.17	Complete tree removal	4.04	4.04	4.04	2.05	-
Bechem	12.92	Coppicing	3.23	3.23	3.23	3.23	-
Boako	20.49	Coppicing	4.04	4.04	4.04	4.04	4.33
Achichire	2.60	Complete tree removal	2.60	-	-	-	-
Breman Asikuma	11.33	Coppicing	2.02	2.02	2.02	2.02	3.25
Assin Foso	2.02	Coppicing	2.02	-	-	-	-
Total	208.04	-	32.33	39.40	37.36	44.00	19.70

Cocoa seed multiplication in Nigeria

Cocoa is an important economic tree crop in Nigeria. In 2008 for instance, the nation produced 360,000 MT of cocoa. It is the largest non-oil foreign exchange earner, and contributes significantly to the nation's GDP. Following the abolition of the Nigerian Cocoa Board and the deregulation of the cocoa economy in 1986, the industry is now essentially private sector driven. Federal and State governments have been providing extensive support in policy direction, provision of inputs and research financing.

The Cocoa Research Institute of Nigeria (CRIN) and International Institute of Tropical Agriculture (IITA)/ Sustainable Tree Crops Programme (STCP) have deepened research lately to benefit the industry, particularly the farmers. Work done in the country suggests that one of the major challenges facing the cocoa industry is the fact that farmers still raise seedlings from seeds collected from their plantations, rather than use improved planting materials collected from approved seed gardens. What is more disturbing is the fact that the average age of cocoa trees in the country is over 40 years old. The future of the farmers in the industry could therefore be improved by regularly providing them with improved planting materials. This is likely to discourage planting of seedlings raised from seeds collected from plantations, which would subsequently guarantee higher yield.

Considerable effort at supporting the cocoa industry through distribution of selected improved hybrids to farmers was embarked upon by the Western Region government since independence. This was realized through the establishment of cocoa seed garden by the CRIN for some states in the country. Most of these gardens are at least 30 years old.

Seed garden location, year established, area and varieties planted

Cocoa seed gardens in Nigeria are located in Ondo, Osun, Oyo States in the South-west zone; in Edo and Cross River State in the South-south zone and; in Abia State in the South-east zone. Information on the location, year establishment and the area of the seed gardens/ experimental plots as well as the varieties planted are presented in Table 23.

Table 23: Seed garden location, year established, area and varieties planted

Zone	State	Location	Year established	Nominal area (Ha)	Effective area (Ha)	Cocoa varieties planted
South-West	Ondo	Ile-Oluji	1968 – 1978	12.03	8.03	C69 x C20 Trinidad; CRIN Series I & II IT, CRIN Elite; NA 32 x PA 35 C75 x C18; C75 x C25; C75 x C14; C77 x C27 C75 x C25; C74 x C24
		Ibule	1962	33.4	11.0	
		Ibule (CRIN)	1977	4.0	2.1	
		Alade	1956	4.5	0.5	
		Idanre	1966	28.0	16.5	
		Owena	1976	4.3	2.0	
	Owena (CRIN)	1962	20.23	9.2		
			1956 - 1978	106.46	49.33	
	Osun	EWS, Ilesa Ilerin Ilesa Esa-Oke	1961	5.2	NAV	C77 x C27
			1962	6.0	"	C74 x C18
1979			5.0	"	C77 x C27	
1961 - 1979			16.2	-		
Oyo	CRIN Hqts IdiAyunre	1964	255.49	229.98	F ₂ and F ₃ Amazon, CRIN Elite. Clones planted in CFC plots are T65XT10/15, T86/2X T22/28, T86/2XT9/15, P7XPA150, P7XT60/887.	
South-south	Edo (Experimental plots)	Plantation	1967-1975	31.5	NAV	Trinidad, F ₃ Amazon
	Cross River (Experimental plots)	Ajassor	1975	4.4	NAV	F ₃ Amazon, CRIN Elite
South-East	Abia (Experimental plots)	Ibeku	1971-1986	28.5	NAV	F ₃ Amazon

