TRAINER OF TRAINERS WORKSHOP FOR COCOA FARMERS


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SUMMARY

As part of the project *"Strengthening Innovations and Technology Dissemination for Sustainable Development in Cereals, Cocoa and Coffee Value Chains in Western and Eastern Africa"* (SATTIFS) in Ghana a field training was conducted for selected Cocoa farmers' group leaders in Goaso in the Brong Ahafo Region. The training was conducted for those farmers who already have old farms that require rehabilitation and those who are going into new field preparation in the current planting year. The training was done by the Manager of the Seed Production Unit of the COCOBOD in Goaso, Mr. Isaac Manghai, and his associates. Thisfield training was conducted as part of a Trainer of Trainers for Farmer Field Schools intended to train local farmers in the effective use of current and appropriate technologies in the cocoa production value chain. Two TOT trainings were done one in October 2014 and the other in January 2015, because most of the farmers were harvesting their cocoa. The emphasis was on the use of appropriate cultural practices and correct application of production inputs that would sustain the environment as well as maximize cocoa production in the field. These technologies were, inter alia, seed varieties, spacing, planting pattern, fertilization, pest and disease control, harvesting and postharvest management.

The training was conducted to:

- Demonstrate to farmers the best technologies locally available in cocoa production.
- Provide a learning platform for farmers to apply these technologies on their farms.
- Interact with famers and select them for the Farmer Field Schools.

The farmers agreed that the training was extremely useful and admitted that by using the technologies and techniques acquired they couldincrease productivity of cocoa per unit area. This would improve their economic and social well being.In all, the participating farmers were very appreciative of the training given to them by the project. The trainingalso gave the CITED Team an opportunity to select farmers for the Farmer Field School to be conducted in 2015 cocoa season.

1.0 INTRODUCTION

The "*Strengthening Innovations and Technology Dissemination for Sustainable Development in Cereals, Cocoa and Coffee Value Chains in Western and Eastern Africa*" is a project aimed at building capacity in science, technology, and innovation in West and East Africa to boost food security and socio-economic development. It is being implemented in several communities in the BrongAhafo and Ashanti Regions of Ghana. The Ministry of Food and Agriculture, cocoa and maize farmers, artisans, processors and other practitioners in the cocoa and maize value chain have been identified as key stakeholders to participate in the research and as beneficiaries of training and the research outcomes of this project. Cocoa is the most important cash crop in Ghana and accounts for more than 50 percent of total agricultural GDP in the country. The bulk of cocoa produced goes into export. This is a report on field training on cocoa conducted as part of the activities of the SATTIFs project.

Table 1: List of Cocoa Farmers and their Organizations

Name of Farmer	**Farmer Organization**	**Sex**
Isaac Manghai	Seed Production Unit	M
Kofi Appiah	Nyame Akwan	M
Yaw Amoako	Adom	M
Ellen Antwiwaa	Mim Bour	F
Daniel Kyei	Fawohoboawrade	M
Yahaya Ahmed	Fama Nyame	M
Ayarma Francis	Redeemers	M
Rose Bronya	Nyame Adom	F
OtchereOwusuKwadwo	Asikafoo	M
Anthony Appiah	Nyame Nti	M
Sarah Boateng	Awurade Na Aye	F
Francisca Adjei	Suro Awurade	F

2.0 METHODOLOGY

The training was conducted to ascertain how the appropriate use of technologies and proper practices could influence the yield in cocoa production. The training was done periodically on selected farms based on the activities involved (Table 2). Each meeting facilitation team was led by the Manager of the Seed Production Unit and his technical team. Facilitation was in the form of dialogue and information sharing, with the farmers actively participating in sharing their own experiences and asking pertinent questions.

