

Access to market opportunities in Ghana's off-road communities



DFID Crop Post-Harvest Programme

Reports submitted under project R7149

Access to market opportunities in Ghana's off-road communities

Project Team

Dr Gina Porter, Centre for Overseas Research and Development,
Department of Geography, University of Durham, UK
r.e.porter@durham.ac.uk

Dr Roderic Dutton, Centre for Overseas Research and Development,
Department of Geography, University of Durham, UK
r.w.dutton@durham.ac.uk

Dr Einir Young, Centre for Arid Zone Studies, University of Wales, Bangor, UK
e.m.young@bangor.ac.uk

Mr Fergus Lyon, Department of Geography, University of Durham, UK
f.lyon@durham.ac.uk

Mr Frank Owusu Acheampong, P.O. Box 3712, Kumasi, Ghana

Dr Wayo Seini, ISSER, University of Ghana, Legon, Ghana
sadaocgh@ghana.com

Dr Albert Abane, Department of Geography, University of Cape Coast, Ghana
csucc@ghana.com

Constraints on Agricultural Production in Gomoa Central Region

**Einir Young, CAZS,
University of Wales, Bangor**

Constraints on agricultural production
in
Gomoa, Central Region
with particular emphasis on maize

Dr Einir M. Young

CAZS
July 1998

Contents

	page
Executive summary	2
1. Introduction	3
2. Terms of Reference and Methodology	3
3. Progress on Terms of Reference	4
4. Recommendations	32
Bibliography	33
Annex 1 – Itinerary	36
Annex 2 – people interviewed	38

Executive Summary

- If the physiological yield potential of a crop is to be realised attention must be paid to soil erosion, management of water resources, soil nutrient status, soil organic matter content and pH, crop rotation and methods of tillage. There is a close relationship between high yielding varieties, soil nutrient status and fertiliser application (especially Nitrogen), plant population density, soil moisture, early planting (i.e. at the start of the rains) and weed control.
- The farming system in Gomoa and Assin districts is a low-input one with virtually no mechanisation of activities from land clearance to harvest. Very little fertiliser is used and farmers move on to fallow land after 2-3 years. Maize yields of subsistence farmers of both districts, as recorded by the PPMED, are very low at 1.1t/ha, below the 1.6t/ha quoted for Ghana as a whole by FAO. Some farmers may be harvesting more than this in seasons immediately following land clearance after fallow. Yield can be improved with better management – use of HYV, addition of fertiliser especially N, following the planting density recommendations and good husbandry. Improving the yield however is futile unless the crop can be stored adequately, sent to market at the optimum time and the returns justify the expenditure on inputs (cash and labour).
- Constraints on farming activities were identified as:
 - rainfall, which is basically bimodal, but erratic;
 - limited access to inputs such as HYV, fertiliser, due to shortage of money;
 - lack of historic records on income and expenditure
 - storage –due to poor storage quality of the HYV in the absence of insecticide protection, lack of adequate storage facilities or having to sell due to cash flow problems
 - poor road conditions, which lead to problems of transport to market and of wholesale buyers to the settlement.
- Land tenure is a complex issue, which needs to be studied in greater detail. It seems that the current land tenure conditions do not encourage more investment in the land. Land shortage is not perceived as an issue and as the farmer can move on when yields begin to fall, there seems little incentive to improve the soil condition. It is unclear the extent to which women are disadvantaged. They have responsibilities other than farming. They cannot clear or produce as much and although they are responsible for marketing both their and their husband's surplus it is more likely that their produce is kept back to feed the family.
- There is a need for a coherent programme of sustainable development in these districts with an emphasis on participatory research and extension work with farmers working in partnership with the District Agricultural Director and his/her team to find sustainable solutions that are workable. Any solution must combine education with improved infrastructure and access to markets and the availability of a fair credit system. Emphasis must be placed on equity for women.
- It would be useful to combine agricultural development with the development of small industries that add value to the produce before it leaves the settlements. The emphasis should be on integrated development, with markets in Ghana and elsewhere identified and targeted. Organic farming should be a viable and attractive option, which needs to be further exploited. On no account should farmers be misled into believing that expansion and an increasing reliance on chemical inputs is the only answer.

1. Introduction

As increasing population pressure sharpens the focus on the need to intensify agricultural production, governments need to devise policies which can assist sustainable and equitable development of rural areas.

Road development is a focus for government and funding bodies alike, but despite this, substantial populations in Ghana as in other sub-Saharan communities live in off-road communities. Off-road communities are often disadvantaged compared to similar communities situated in roadside locations, with the movement of commodities in and out of such communities restricted.

The DFID funded project 'Access to market opportunities in Ghana's off-road communities' aims to assess the scale and nature of community access problems for men and women in off-road areas and to identify strategies for developing more effective market integration and market opportunities. A major factor associated with access to market is the marketable produce, which in the case of rural Ghana is mainly agricultural. There is very little to be gained in increasing yields of perishable products if they cannot be transported to market in time. Strategically it is better when resources are limited to improve the access to higher potential areas.