Ondo State Seed Gardens

Of the seven (7) seed gardens in Ondo State, five (5) belonged to the state government, and two (2) to CRIN. The state government seed gardens are located at Ile-Oluji, Ibule, Alade Idanre, Owena and Otu (Ore). The two (2) seed gardens owned by CRIN are at Ibule and Owena where the state government also has established its own seed gardens. In Ile Oluji, there are three (3) seed gardens belonging to Ondo State Government. These were established between 1968 and 1978, and occupy a total area of 12.03 ha, with an effective area of 8.03 ha under plantation. There is a state seed garden in Ibule, which was established in 1962 and occupies an area of 33.4 ha, with effective coverage of only 11 ha. Another seed garden is located in Alade Idanre and established in 1956, but the effective coverage has dwindled from 4.5 ha to only 0.5 ha. The seed garden at Owena was established in 1966 and occupies an effective area of 16.5 ha which is a far cry from the initial 28 ha. The Otu (Ore) seed garden was established in 1962. The effective area is now 9.2 ha as against the former 20.23 ha.

It must be noted that the effective sizes of all the seed gardens in Ondo State have dwindled to between 11 and 66.7 per cent of their nominal areas with most of them being less than half of their nominal areas. There are diverse cocoa varieties and clonal materials planted in these gardens. Cocoa varieties planted in the state government seed gardens include C75 x C18; C75 x C25; C75 x C14; C77 x C27 and NA32 x PA35.

CRIN seed gardens

The CRIN seed gardens were established later in the seventies and are similarly not effectively planted up. The position of CRIN seed gardens in Ibule and Owena is similar to those owned by the State Government. For example, the Ibule seed garden established in 1977 effectively covers 2.1 ha as against the nominal area of 4 ha, while the effective area of the Owena garden is 2 ha as against the nominal area of 4.3 ha. The CRIN seed gardens at Ibule and Owena have CRIN Series 1 and 11; CRIN Elite and Trinidad.

Osun State seed gardens

There are three (3) state own seed gardens located here. The garden at EWS, Ilesa was established in 1961, the one in Ilerin-Ilesa was established in 1962 and Esa-Oke was established in 1979. The nominal area of the seed gardens at their time of establishment were 5.2 ha, 6.0 ha and 5.0 ha respectively. Estimates of their effective areas are not available, but they are likely to be the same as their Ondo State counterparts where most of the gardens are currently less than 50% in their effective sizes. The main cocoa varieties planted in the gardens are C77 x C27 and C74 x C18.

Oyo State seed gardens

Four cocoa seed gardens were established by CRIN at its headquarters in Oyo State in 1964. The fifth plot that has improved clonal materials is actually an experimental plot which was established in 1999 with funds from the Common Fund for Commodities. Their nominal area is 255.49 ha out of which 229.98 ha were planted with different cocoa varieties in the 1960s while the remaining 25.51 ha are planted to other crops. Available cocoa varieties in the seed gardens include F₂ & F₃ Amazon, CRIN Elite, Amelonado, T65/7 XT10/15, T86/2 X T22/28, T86/2 X T9/15, P7 XPA150, P7 X T60/887.

Edo State seed garden

The cocoa seed garden in Edo State, South-south Zone is in Uhonmora. It was established in 1967 as an experimental plot and occupies an area of 31.5 ha. An additional 2 ha is currently being added to it. The main cocoa varieties planted in the garden are F₃ Amazon and Trinidad.

Cross River State Seed Garden

The seed garden in South-south Zone is located in Ajassor and it is owned by CRIN. It was established in 1975 and occupies an area of 4.4 ha. The main cocoa varieties planted in the garden are F₃ Amazon and CRIN Elite.

Abia State Seed Garden

The cocoa seed garden is located in Ibeku and was established between 1971 and 1986. It occupies an area of 28.5 ha. The predominant cocoa variety planted in the garden is the F₃ Amazon.

Cocoa pod production method, output and distribution

Information on cocoa pod production methods, output and distribution are provided in Table 24. There are two main methods of cocoa pod production in all the seed gardens. These are open and hand pollination methods. Operators of most seed gardens in Ondo combined both methods. The pod production method in all the seed gardens of CRIN's headquarters in Oyo State as well as the experimental plantations in Edo, Abia and Cross Rivers, are exclusively by open pollination. However, in Osun and Ondo State seed gardens, both open and hand pollination methods are employed..