TABLE 2. Production protocol of field training for cocoa farmers

DATE	ACTIVITY
6th AUGUST, 2014	NURSERY PRACTICES (Seed production Unit nursery)
15th -17th AUGUST 2014	PRE-PLANTING OPERATIONS
8th SEPTEMBER, 2014	LINING AND PEGGING
15th -20th SEPTEMBER, 2014	FACILITATION OF FIELD OPERATIONS.
8th OCTOBER, 2014	CONTROL OF DISEASES AND PESTS OF COCOA
15th OCTOBER, 2014	HARVESTING
10th NOVEMBER, 2014	SATTIFS NURSERY
15th-19th NOVEMBER, 2014	NURSERY MAINTENANCE
30th JANUARY, 2015	FINAL WORKSHOP FOR TOTs

2.1 Training Schedules

a. Nursery practices

The farmers were taken through site selection for cocoa nurseries:

1. Select a flat or gently sloping area for the cocoa nursery.
2. The site should be near a reliable source of water.
3. The site should not be too far from the proposed farm.
4. The soil should be permeable to prevent water logging.
5. If there is an existing cocoa farm, the nursery should be sited at least 10 m away from it and again not near undesirable trees to prevent possible Cocoa Swollen Shoot Disease (CSSVD) infection.

Site Preparation

- Weed the area clean and remove any obstacles or debris from the site.

Shading in the Nursery

- Cocoa seedlings should be protected from direct sunlight.
- Temporary shade using palm fronds or shade netting should therefore be erected.
- Alternatively, existing desirable trees could serve as shade.


Fig 1: (i) select a good site for nursery ii. Germinating seedlings on a project nursery

There are two methods of raising cocoa seedlings in a nursery:

- ❑ the polythene bag method and
- ❑ The seed bed method.

Planting Materials

The recommended planting material is the HYBRIDS. These consist of crosses between Amazon parents and selected local types, both local hybrids and Amelonado. The advantages of the hybrids over the Amelonado and Amazon types are:

- ❑ They establish easily.
- ❑ They are early bearing.
- ❑ They give sustained high yields.
- ❑ They have high bean numbers per pod.
- ❑ They produce many pods per tree.
- ❑ They have quick maturing pods.
- ❑ They are suitable for large-scale seed production.


Fig 2: Hybrid Cocoa seeds for nursery

Typical Nursery Schedule

- SEPTEMBER: Clearing up of the previous year's nursery and checking the requirements for the year.
- OCTOBER: Levelling of site (if new). Use polythene bags measuring 18cm wide and 25cm high (7ins x 10ins). Fill the bags with top soil to the brim. The best available top soil of good stable structure must be used. The soil should have satisfactory organic matter content, reasonable nutrient reserves and PH not less than 4.5. After filling, the bags should be arranged in beds in rows of five wide leaving path of about 60.9cm – 152.4cm access path to make watering easy to ensure healthy growth.
- NOVEMBER: Nursery shade should be provided. The shade provided intercept 70-80% sunlight during the initial two months that seedlings are held in nursery. Excessive shading causes retarded and spindly seedling development while over exposure may also reduce plant vigour.

  The initial shade may be of palm frond held on a suitable framework at about 175cm in height. Alternatively, the nursery may be located under trees (e.g. Glyricidia) which provide the desired level of protection.

  Progressive thinning of the frond or tree should be carried out after two months or earlier if the seedlings display symptoms of etiolation.

  Finally nursery shade density ideally must match that in the field where seedlings will be planted. This process is known as acclimatization or hardening.

Leaving about ½in from the top so that water could be retained in the bags. Or water does not run off during watering.

- DECEMBER: Before planting of the beans water the soil in the bags. Place in each bag one fresh bean with the pointed end up at a depth of 2cm. If in doubt about which is the pointed end place the bean flat at the same depth in the soil. Avoid sowing already germinated beans. Water the seedlings every other day in the evening or in the morning. In the rainy season, however, water the seedlings once a week. During the harmattan, daily watering of seedling should be done.
- JANUARY: Carry out pest and disease control if found necessary. As cocoa is attractive to a wide variety of insect pests, close attention is necessary to ensure timely application of insecticides for control of pest which inflict economic damage.
- FEBRUARY – MAY: The maintenance of the plants continues, the shade is thinned as from late April, but is finally removed by the third week of May.
- JUNE: The seedlings are transplanted as soon as the rains become steady.

PRE-PLANTING OPERATIONS

Clear secondary bush or forest in December and February. Fell all undesirable shade trees and leave 15 to 18 desirable shade trees per hectare (6-9 per acre) to provide permanent shade.