A team of two (agronomist and social scientist) conducted an evaluation in Gomoa and Assin Districts of the Central Region of Ghana, to select 2-3 settlements for further study. The field visit took place during May 1998. The following report presents the findings of the agronomist.

2. Terms of Reference and Methodology

2.1 The Terms of Reference are listed below

- i) Provide an overview of factors affecting yield with emphasis on maize
- ii) Select settlements for further study
- iii) Summary and recommendations

2.2 Methodology

The methodology adopted included the following activities

- i) Literature review
- ii) Field Visit to Gomoa and Assin Districts conducted by the members of the team involving:
 - a) Participatory appraisals with groups of farmers in 8 villages
 - b) Semi-structured interviews with MoA staff and others at district and regional level in Apam, Cape Coast and Foso
 - c) Field observations of farming practices

3. Progress on the Terms of Reference

3.1 Factors affecting yield, with emphasis on maize

3.1.1. Control of Soil erosion

Soil erosion is a serious problem in coastal Ghana. A rainfall erosivity map of Ghana (Oduroafriyie 1996)¹ divides Ghana into five major erosion risk zones and the coastal sector is in the severe to extremely severe erosion risk zone. As the population pressure increases, so will the need to clear more land for food production and fuelwood supply and without proper management the erosion problems will be exacerbated.

The soils of coastal Ghana in the Gomoa area are Ferric acrisols of coarse to medium texture on level to undulating topography. In Assin the soils are orthic acrisols. These broad categories have been further classified as shown in Box 1.

3.1.2. Management of water resources

Water availability and usage is a major factor in the production of food. In rainfed situations water is at a premium and distribution is as important as total amount. The mean annual rainfall can be similar from year to year but farmers have to contend with many variations such as unseasonal downpours. Ideally water conservation methods or irrigation would alleviate some of the risk. Irrigation is confined to the dam area in Eastern Gomoa. Assin district has a tropical rainfall pattern from February to November.

The agricultural extension services are promoting contour planting to reduce run-off, but many farmers find that it takes too long to mark out the rows and continue with traditional random planting.

3.1.3. Nutrient status and crop rotation

Crop rotation is dependent on the crops grown. The nutrient requirements of maize are greater than cassava. To produce one ton of corn, the plants take from the soil 24kg N, 4kg P and 23kg K². For the production of 1t of fresh roots of cassava, the whole plant will remove from the soil about 3kg N, 1 kg P and 7kg K³. Therefore, when the land is first cleared, maize is grown for a year or two and then maize cassava are inter-cropped. The maize is then harvested and the cassava allowed to grow into the next season. After cassava, the land is left fallow.

3.1.4. Methods of soil tillage

The cultivation method is basically slash and burn. It depends on the population pressure and the availability of land whether the same land is cultivated for two or three years. The land is left fallow for 2 years at least before being cultivated again.

The land is cleared with a cutlass and hoe and the vegetation burnt prior to planting. Some farmers wait until after the first rain to minimise the risk of bush fires, others burn before the rain. The ash is a source of potassium hence the recommended fertiliser NPK 15:15:0

Box 1.

The main characteristics of the soils of Gomoa and Assin Districts

SOILS^{4,5}

The soils of coastal Ghana in the Gomoa area are Ferric Acrisols of coarse to medium texture on level to undulating topography. In Assin the soils are orthic Acrisols. These broad categories have been further classified:

ASSIN DISTRICT

The main soil type found in Assin District is the G2 type:

G2 Nsaba-Swedru/ Nta Ofin Compound

- i. Deep, red, well drained, gravelly and concretionary clay loam on summits and upper slopes (Swedru Series)
- ii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on upper to middle slopes (Nsaba Series).
- iii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on lower to middle slopes (Akroso series).
- iv. Deep brown, imperfectly drained colluvial-alluvial sandy loams to sandy on lower slopes (Nta Series).
- v. Valley bottoms consist of deep, grey poorly drained transported sands and clays. (Ofin series).

This soil is also the predominant type in the 'Potential agricultural region' of Gomoa district.

GOMOA

Gomoa district has a patchwork of different soil types. The most predominant are:

LB1 Bekwai-Nzema/Oda Compound (found in Gomoa Sampa)

- i. Red well drained (Bekwai Series) and yellowish red, moderately drained (Nzema series) quartz gravelly and ironstone concretionary silty clay loams and clays found on summits, upper and middle slopes. Sometimes deep, red, well drained, gravel-free clays (Akumadan Series) may be encountered on summits.
- ii. Yellowish brown imperfectly drained, deep, non-gravelly clays and silty clay loams (Kokofu series) developed from colluvium on middle and lower slopes
- iii. Grey, poorly drained, deep, non-gravelly alluvial silty clays and silty clay loams (Oda Series) and fine sandy loams (Temang Series) found on valley bottoms.

G1 Asuansi-Kumasi/Nta-Ofin Compound

- i. Deep, red, well drained, gravelly and concretionary gritty clays on summits and upper slopes (Kumasi series)

- ii. Deep, yellowish red, gravelly and concretionary clay loams and clays on middle to upper slopes (Asunasi Series)
- iii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on lower to middle slopes (Akroso series).
- iv. Deep brown, imperfectly drained colluvial alluvial sandy loams to sandy on lower slopes (Nta series)
- v. Valley bottoms consist of deep grey poorly drained transported sands and clays (Ofin series).