Table 24: Cocoa pod production method, output and distribution in selected seed gardens

Zone	State	Responses on production		Pod production			Quantity of pods Distributed and Beneficiaries				
		OPEN POLLI-NATED	HAND POLLI-NATED	2006	2007	2008	2006 QTY NO	2007 QTY NO	2008 QTY NO		
South-West	Ondo										
	Ile-Oluji	✓	✓	17,493	38,281	7,871	1,371 -	1,000 -	1,500 -		
	Ibule	✓	✓	25,572	21,841	22,587	700 -	1,500 -	-	-	
	Ibule (CRIN)	✓	✓	-	14,687	12,950	- -	- -	- -	- -	
	Alade Idanre	✓	✓	13,681	27,002	8,537	- -	1,000 -	- -	- -	
	Owena	✓	✓	86,976	84,029	27,662	4,185 -	1,500 -	- -	- -	
	Owena (CRIN)	✓	✓		16,686	15,871	- -	1,127	185		
	Out Ore	✓	✓	15,937	23,260	10,428	- -	- -	- -	- -	
	Osun										
	EWS, Ilesa	✓	✓	}44,451	51,010	42,595	(Little) -	(Little) -	(Little) -		
Ilerin Ilesa	✓	✓	}								
Esa-Oke	✓	✓	}								
Oyo											
CRIN Headquarters	✓		347,592	263,059	293,406	57,576 13	60,255 13	-	-		
South-South	Edo										
	Plantation Experimental Plot, Uhonmora	✓		30,973	20,352	10,758	4,356 -	1,400 4	20 1		
Cross River											
Ajassor	✓		-	970	900	- -	- -	850			
South-East	Abia										
	Ibeku	✓		20,477	42,101	18,301	- -	- -	- -		
TOTAL			617,839	603,288	471,866						

Pod production in most of the seed gardens studied in the three zones did not show any trend over the last 3 years. In Ondo State, the five state-owned seed gardens at Ile-Oluji, Ibule, Alade Idanre, Owena and Otu (Ore), produced 160,109 pods in 2006, 194,413 pods in 2007 and 76,985 pods in 2008. In Osun State, the cumulative figures for the three seed gardens at EWS Ilesa, Ilerin Ilesa and Esa Oke were 44,451, 51,010 and 42,101 pods in 2006, 2007 and 2008 respectively. At CRIN headquarters in Oyo State, the total pod production from the 4 seed gardens was 347,592 in 2006, 263,059 in 2007 and 293,406 in 2008. In Edo State, the experimental plantation plots at Uhonmura produced 30,973, 20,352 and 10,758 pods during the 3-year study. Production in Ibeku in Abia State for the 3 years was 20,477, 42,101 and 18,301 pods respectively.

It could be seen in the production figures that outputs fluctuate over the years with a cycle of high production followed by a year of low production. It was observed during data collection that there was a lot of irregularities in the pod yield figures per unit area. This was attributed to poor record keeping. However Tree Crop Unit staff explained that late rains in 2008 and shortage of experienced pollinators to carry out the hand pollination accounted for the low pod production in 2008.

Pod distribution mechanism

There is little or no information on pod requirement by beneficiaries. Data on pod distribution are very scanty, while available information does not march with production figures. For example, records on pods distributed at Ile –Oluji seed garden in Ondo State indicated that only 1000 and 1500 pods were distributed in 2006 and 2008 respectively. This was far less than the 7,871 and 38,281 pods produced by the seed garden for the same period. In Uhonmura, pod distribution figures were 4,356 in 2006, 1,400 in 2007 and only 20 in 2008. Pod distribution figures for CRIN headquarters are only available for 2006 and 2007, that is, 57,576 pods and 60,255 pods respectively. Distribution of pods in Ibeku (Abia State) and Ajassor Cross River State were not available, while the responses in EWS Ilesa seed garden in Osun State were sketchy as the operators reported that they distributed ‘little’ quantities. Observations show that while the improved cocoa pods are available at the seed gardens, direct farmers’ patronage of the seed gardens is still low.

Several reasons can be attributed to low demand of improved seeds from seed gardens by farmers. Firstly, farmers in Nigeria rely on seedlings raised by the State governments for planting. As a norm many farmers directly purchase or collect improved seedlings for planting from government sources and so do not buy pods from the seed gardens. This is the situation in many cases as the State and Federal Ministries have been intervening in the production of improved planting materials at subsidized prices. Typically, the individual the states collect pods from their seed gardens, raise seedlings and distribute to farmers at subsidized rates. The States have yearly programs of seedling production. For example, for the past four years the Ondo State has produced and distributed improved cocoa seedlings as follows:

Year	No of seedlings produced
2005	2,736,530
2006	3,040,000
2007	2,000,000
2008	1,000,000
2010	1.5m (projection for 2010)

Secondly, most farmers raise cocoa seedlings from pods collected from their fields or other unapproved sources, including neighbours' fields.