- For replanting of old cocoa, cut all the cocoa trees. Thin the forest shade leaving 15 to 18 desirable shade trees per hectare, (6-9 per acre).
- Do not burn the litter; leave the dry vegetation to rot to improve the soil fertility and prevent erosion.
- Line and peg the farm at the recommended spacing of 3m x 3m in March. *Glyricidia can be planted at 6m x 6m* in April to supplement the shade.

The undesirable trees that should be eliminated during land preparation:

- Trees which can be affected by the Cocoa Swollen shoot Virus (Alternate host) *e.g. Ceiba pentandra –(*Onyina), *Cola gigantea-(*Watapuo), *Cola chlamydantha-(*Kra-bise)
- Trees which habour unwanted insects *e.g. Citrus* (Mealybugs and Ants). *Canthium glabriflorum (*Ntateadupon*)-(*Ants*) and Kola (*Capsids*).*

- Trees which are brittle and tend to break off or are blown down by wind easily *e.g. Musanga cecropioides (*Odwuma*) and Triplochiton scleroxylon (*Wawa*)*
- Dry trees which tend to remove too much moisture from the soil) e.g. *Triplochiton schloroxylon* (Wawa), *Piptadeniastrum africanum* (Odahoma)
- Trees with too dense as canopy e.g. *Samania saman* ("Agriculture dua"), *Musanga cecropioides* (Odwuma).
- "Hungry" trees – (those which are surface rooting and compete with cocoa for available plant nutrients e.g.*Wild fig* (Mamtamdua). *Ficus exasperate* (Nyankyeren)
- Host for mistletoes e.g. *Citrus spp*. (Citrus), *Persea Americana* (Avocado), *Cola spp*. (Kola), *Alstonia boonei* (Nyamedua), *Funtumia elastica* (Funtum), *Ficus exaperata* (Nyamekyeren)

Generally desirable trees should tower high above the cocoa, provide some shade and yet allow light into the cocoa. Some examples of desirable trees are; *Funtumia elastica* (Ofuntum), *Alstonia boonei* (Nyamedua), *Pycnanthus angolensis* (Otie), *Milicia excelsa* (Odum), *Spathodea campanulata* (Akuakuoninsuo).

- Proper shade in cocoa sustains yield over a long period.
- Proper shade adjustment reduces the incidence of blackpod (pod rot) disease and rodents attack.
- Proper shade will reduce the cost of weed control.

Lining and Pegging

Line and peg the farm at the recommended spacing of 3m x 3m (10ft x 10ft) in March – April for major rains and July- August for the minor rains before planting.

Advantages of Lining and Pegging:

- It makes all the treatment of swollen shoot easy.
- It makes harvesting very easy
- It makes weeding of farms very easy
- It makes mechanisation in farm very easy
- It makes filling of vacancies easy
- Every plant is given its feeding space.

Planting in the Field

The best time for planting cocoa is May to July which is the major rainy season.

Cocoa seedlings between the ages of 3 and 6 months may be transplanted in May/June using the bare root method. However, younger seedlings are preferred since it reduces the length of time and thus cost of nursing. Water the beds thoroughly before lifting the seedlings. Carefully uproot the seedling with some soil around the roots using a cutlass. Prune very long taproots to prevent them bending in the hole during planting.

IMPORTANT AGRONOMIC PRACTICES NEEDED TO OPTIMIZE PRODUCTIVITY AND FACILITATE FIELD OPERATIONS

a. MULCHING

This is essential for young cocoa during the first and second years especially in dry areas. Mulching helps to:

- Conserve soil moisture
- Promote the activities of soil organisms
- Smoother weeds by cutting off light for their growth
- Reduce the direct impact of rain drops on the soil
- Slow down run-off and improve infiltration
- Improve the nutrient status of the soil when the mulch decays
- Regulate soil temperature

Mulching should be done by spreading plant materials such as dry grass, plantain pseudostem,etc around the base of the cocoa seedling towards the end of the rainy (October); and planting food crops like plantain and cocoyam in the open spaces of the planted cocoa seedlings.

In termite infested areas, the mulch material should be treated with a solution of 60 ml of confidor in 4.5l of water.

Fig 3: i) Newly established farm with plantain and cocoyam ii) Termite infested farm to be treated with confidor

b. PRUNING

Pruning of young cocoa

- This is done with the 3rd and 4th year of establishment.
- The pruning process in this case involves;

1. Cutting off low lying branches to maintain the first point of branching (jorquette) at the height of at least 1.5m.
2. Removing excess shoots when more than 2 arise from the jorquette and leaving the 2 shoots facing each other.