G2 Nsaba-Swedru/ Nta Ofin Compound

- vi. Deep, red, well drained, gravelly and concretionary clay loam on summits and upper slopes (Swedru Series)
- vii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on upper to middle slopes (Nsaba Series).
- viii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on lower to middle slopes (Akroso series).
- ix. Deep brown, imperfectly drained colluvial-alluvial sandy loams to sandy on lower slopes (Nta Series).
- x. Valley bottoms consist of deep, grey poorly drained transported sands and clays. (Ofin series).

G3 Adwaso-Bawjiase/Nta-Ofn Compound

- i. Deep, yellowish red to red, well drained, very gravelly and droughty sandy clay loams and clays on summits to uppers slope sites.
- ii. Deep, yellowish brown, moderately well drained colluvoial gritty clay loams on lower to middle slopes (Akroso Series).
- iii. Deep brown, imperfectly drained colluvial alluvial sandy loams to sandy on lower slopes (Nta Series).
- iv. Valley bottoms consist of deep, grey, poorly drained transported sands and clays (Ofin Series)

GNS 1 Simpa-Agotaw Simple

Pale coloured sands overlying gravelly sandy loam to sandy clay on uplands and slopes, grey-brown compact calcareous clays on lowlands.

3.1.5. Organic matter content and pH

Application of organic manure is not common. There are a number of reasons for this. i) Not many people keep animals on a large scale and therefore access to manure is limited. ii) Transport of bulky material such as manure from its production site to the settlement is expensive. The farmers then have the added problem of ferrying the material to their farms along footpaths. Labour and access to cash are both limiting factors.

There is no tradition of making compost from household waste either, and this is a potential area for development. Household compost heaps could be used to produce manure for vegetable crops such as tomatoes, pepper and garden eggs.

There is very little information available on soil composition, nutrient status or pH. Farmers do not adjust the pH.

3.2. Selection of settlements for further study

3.2.1. GOMOA DISTRICT

Following discussions with the District Crops Officer and the District Assembly a number of settlements of varying distances from the tarred road were selected and visited. Semi-structured interviews and farm visits were conducted with farmers.

3.2.1.1. ABORA

Abora is 2 miles south of the main tarred road. It has around 500 inhabitants consisting of the Tuidan and four other family groups. Farming is the main economic activity with all men and women participating to some degree. The women also engage in trading and there are some small artisans. The village has no fishermen and none of the women process fish. There are no matt or basket weaving activities or gin distilling, although they sell gin. There is some charcoal burning activity with men producing the charcoal and the women selling it. The farming and charcoal producing activities coincide as they make charcoal with the material cleared from the farm land.

Maize is the major crop grown and is grown on a larger scale than the other crops – tomato, pepper, cassava, onion and okra.

There is no shortage of land and people come here from surrounding villages such as Ankamu, Apam, Brofuedor and Abutsia to farm. A sum of money is paid to the landlord and following harvest, the land is returned. Although most people have small parcels of land 1-3 acres, some individuals cultivate up to 10 acres and employ labour to assist them with the cultivation activities.

Family land tenure system is practised with the land belonging to the Tuidan family. Other Abora families obtain their land from the Tuidan, but it is only non-Abora people/non-family members who have to pay for the right to farm on a piece of land. The payment of 5000 cedis is a nominal sum to indicate the relationship between 'landlord' and 'tenant'. This fee is not paid by the Tuidan or by other Abora families. Allocation of land is on a first come first serve basis for seasonal farming. Long term commitments are rare.

There is no tradition of livestock rearing on a large scale in this village. Small ruminants and fowl are kept for domestic consumption.

There are no crop processing facilities and all crops are sold un-processed. Maize is taken to Apam Junction (Ankamu) for grinding and then brought back.

The road to Aboro is untarred and during the rainy season the village can be marooned for several days in three directions. This has prompted the inhabitants to seek an alternative location nearer the tarred road beyond the area prone to flooding. A site has been identified and the migration will slowly take place as more and more people can afford to build their houses at the new site.

Maize is the most important economic crop grown by farmers in Aboro with pepper, cassava, okro and tomatoes also being grown. The soil is described as a black clayey soil and considered a fertile soil.

Agricultural production is entirely dependent on rainfall and the rainfall pattern is erratic. Generally the rainfall is bimodal with the main rainy season in the spring with a second shorter rainy season in September. Farmers clear the land in anticipation of the rain, beginning in January. Most farmers delay burning until after the first rain to minimise the risk of bush fires. However, some farmers burn before it rains. In 1998 the first rain came on May 1st and the crops sown 3 days later.

The village is situated roughly in the centre of the farming lands with varying distances to the fields. Most farmers have a single parcel of land and 2-3 acres or 3-4 poles is the average size of a holding¹.

May and June are the busiest months with planting, weeding and maintenance of fields labour intensive activities. There is a taboo on farming on Fridays for Moslems and on Sundays for Christians. It is not easy to find labour to work on the farms. At times gangs come to the village from Brofyeda and Ankamu to earn money to supplement their own farming activities.