Cost of labour, materials and infrastructure for expanding output of seed gardens by 15%

Responses received on the category of workers who are engaged in the operations of the gardens indicate that both skilled and unskilled workers are required. The results from the three zones show that there is inadequate staffing of the seed gardens in terms of permanent/regular and casual workers, e.g., pollinators

Inventories of equipment, agrochemicals and infrastructure in most gardens are shown in Table 25. Many of the equipment needed maintenance and/or replacement. Also available materials were too thinly distributed across the various seed gardens.

Table 25: List of equipment, agrochemicals and infrastructure in seed gardens

Equipment/Agrochemicals	Infrastructure
Cutlass	Boreholes
Forceps	Farm shed/farm house
Wheel barrow	Office building
Knapsack sprayers	Chain saw
Motorized sprayers	Tractors
Head pan	Motor cycles
Water pumps	
Solo pump	
Drying slabs/raised platforms	
Weighing scale	
Tractor (owned by few)	
Insecticides	
Fungicides	

The study considered specific activities that need to be undertaken, and the facilities that should be provided to help improve the output of the seed gardens by at least 15%. In response to the above, most seed garden operators were of the view that improvement efforts should target maintenance operations. Some suggested the provision of fertilizer, agrochemicals and procurement of appropriate equipment.

Based on the above requests, and the available labour materials and infrastructure, effort was made to estimate the requirements to achieve 15% output expansion for an average 3 ha seed garden. The computed estimates are indicated in Table 26.

Table 26: Estimate of labour and infrastructure required per 3-hectare seed garden

Labour, Material and Infrastructure	Number	Unit Price (N)	Total Cost (N)
1. Labour			
Labour (per annum)	10 No	120,000	1,200,000
Pollinator (per annum)	3 No	120,000	360,000
Security men (per annum)	2 No	120,000	<u>240,000</u>
			1,800,000
2. Materials			
Fertilizer (50kg)	3 bags	3,000	9,000
Knapsack sprayer	4 No	10,000	40,000
Motorized sprayer	2 No	90,000	180,000
Agrochemicals (Assorted)	50 Lts	3,000	<u>150,000</u>
			379,000
3. Infrastructure			
Hand dug well	1 No	100,000	100,000
Farm house	1 No	500,000	500,000
Drying slab	2 No	17,000	<u>34,000</u>
			634,000
TOTAL			2,813,000 =====

Challenges and Opportunities of seed gardens

Many challenges currently affect the smooth operation of the seed gardens in the three zones.

These include the following:

- Shortage of technical workers (e.g., pollinators) and casual labourers
- Over aged cocoa trees
- Poor maintenance operations
- Inadequate and untimely fund releases
- Low demand of pods
- Depleted soil nutrients
- Inadequate number and poor condition of equipment
- Limited infrastructure such as borehole, farm shed, etc.

Despite the above challenges, cocoa seed gardens offer a lot of opportunities for the growth and development of the cocoa industry as follows:

- Provision of high quality planting materials (early, maturing and high-yielding)
- Opportunities for research
- Provision of higher income for farmers

National seed garden expansion program

In a recent effort to support the cocoa industry through supply of improved hybrids to farmers, especially the recently selected highly precocious materials from CRIN, Nigeria, the federal government of Nigeria mandated CRIN to establish a two-hectare seed garden plot in each of the 14 cocoa growing States of Nigeria. The objectives of the Project, among others, are as follows:

- Empower CRIN to develop infrastructure for rapid multiplication of the new cocoa variety
- Facilitate the establishment of seed gardens at CRIN headquarters, substations and the 14 cocoa producing States.

This project began in 2007 and is expected to be completed by 2011. Once successfully completed, cocoa farmers would have access to cocoa varieties with yield potentials in excess of 2.5 to 3.5 tons/ha. Some of the selections are also highly resistant to the black pod disease of cocoa. It is expected that, with a well maintenance regime in the seed gardens coupled with application of appropriate hand pollination techniques would, have a tremendous impact on the Nigerian cocoa industry to increase production volumes, farm household earnings and foreign exchange from exports.