Shoots are removed from the center to open up the cocoa canopy.Pruning of mature cocoa involves the removal of:

- Basal shoots (chupons) from the main stem at every round weeding.
- All disease infected branches.
- Excess branches
- Epiphytes and mistletoes on the branches of the cocoa in the canopy. (mistletoes can be removed between September and March when they can be easily detected due to the presence of flowers)

Pruning is necessary since it

- makes access through the farm and farm operations easy.
- provides shape to the plant.
- controls mistletoes and the spread of insect pests.

- improves air circulation in the farm and as a result reduces the incidence and spread of diseases such as black pod.
- helps to reduce the cost on chemicals used for spraying against pests and diseases.
- opens the canopy to allow more lights into the farm.

SHADE MANAGEMENT

- Shade management is the practice of selective thinning, natural regeneration, or propagation of native forest trees and/or the planting of shade trees to achieve optimal light levels for cocoa production.
- A matured cocoa farm requires about 60% sunlight to penetrate to the ground i.e 40% shade.

The correct shade level in cocoa is important because it helps:

1. to achieve in high cocoa yields.
2. to reduce the incidence of black pod (pod rot) disease and rodent damage of cocoa pods.
3. to reduce capsid damage.
4. to reduce nutritional imbalance and dieback in mature cocoa.

WEED MANAGEMENT

Weed control in cocoa farms is necessary because weeds:

- compete with cocoa for nutrients, water and light,
- encourage the incidence of insect pests and rodents that attack the plants,
- make the farm humid and increase the incidence of the black pod diseases,
- impede farm operations like spraying,
- make the collection of harvested pods difficult resulting in loss of pods.

Weed incidence is usually high where the cocoa canopy is not completely closed.

Weeds can be controlled manually with machete (cutlass) or chemically with herbicides.

Manual Weed Control

- Should be done 3-4 times in a year for young cocoa farms and about twice a year in a mature cocoa farm.
- The weeds are brushed close to the ground and climbers on the cocoa trees are removed.

Chemical Weed Control

- Herbicides such as Glyphosate may be used to control weeds.
- For young cocoa, 1.5-2 liters of Glyphosate in 100liters of water per hectare may be applied.
- The knapsack sprayer can be used and it must be fitted with a low volume nozzle for maximum efficiency and economy.

❑ When Glyphosate is used, weeds are controlled or suppressed over a long period than manual weeding.

❑ Much time is saved (e.g. 1.5 man days are required per hectare) and

❑ long-term savings in cost (about 30%) of weed control are achieved.

The efficiency of herbicide application is very much improved when the cocoa is planted in lines.

- It is important to avoid contact between the cocoa seedling, food crops and the herbicide by directing the spray against the weeds.

To avoid spray drift on cocoa seedlings and food crops;

Spraying should be done early in the morning or late in the afternoon.

❖ Do not spray Glyphosate when it is threatening to rain since at least 4 hours of dry weather is required for the chemical to be effective.

For safety reasons;

✓ Wear protective clothing and avoid eating, drinking or smoking whilst spraying.

✓ Wash down immediately after spraying and avoid contaminating nearby streams and other water bodies.

✓ Properly dispose of herbicide containers by burying them and do not use them for storing water or food. Check leakages of knapsack sprayers before use

SOIL FERTILITY AND PLANT NUTRITION

- Cocoa production requires a soil with high fertility.
- Continuous cropping on these soils has resulted in the reduction of soil fertility.
- The fertility of such soils can be improved by the use of fertilizers.
- Continuous fertilizer applications for 3-4 years can double yields of cocoa.
- However, cocoa yield increases in the first two years of application are usually minimal.

- To obtain maximum benefit from fertilizer application, the under-listed factors must be considered;

1. High yielding CRIG recommended cocoa varieties obtainable from the Seed Production Unit of COCOBOD must be used when establishing new farms.
2. Weeds, insect pests and black pod disease must be controlled as recommended.
3. Swollen shoot infected trees, chupons and mistletoes must be removed.
4. Shade at the recommended level should be maintained.