All crops grown are sold – they generally sell 2/3 and keep 1/3. Farmers harvest the crops themselves, but if they have money they will hire labour, if available. Men are mostly responsible for harvesting whilst women are exclusively responsible for marketing. Costs per pole for maize production is currently in the region of 100,000 cedis (Table 1).

¹ 1 hectare = 10,000 m²

1 hectare = 2.471 acres

1 acre = 4047m² or 4840 yd²

Pole = the square of the distance (approx 56.7 m) between two (old type) telephone poles or the equivalent of 90 times the length of a crocodile machete. Area of one pole = 3315m²

1 pole = 3.02 ha or 0.82 acres

Table 1

Costs per pole for maize production

Land clearing	25,000 cedis
Seed maize	6,000 cedis per bag x 3
Food for labourers (chop)	40,000 cedis
Maintenance	25,000 cedis
Equipment:	
Cutlass	7,000 cedis
Sharpened stone	3,000 cedis
Axe	20,000 cedis (everyone cannot afford an axe – hire for 2,500 cedis/day)
Hoe	3,000 cedis
Tractor	40,000 cedis per acre (30,000 cedis per acre last year)

1 mini bag of maize at the time of the visit was selling for 50,000 cedis.

It was claimed that 10 mini bags which consisting of 10 rubber buckets could be harvested from one pole of land. There is some discrepancy regarding the size of the rubber bucket. In Adabra one rubber bucket of maize weighed 9kg. According to the agricultural extension workers it should weigh 7kg and according to Dr Tetteh⁵ at Cape Coast it weighs 5 kg. The merchants who come to buy the maize have different buckets for different activities. They modify their rubber bucket to hold more maize by immersing it in hot water and stretching it to increase the volume. Unmodified buckets are used for selling on to customers.

One farmer reported a harvest of 20 bags per pole in the first season after clearing the land. Last year he harvested 8 bags per pole on the same land (see section 4.5) and 'didn't do to well'. He didn't have much recollection as to the differences in conditions but thought that it might have rained too much at the wrong time last year. The rain is expected to start at any time from March onwards and the early rain is lighter and more conducive to seedling growth than the very heavy downpours that occur later.

Most farmers in Aboro store their grain at home. The price of maize fluctuates with season. The goal is to store as much as possible until May, when prices peak just before the maize harvest which begins in June (normally).

Credit is a major problem for the farmers. They have a cash flow problem and have no access to reasonable, reputable source of credit. It is possible to obtain money for a bag of maize at the time of planting. However a farmer will receive 8,000 cedis from a creditor at the time of planting and have to pay one mini bag of maize at harvest. This can cause some farmers to fall into a credit trap.

None of the farmers interviewed kept any form of records of their farming activities and their perceptions of how good or bad they had done were anecdotal. However, this year ADRA had organised a seminar to encourage some form of farm recording. 8 farmers from Aboro and 4 from elsewhere had attended the seminar and one had started recording his activities. A secretary had been appointed to assist illiterate farmers.

Unfortunately, the farmers were not entirely clear as to what needed to be done. The instructions had been written on a blackboard during the seminar, but they had not received a template or guidance to take home with them.

3.2.1.2 OBIRI

Obiri is a small community of about 500 people situated about 3 miles inland on the Dago road, and about 4 miles from the tarred Accra to Cape Coast road. The population, both male and female engage in farming activities and there are is no interest in fishing – catching or processing. Obiri is a major charcoal-producing centre, with the charcoal production providing income in the dry season when the farming activities are over. This is in contrast to Aboro where the charcoal production was a by-product of the land clearance activities and took place during the cropping season.

In the last 2-3 years major road improvements have taken place on the Dago road and the community is benefiting from easier access to larger towns. The negative aspect of the road development is water related – the contractor cut through the mains water pipe 2 years ago and the water supply to the stand pipes are yet to be restored. The community depends on a single, brackish bore hole and a 300-400 gallon reservoir, which collects rainwater, for their water supply. The village does not enjoy an electricity supply or a clinic. The hospital is at Apam, about 13 miles away and the schools (primary and JSS) are overflowing.

Land availability is not a problem in Obiri, and no-one rents. Farming in Obiri is for subsistence. The land is considered to be fertile and very few people apply fertiliser to their crops. Erratic and unpredictable rainfall is the major constraint on the farming activities. They expect the first rain to fall in March but this year it did not start until 30th of April. Last year, maize was sown on April 16th but sowing was delayed until May 4th this year. Maize is the major crop grown but they consume more than they sell, they also consume more maize than any other food. Cassava is also grown - mainly for home consumption. Pepper, water yam, plantain, tomatoes and garden eggs are also grown and some people are increasingly involved with planting trees under the auspices of ADRA.

Land clearance starts in early January but most people postpone the burning until after the first rain in order to minimise the risk of bush fires. The land is cleared using cutlass and hoe – access for a tractor even if one was available could be a problem. The cultivated areas surround the settlement and fields can be 1-2 miles away.