Sites have been selected in all the fourteen States namely, Abia, Adamawa, Akwa Ibom, Cross River, Delta, Edo, Ekiti, Kogi, Kwara, Ondo, Osun, Ogun, Oyo and Taraba States as well as

CRIN headquarters. The size of each seed garden is 2 ha. Planting of plantain suckers as shade plants has occurred in most of the States, while planting of improved seedlings of cocoa have been done in some States and CRIN headquarters.

Table 27: Status of the National Seed Garden Project in the 14 cocoa producing States

State	Plantain suckers planted	Cocoa seedlings planted	Suckers and cocoa seedlings
Abia	-	-	✓
Adamawa	✓	-	-
Akwa Ibom	✓	-	✓
Cross River	✓	-	-
Delta	-	-	✓
Edo	-	-	-
Ekiti	-	-	✓
Kogi	✓	-	-
Kwara	✓	-	-
Ogun	-	-	✓
Ondo	-	-	✓
Osun	-	-	✓
Oyo	-	-	✓
Taraba	✓	-	-
CRIN Headquarters	-	-	✓

Conclusion and recommendations

It is difficult to conclude whether cocoa seed gardens in Cameroon, Ghana and Nigeria are under producing since there is no identified mechanism in place to estimate farmer demand. However, respondents interviewed including officials indicated that production is lower than expected demand. With current government's efforts to increase national cocoa production due to low productivity of over aged trees, there is the need to increase production of improved planting materials to rehabilitate old farms and establish new ones. For this reason, it is recommended that the respective countries consider the following:

In Cameroon:

- Government should provide funds to support the private sector to establish seed multiplication and distribution centers to produce improved cocoa hybrids
- Government should provide funds for research into modern technologies in seed multiplication like somatic embryogenesis, grafting and budding and to also train more personnel in this technology
- Create more hybrid cocoa seed gardens
- Support existing research centers to produce cocoa seeds: There are a number of research centers in Cameroon that should be supported
- Improve facilities and infrastructure in the seed gardens to encourage good working conditions
- A systematic procedure in estimating annual pod demand and supply. This will help the seed gardens to plan well for its activities.

Based on the findings from the Ghana study, it is recommended that:

- Government should provide funds for research into modern technologies in seed multiplication like somatic embryogenesis, grafting and budding and to also train more personnel in managing this technology.
- There should be an aggressive rehabilitation regime in all the seed gardens to replace the old cocoa trees with new improved planting materials. These new planting materials should be planted in an expansion program in the various seed gardens, especially in the Western region since it produces over 50% of Ghana's cocoa output. Some of the plots to be replanted and expanded could be devoted to the establishment of bi-clonal seed gardens which could produce additional pod even if they are not pollinated.
- The expansion program should take advantage of the existing fallow land. This will reduce and in some cases avoid encroachment going on some of the cocoa stations. This will also partially address the land litigation problem.

- The seed gardens should adopt an irrigation scheme in order to reduce the over reliance of annual rainfall for production. This will ensure an all year round production as opposed to the current seasonal production being done.
- There should be a systematic procedure for estimating annual pod demand and supply. This will help the SPU to plan well for its activities.
- The SPU should invest in modern equipments for its operations on the seed gardens since most of its equipment are obsolete.
- Government should provide funds for research into modern technologies in seed multiplication like somatic embryogenesis, grafting and budding and to also train more personnel in these technologies
- A systematic procedure in estimating annual pod demand and supply. This will help the seed gardens to plan well for its activities
- The SPU should supply other different types of planting materials like bud woods to reduce the over reliance of seeds as the only source of planting materials in the country.
- COCOBOD should collaborate with other private partners to develop a reliable and sustainable planting material multiplication and distribution systems for new cocoa farm establishment.

From the Nigerian assessment it is recommended that:

- The states develop a package whereby government will pay for the pods which will be distributed to farmers
- State governments should provide funds for research into modern technologies in seed multiplication like somatic embryogenesis, grafting and budding and to also train more personnel in this technologies
- Expand existing seed gardens to increase production
- State governments should provide funds for the maintenance of the seed gardens in terms of equipment and agro-chemicals
- Improve facilities and infrastructures on the seed gardens to encourage good working conditions
- A systematic procedure in estimating annual pod demand and supply. This will help the seed gardens to plan well for its activities