Fertilizers

Fertilizers are substances that contain nutrients and are applied to the soil or plant leaves to provide nourishment for plants. Examples of such nutrients are nitrogen, phosphorus, potassium, sulphur, etc.

Two main types of fertilizers;

I. Organic fertilizers and
II. Inorganic fertilizers.

Organic fertilizers are derived from plant and animal sources. Examples; poultry manure, compost, cocoa pod ash, etc.

Inorganic fertilizers are made from non-living substances such as gases, rocks, industrial chemicals, etc. Inorganic fertilizers are made of solid and liquid fertilizers.

Three types of fertilizers recommended by COCOBOD for cocoa are as follows;

1. Conventional (inorganic) fertilizers

i. Asaase Wura
ii. Cocofeed
iii. Ammonium sulphate
iv. Triple super phosphate + Muriate of potash mixture

- Conventional fertilizers are applied to the soil either by broadcasting of ringing under cocoa tree once a year.The best time of application is at the beginning of the main rains (April/May).Fertilizer application can be carried out on the same plot for four conservative years with a 1-2 year break.

2. Foliar/Liquid fertilizers

- Foliar/Liquid fertilizers usually contain minor nutrients, such as magnesium, zinc, boron, etc., that are required in small quantities and sometimes some in addition to major plant nutrients, such as nitrogen, potassium, etc.
- Usually applied when there is lack of soil moisture and solid fertilizers cannot be applied
- It can be applied when there is the need to obtain a quick response from fertilizers to correct nutrient deficiencies since uptake of nutrient through the leave is much faster than through the roots.
- The recommended types are Sidalco liquid fertilizers that come in three formulations:

i. N:P:K 10:10:10 (balanced),
ii. N:P:K 20:2:4 (Nitrogen-rich) and
iii. N:P:K 6:0:20 (Potassium-rich).

Currently it is recommended to apply these foliar/Liquid fertilizers at monthly intervals.

Conditions for use of foliar/Liquid fertilizers:

- It is to be applied once a month throughout the year.
- Avoid spraying on cocoa plants under stress.
- Apply in the morning to avoid high wind and strong sunshine.
- Apply with the mist blower for tall cocoa plants and a knapsack for medium-sized plants.

Disposal of Foliar Fertilizer Containers:

Properly dispose of fertilizer containers by crushing and burying them.

Do not use the Foliar fertilizer containers for storing water or food.

3. Organic fertilizers:

- Organic fertilizers contain appreciable amount of macro and micro nutrients that can be made available to plants after mineralization.
- They also improve soil physical characteristics and soil moisture regulation and conservation.
- The use of organic fertilizers also reduce the risk of environmental pollution associated with conventional fertilizers.
- Examples of organic fertilizers include poultry manure, cocoa pod ash, compost,etc.

Cocoa Diseases

Swollen Shoot Disease:

Damage cause: Affects cocoa trees causing defoliation, yield reduction and death of the tree.

Causal Agent : the disease is caused by a virus

Vector: the disease is spread by female mealy bug.

Symptoms

- Mosaic in the leaf.
- Swellings on chupons and fan tips.
- Mosaic on pods
- Round pods

Alternate Host:

Some identified forest trees have the virus and can infect cocoa in the field. These include;

Cola chlamydantha - kra-bise, Asenkrobia

Sterculia trangacatha – Foto

Adansonia digitata – Odadee

Ceiba pentandra – Onyina

Combretodendron macroparpum – Esa

- Effects
  - Infectious disease which spreads to other cocoa farms if not controlled early.
  - Can destroy a cocoa farm within 18 to 24 months
- Control
  - Infected trees and contact trees are destroyed by cutting out below ground level.
  - Trees cut are packed away from the farm.
  - Re – inspection of outbreak farms is done monthly to further destroy trees showing symptoms.
  - Outbreak is considered controlled if no symptoms are found after several inspections.

Black pod disease

It results in the browning, blackening and rotting of cocoa pods and beans.

- *Causal Agent: a fungus called* Phytophthora.

- There are two types found in Ghana and these are:
  - *P.palmivora*-less destructive
  - *P. megakarya* – very destructive
- *Symptoms*
  - small brown spot on pod which grows darker and expand rapidly.
  - Whitish spores (seeds) are produced on the brown surface.
  - The whole surface of he pod may become black within14 days.
- The disease is favoured by humid or damp environment.