Local varieties are used mainly. ADRA have supplied seeds of Obatanpa, an improved, short duration variety in the past but despite being higher yielding there is some resistance to its adoption because it doesn't store well without chemical treatment (see section 4.6). Some farmers have kept their own

seeds of this variety and have planted small areas, the grain from which they will sell immediately, keeping the local varieties for storage. Obatanpa is reputed to be drought tolerant, which can be an advantage in drier years.

Farmers in Obiri very rarely use fertiliser. The agriculture extension service recommends that they apply a teaspoon of fertiliser (e.g. ammonia top-dressing 2 weeks after emergence) to each plant. This is time consuming and farmers are unsure as to the cost effectiveness of this as they perceive the land to be fairly fertile.

Late planting causes pest problems, in particular weevils because the crop ripens later when the weevils are endemic. Plants are left in the field to dry for 3-4 weeks after and are then hand picked. The stalks are used for roofing and barn building.

Farmers build the barns for storing the cobs both in a convenient position near the field and close to their houses. Men build the barns but space is allocated for the women's crops. The barns are raised at least one metre from the ground and if necessary a fire is lit to deter mice and other pests. The grain is stored, unthreshed, in regular layers. The cobs are threshed by hand at the field site and then head loaded back to the village by the farmers and members of their families, for sale or consumption.

Shortage of labour is cited as a major constraint in Obiri. They do not form groups to assist each other but one or two farmers often combine their activities. Those who can afford to do so sometimes employ members of other families to work on their farms.

The produce is taken to Kyrien-nkwanta market at Dago junction. People from Dago and on some occasions, traders come to the village to purchase maize. There has been a serious improvement in access since the road was improved 2-3 years ago. The effects are only beginning to be felt, but already people are beginning to consider purchasing vehicles whereas previously only one person (the then Director of Education) owned a car. More traders are coming down to the village to purchase produce than in the past and when they come they bring consumables to sell as well.

Access to Credit is a major problem here as elsewhere. Those who have the means bank at the Rural bank in Durampong, however, it is very difficult to get credit from the bank even if an account is held there. There is some suspicion of corruption regarding this matter.

Unlike Aboro where farmers sold mini-bags of maize at sowing time in order to obtain credit, this does not happen in Obiri. However there is credit available from individuals on the charcoal business where a bag of charcoal is bought for 3,000 cedis and delivered about 3 weeks later. The interest on the transaction is 1000 cedis.

3.2.1.3 ADABRA

Adabra is 5 miles from the nearest tarred road. The main occupation of the citizens is farming and they grow maize, cassava, pepper, yam, tomatoes and groundnut. Some men from the settlement are drivers or learning a trade but all are involved in some form of farming. Women also farm, some exclusively and others combine it with trading activities. There are no fishermen here but

about 6 women fry and smoke fish and about 4 men make baskets to sell. Some men distil apatache. No families or individuals specialise in one crop over others

Land is available for anyone who wants it and all the families have family land. If strangers come to farm they must pay a 'knocking fee' of 100,000 cedis (which is subject to negotiation) and then pay 30,000 per hectare. If the knocking fee has been paid then there is no obligation to share the crop with the landlord.

Men and women farm together on the same piece of land and women here do not have separate pieces of land.

There is a significant Ewe population in this settlement and they have to pay for farming. The first settler arrived about 10 years ago from the Akatsi – it is suspected that some may have come from Togo but this is not confirmed. The Ewe people are considered to be very good farmers and have taught the local farmers how to cultivate groundnuts.

Generally the livestock kept is for domestic purposes, fowls, sheep and goats, with one man who keeps goats on a larger scale. He grazes them in the bush and no problems were reported of trampling or eating of crops by the animals. The men and women who rear livestock on a small scale have pens to keep them from roaming onto the crops.

There is some crop processing activity – one diesel powered machine to grind cassava for gari production, another for corn grinding. An Ewe man who has lived here for some time bought both about two years ago.

The soil is described as a sandy/clay (G3 – see Box 1). The settlement is central in relation to the cultivated fields and there did not seem to be any premium attached to any piece of land or location.

From the beginning of January farmers clear and burn the land (they are not as concerned to wait for the rain before burning here). The land is cleared manually with cutlasses and hoes – there is no access to a tractor.

In the month that the rain starts (May this year) maize, cassava, groundnuts, garden eggs and tomatoes are planted. The cassava stays in the ground for 12 months, the maize is harvested three and a half months or so after planting, groundnuts and garden eggs take about 3 months to mature. July/August are the busiest harvesting month. In September during the second, shorter rainy season maize and tomatoes are planted.

Maize and cassava are inter-cropped and if cassava is grown then the following year, new land is cleared for the maize. They claim not to have any land fallow, but during the farm walk there were many areas of uncultivated land that had obviously been cultivated previously.

Labour in itself is not a problem in this village, the farmers either do the work themselves or recruit labour from surrounding villages. They do not generally farm together except during land clearance, when they work in groups on each others' farms. It is not difficult to attract labour but paying for it is more problematic. It costs 40,000 cedis per acre for weeding and 4,000 cedis per day for planting if the area is too large for the individual to plant alone. June

and July are the busiest months, with the rains making weeding and crop maintenance a chore.

Men, women and children are involved in the harvesting of the crops. During the harvesting months people come to the village which to offer their services. School children are also heavily relied upon to do this work.

Obatanpa the synthetic variety promoted by the agriculture extension service is grown here. It gives a better yield than Abasa the local variety, which is also grown, but does not store as well and requires chemicals to preserve it.

A similar yield - around 8 mini bags per acre with 10 bags in a good year was reported here as at Aboro. They do not apply chemical fertilisers, as they cannot afford it but would like to do so if they had the funds. They were not specific in their description of pests and diseases but apply 'medicine'. The chemicals are kept in unlabelled bottles in small sheds in the fields with scant regard to safety in storage or application. Chemicals are freely passed from bottle to bottle regardless of what was in the bottle previously and there is little or no knowledge of dilution or safety procedures. It seems as any 'medicine' is better than none and applied in the hope that it will cure the problem. Advice is sought on these issues from the Agriculture Extension Services. A herbicide (probably Round-up) is applied in August and a sprayer is hired for this task from Amwanda, one farmer in the village has his own sprayer but no protective clothing is worn at all. The lack of such clothing was not considered to be an issue. The dilution used is one milk-tin of chemical in one bucket of water and poured into the sprayer.

Karate, an insecticide from ICI was the only chemical referred to by name and this was stored in an old chloroquine bottle (see section 4.7 and 4.7.1.1).

3.2.1.4 GOMOA SAMPA

Gomoa Sampa has a population of around 350 people most of whom are farmers, with some masons and carpenters. Both women and men farm with most of the women involved in trading. Some 10 or so women buy fish a Mankessim market and smoke them in clay ovens. Some youths weave baskets to sell at Kyrien-nkwanta market and some men distil local gin.

Men and women farm maize, cassava, tomatoes, oranges, palm oil, sugarcane and pepper. Pepper is considered a crop for women in this village.

The land is family land and there is sufficient land for all that wish to farm, some families have more land than others. There are no farmers from outside the settlement (such as the Ewes of Adabra or farmers from neighbouring villages as in Aboro). There is no reason for this – if people wish to come they would be welcome.

The Regent has the most cultivated land and farms 3 acres of cocoa, 4 acres of oranges, 1 acre of sugarcane, 6 acres of palm oil, 4 acres of maize, 2 acres of cassava and 2 acres of tomatoes at 3 different sites. Most people have scattered plots rather than one holding. Women do not have separate land, but farm parts of their husband's fields.

Most people have livestock, which are owned by both men and women. Sheep, goats and hens are kept on a small scale for consumption and selling. One person can have as much as 20-30 animals and are responsible for their

care. Children take the animals to their grazing in the morning and to collect them in the evening. They do not stray onto crop lands.

Some gari processing takes place in the village. There are 2 maize grinders owned by men and powered by gas oil. One man owns a mechanical sprayer for cocoa, oranges and tomatoes.

The soil is a red soil (LB1 Bekwai-Nzema/Oda compound – Box 1) and considered to be quite fertile. To the west of the settlement there is a river and the land adjacent to the river is available for cultivation in the dry season, initially from the draw down as the flooding recedes and by irrigation from the river. Cash crops such as palm oil, garden eggs, okra, sugar cane, tomatoes are concentrated along the river banks whilst maize and cassava are grown further away from the river where flooding is not a risk.

The soil is considered to be fertile. They apply little or no fertiliser and leave the land fallow. The farmers interviewed did not use fertiliser due to the expense (including difficulties transporting fertiliser to the village)

Normally, the rains are expected at the end of February but this year the first rain did not fall until April 28.

In January the main activity is weeding new land for cultivation and maintaining the old farms. In February the cassava fields are prepared in anticipation of rains at the end of the month. In March the land is cleared for maize in preparation of the major season. Maize, pepper, okra, tomatoes are planted in early April if the rains have started in May the oranges are harvested and sugar cane planted. The small season cocoa is harvested in May and June and the cocoa farm is expanded during June as well. New cocoa bushes take 3 years to mature, whilst old bushes can last up to 30 years. Maize and the other crops are harvested around the end of July, beginning of August and the sugarcane in October. Plantain and cocoyam are inter-cropped initially and then the plantain is allowed to grow on from about 9 months to 6 years.

The main cocoa season is between October-December. Pods are harvested with a long hook when they are yellow. They are then covered with leaves until they are red - for about 5 days before being carried home to dry. Drying takes about 2 weeks if there is enough sunshine. They are then sacked and sent to the Cocoa Marketing Board in Akropong (2.5 km North of the village). From there they are sent to Accra and Tema for export.

Oranges are harvested from October-January. Traders come to the village from Accra. During the peak of the season there are more oranges than can be managed.

The Agricultural Extension Officers visit frequently and can be contacted at any time for advice.

Cassava and maize are inter-cropped and is maize is grown by itself on a piece of land it is then left fallow for two years. Maize and cassava are the most important crop, and the maize is mostly harvested dry rather than fresh. The maize is left to dry as much as possible in the field before harvested and then it is stored. However, if people request fresh cobs then it is possible to buy them.