Means of spread:

  - Healthy pods in contact with infected pods.
  - Rain drops hitting infected pods splash spores onto healthy pods.
  - Drips of water from infected pods falling on healthy pods.
  - Pods in direct contact with infected soil.
  - Through the activities of pests and rodents.
  - Through harvesting implements and contaminated hands.
  - Through carrying of infected pods from one farm to another farm.
- A. Cultural Control
  - Reduction of shade trees.
  - Regular weeding.
  - Draining standing waters.
  - Regular harvesting.
  - Remove chupons and reduce heavy canopy to admit light.
  - Remove diseased pods from the farm to an open space and either burn or bury them.
- B. Chemical Control

This involves spraying of recommended fungicides to coat the pods against the fungus (*Phytophthora* sp). It should be noted that spraying must start as early as cherelles appear. Spraying must be done every 3 weeks intervals. About 6-9 sprays per year are required depending on the length of the rainy season.

Spray early on a day when the weather is clear, for the chemical to get the chance to dry on the pods. If it rains within 3 hours of spraying then spray again.

Note: for effective control of black pod, the two methods should be combined.

INSECT PESTS

- There are two major pests of cocoa in the area, these are:
  - *Capsids*

These are brown or black bugs which feed on young shoots and pods of cocoa.

Fig 4: Cocoa Capsid, a pest infesting a cocoa tree/farm

Types

There are two main types found in Ghana and these are:

- *Distantiella theobroma* – black capsid
- *Sahlbergella singularis* –brown capsid.

Minimum occurrence-February-July

Maximum occurrence-August-January

Six (6) capsids per 10 trees indicate high and damaging population level.

Damage caused:

- Capsid cause damage to young tissue of cocoa trees.
- They pierce young shoots, inject poisonous saliva and suck liquid from the wound.
- Young cherelles (okro pods) may also be destroyed.

- ***Alternate host plants:***

Kola tree species; citrus; silk cotton tree.

Control

Chemical method

Spray with recommended insecticides such as those below

List of approved insecticides by for cocoa by CRIG

Trade name of insecticide	Active ingredient	Dosage
Akate Master	Bifenthrin	500ml/ha
Actara	Thiomethoxam	85ml/ha
Confidor	Imidacloprid (200SL)	150ml/ha

Recommended spraying equipments:

a. Motorized knapsack machine-for mature cocoa of over 2 years
b. Hand –operated sprayer (MATABI)-for young cocoa under 2 years

Bathycoelia thalassina (Atee)

These are large green insects which feed on cocoa pods. They lay their eggs on leaves, trunks and branches.

Damage caused

They pierce the pods husk with their mouth parts and suck out the content of the beans. As a result young pods turn yellow and then black, large pods stop growing and becomes yellow.

Control: Spray with recommended insecticides. Also hand pick any visible bugs.

HARVESTING

- The old types of cocoa (Amelonado and Amazon) produced their crop in two distinct peaks. It was therefore possible to separate the crop into major (October-March) and minor (April-July) seasons.
- For the major season, cocoa should be harvested at 3 to 4 weeks intervals. In the minor season cocoa should be harvested at 4 to 6 weeks intervals.
- The Tafo cocoa hybrids on the other hand, continue to produce pods throughout the year. It is therefore necessary to harvest several times in the year.

- Ripe pods not harvested early turn black and the beans germinate or rot in the pod. Delay in harvesting therefore causes loss of crop and loss of income.
- In areas where black pod and other pod diseases are common, unharvested pods cause the spread of the diseases to other pods.
- Open pods by means of a cutlass, club or by hitting against a stone. Avoid damaging the beans inside the pod. Breaking should be done within four days after harvesting. Over, 4 days, one will encounter the problem of germination.

FERMENTATION

Fermentation is the process of curing the beans to give the characteristic cocoa flavour. The reasons for fermentation are as follows:

- To develop colour, flavour and taste associated with cocoa products.
- To kill the embryo and stop germination.
- To remove the pulp.
- To loosen the testa and cause the cotyledons to spread out

Heap fermentation

- Fresh beans are heaped on a mat of plantain or banana leaves and well covered with same. The leaves are held in place by pieces of wood to ensure that the fermentating heap is airtight. The plantain or banana leaves should be laid on a gentle slope to allow for drainage of sweating or rain water during the fermentation process. After covering, the beans are left in the fermenting heap for 6 days. The heap is uncovered and the beans are turned after every 2 days so that beans in the middle also gain oxygen for proper fermentation. Two turnings must be done before the beans are transferred onto the drying mat on the 7^{th} day.