Crops are head-loaded in baskets from the fields into barns near the town. This was the only town where thieving from the bush was cited as a problem. One farmer had given up growing pineapple because they were stolen – not maliciously in his opinion, but as people walk past they take the opportunity to help themselves.

During the major season a lorry comes to the village although the road is rather bad. During the other times of the year traffic is very sporadic and they have to walk to the main road.

Labour is not much of a problem, they help each other with communal labour to harvest. If people help with harvesting cassava for example they are given some cassava in return.

Weeding 1 acre here costs 20,000 cedis and they employ only the young people from the town – they do not bring in labour from outside.

Tomatoes are harvested in the evening before the lorry is expected. If the road is particularly bad and the lorry does not turn up then someone has to be employed to carry the fruit to market. It is a particular problem in the off-season when lorries do not make the trip so regularly.

The major constraint on expansion here is the lack of a tractor to clear the land. The rough grassland is particularly difficult for people to clear because the grass has very sharp blades.

May and June are the busiest time and planting and maintaining are more difficult tasks than harvesting.

Both the synthetic variety Obatanpa and a local variety 'Eburow tsin' are planted. Obatanpa matures in about 2.5 months and the local variety in 3 months. Obatanpa, which has a higher yield, is sold as soon as possible due to its poor storing quality. If they apply an insecticide it could be stored longer, however, they cannot afford this 'medicine'.

Maize production is similar here to elsewhere at about 10 minibags per acre. Of the ten bags produced about 4 are kept for home consumption and 6 are sold. Weeding the cassava and sugar cane clashes with the maize harvest causing a labour bottleneck.

Maize is sold during January, February and March but ideally if the farmer is not in financial difficulties, it is kept until May. Women are responsible for taking the maize to the market

Estimating cassava production is more complex as the number of baskets gathered depends on the neatness of the person stacking the cassava. The farmers reckon that they invest about 120,000 cedis and expect to make a gross of 480, 000 cedis (around 8,000 cedis per basket) which is a net profit of 360,000 cedis.

People outside the village come to buy cassava in the field. The purchaser is responsible for lifting and transporting the cassava. One reason for the popularity of this arrangement is the tradition that people lifting cassava can take the damaged roots home. Farmers believe that the damage is unnecessarily high and prefer not to have to deal with it.

More cassava is sold fresh than processed although there is some gari processing activities in the village. Maize is also mostly sold as grain (not fresh cobs). Inaccessibility to market reduced their income – a rubber bucket of maize in Sampa can be sold for 4,000 cedis and in the market the same volume would be sold for 6,500. However, since transport to the market costs money many farmers prefer to sell directly to the traders either one of the 5 big resident women traders or to those who come from elsewhere. The women determine prices.

The calculations of profit made by farmers on all of their crops are based on guesswork and estimates. Farm recording is not practised in this village but the farmers considered that the idea would be a useful management tool.

Credit is not available in the town – the farmers interviewed did not know of anyone who has credit or where exactly to access such a facility. About 8-10 people have a bank account at Durampong.

3.2.1.5 LOME

Lome is 3.5 miles from the tarred road in the area designated by the District Assembly as a 'Potential Agricultural Region'. The soils are G3 Adawso-Bawjiase/Nta-Ofin compound (Box 1), which is also the main soil type found in Assin.

The settlement is about 3 miles away from the furthest farming lands and the farmers spend most of the week in the bush on their farms, returning home at weekends. Both men and women go to the remote sites, although men stay there for longer periods of time. Women tend to carry the food and fuelwood for their husbands and stay only if the workload is heavy. The women carry their babies with them and children who can walk also make the journey. The other children who are in school go up at weekends. At times, parents request that children be allowed to work instead of attending school.

Vegetables and cassava are grown on the fields nearest to the settlement for ease of access to food supply and because vegetables are perishable and need to be shipped out as soon as possible after harvesting. They work on these crops on their days at home.

Ten farmers were interviewed at Ahemakwaa, which is currently a temporary settlement 3 miles away from the settlement along a footpath. Previous attempts at settling permanently at the site were thwarted by a shortage of water.

Lome people exclusively farm the surrounding land. The land nearest the forest reserve, and towards Dahame is considered the best land whilst the land towards Ogudan village is less rich and the land along the Abonko road the poorest. The quality of the land is judged according to texture (loamy soil preferred) from the yields and from the indigenous vegetation. In some places a hard laterite stratum occurs at 4ft from the surface. The land is family land and clan members do not have to pay for their holdings. People who are not clan members pay 10,000 cedis with some heads of family fixing a price for a piece of land and if more land is cleared then extra money must be paid.

The track to the temporary settlement, which is near some of the best agricultural land, used to be passable by vehicle until about 8 years ago when

the river, about a mile from the settlement, cut through the road. Cars were never able to traverse the route, which was used mainly by tractors.

Maize is the main crop grown but they also grow tomatoes, pepper and garden eggs as a sideline – there is nothing much else to do. Women from surrounding settlements such as Onyadze come on foot to buy maize from men and women at the temporary settlement between September and May. The time chosen by each individual to sell depends on their financial situation at the time.