Fig 5: Breaking pods and heaping beans for fermentation

Basket Fermentation

- This method is used when dealing with small quantities of beans. Fresh beans are put into a basket lined with plantain or banana leaves and covered with more leaves. Beans are turned twice after every two days. The beans are left to ferment for 6 days and transferred onto drying mats on the 7^{th} day. It must be noted that provision should be made for drainage of sweating and access of air.

Box Fermentation

- The beans are fermented in a set of three boxes which are arranged in tiers one above the other. The beans are put first in the top box then after 2 days are shoveled into the second and after another 2 days into the bottom one. Third ensures thorough mixing and therefore even fermentation.

Fermentation is completed when the following changes occur:

- The beans swell.
- Beans develop certain odour.
- Cotyledons turn brown.
- Temperature falls.

DRYING OF COCOA BEANS

Reasons for proper drying of beans:

- To reduce the moisture content of the beans from above 60% to 6-7% level which is safe for storage and shipment.
- To reduce the bitterness and astringency of the beans.

Drying Methods:

a. Sun drying

Fermented beans are dried on mats on raised platforms in the sun. gradual drying is done in the first 2 days before beans are spread out evenly on the drying mat. Frequent turning and polishing of the beans must be done. Clumped beans must also be separated and then all defective beans removed. These includes: flat, germinated and broken beans. Also all foreign material such as placental parts, bits and pieces of pods and stones must be removed. In good condition, beans should be thoroughly dried between 10-14 days.

Fig 6: Sun drying Cocoa on the farm

Drying cocoa beans: When the beans are well fermented, they must be dried. Dry daily in the sun on raised mat, not on the floor. Stir the beans often and protect them from rain. When the cocoa is quite dry, the beans are sorted. Remove all:

- Mouldy bean: a bean on the internal parts of which is visible to the naked eye.
- Slaty bean: a bean which shows a slatey colour over half or more of the surface exposed.
- Insect damaged bean: a bean whose internal parts contain insects at any stage of development, or have been attacked by insects which have caused damage visible to the naked eye.
- Germinated bean: a bean the shell of which has been pierced, slit or broken by the growth of the seed germ.

- Flat bean: a bean of which the two cotyledons are so thin that it is not possible to obtain a cotyledon surface by cutting.
- Smoky bean: a bean which has a smoky smell or taste or which shows signs of contamination by smoke.
- Broken bean: a bean of which a fragment is missing, the missing part being equivalent to less than half the bean.
- Fragment: a piece of bean equal to or less than half the original bean.
- Piece of shell: part of the shell without any of the kernel.

When cocoa has been evenly dried throughout the moisture content must not exceed 7.5%.

STORAGE

Dried beans must be properly stored to avoid contamination and deterioration. The dried beans are put in jute bags or clean baskets and stored in dry place from fire and smoke. The bags or baskets must be kept off the floor. Dry beans should be sold at the buying centres without delay.

5.0 LESSONS LEARNT

The farmers who participated in the training assisted in establishing the nursery using the knowledge acquired during the training. All participating farmers would be given seedlings from the project nursery and their farms would be used as demonstration farms during the Farmer Field School.

6.0 CONCLUSION

In all, the participating farmers were very appreciative of the training given to them by the project. The field training gave us the opportunity to select farmers for the Farmer Field Schoolto be conducted in 2015. In all, 35 farmers wereselected from 7 farmer based organizations.Each farmer would be provided with seedlings from the project nursery and the Seed Production Unit nursery. The beneficiary farmers would be assisted by the project to develop their own farms using the technologies and techniques available locally and being promoted by the COCOBOD. In this way, participating farmers would be encouraged and guided to reproduce the Field School experience. At the end of the season each farm would be assessed to see if the technologies applied produced better yields than the fields in which they used the traditional production

methods. All these would be under the supervision of the Technical Officers from the Seed Production Unit of COCOBOD in Goaso.