The tomatoes are sold at Lome. They are harvested every four days whilst garden eggs are harvested once a week. Pepper is at its most fresh a day after harvesting but can be kept for up to 4 days. It is sold fresh and dried.

The farmers and their families harvest the maize themselves, however, at times they sell their cassava crops *in situ*. The main reason for this is similar to that mentioned by Sampa farmers i.e. labourers are invited to take the discards home, and rogue labourers ensure that an unacceptable amount of the crop becomes unmarketable so that they can claim it for themselves.

There are times when there is no one at the temporary settlement but thieving is not a problem due to the distance from the settlements and the difficulty in transporting the stolen goods. Some stealing occurs from the vegetable fields nearer the town.

The farmers and their families are the main source of labour. All the farmers in the group would hire labour if the funds were available. It costs 15,000 per pole for weeding and land clearing here.

Access to Credit is a constraint. It is impossible to obtain credit without some form of collateral. There are banks in Durampong and Nyakrom which are used by some especially those who have migrated to the cocoa growing areas.

Some of the farmers interviewed had areas of cocoa which they visited for the main cocoa harvest in August/September. One man had inherited the cocoa farm from his family who bought the land for £20 in 1967.

There are absentee farmers in this high production potential area – some from Accra and other urban areas. Some of these farmers are people from elsewhere and others are local people who have migrated to the city.

Sasakwa-Global 2000, an international organisation that works to spread improved agricultural technology in Africa has worked with three communities in the district since 1987 and in Lome since 1989. Initially a group of about 10 farmers (including 4 women farmers) were conducting extension plot trials. A group meeting was held and some farmers, with the help of the extension officer filled in application forms. They are given inputs for 1 acre (Obatanpa 9kg/acre, 1 50kg bag each of 20:20:0 fertiliser and ammonia top dressing and sumicombi fungicide for storage). Only one farmer, a woman, has persisted with the scheme since its inception.

3.2.2 ASSIN DISTRICT

Following discussions with the District Chief Executive it was decided to visit Awrobo, a town 15 miles from the tarred road. A 4x4 vehicle was provided by the DCE, without which access would have been impossible.

3.2.2.1 AWBORO

The population of Awrobo is 600-800, which together with the population of the surrounding villages is about 1000. Cocoa, oil palm, rice, maize and cassava are the main crops grown and farming is the main economic activity.

The rainfall pattern is tropical and it rains from February to November. The natural vegetation is secondary tropical rainforest and the general soil type is G2 Nsaba-Swedru/ Nta Ofin Compound (Box 1). Local variations are exploited for different crops – loamy soil for cocoa, sandy soil for oil palm, and riverine swamp land for rice. The soil is considered fertile and very little fertiliser is used.

Accessibility is a major problem here. Akonfaidi, the third largest town in the district can only be reached by walking 3 km through the forest – a problem for reaching the hospital in particular. All the traffic accessing the town do so via Eastern Region roads, with the Central Region side not well connected. The nearest market along the road is 5 miles away at Akropong Odumase, 10 miles from the tarred road.

Every man and woman is a farmer and they keep livestock on a small scale as well. Although there is a river nearby, they do not fish. Some men weave baskets of palm fronds and palm rafia and women make brooms from palm fronds. Local apatache is distilled from palm but this is an activity undertaken by men only.

Land is readily available and people settle from other areas such as Gomoa, Ewe, Acrobos etc. However the indigenous population outnumbers the settlers. The settlers are almost permanent residents, going 'home' for festivals only.

The amount of money paid for land depends on the acreage. Previously there was two systems, either where money was paid for the use of the land or abusan (1:2 share cropping). The share cropping has been suspended for the time being as there is a court case pending.

The land is owned by the Akoti stool and the Chief is the custodian. Individual families do not own land. The women farmers are given land by their husbands and are involved in all aspects of farming including cocoa. However, not all men and women own cocoa plants.

There are some crop processing activities – gari, palm oil, palm kernel oil. They do not have a machine for gari production in the settlement only a grater.

The Ghana Cocoa Industry has been important for a long time, earning a substantial amount of foreign exchange. However, in the late 1970s and early 1980s production fell and Ghana is no longer the world leader in cocoa production. The Ghana Cocoa Board (COCOBOD) has been revamped in line with the government's liberalisation policy and has resumed a new role

monitoring and regulating the Cocoa Industry in Ghana⁷. The farmers of Awrobe reported a decline in the involvement of the Cocoa Board. In the past they supplied pesticides such as DDT and information on production. Now their access to inputs and information is very limited. It is difficult for them to get inorganic chemicals and the information regarding their use.

The settlement here, as elsewhere is central to the fields but land holdings here are larger than in the settlements visited in Gomoa with many farmers owning between 10-15 poles. They have a wide range of crops – maize, rice, cassava, cocoa, oil palm, pineapple, plantain, yam, groundnut and vegetables (tomatoes, garden eggs, pepper). The tree crops are the main cash crops with maize grown for subsistence and the surplus sold. All the people are involved in commercial and subsistence farming.

There is some group farming activities here with farmers coming together to clear the land for maize and rice production. They also have group sowings and share the harvest according to the proportion of input they contributed.

They practice shifting cultivation and mixed cropping. They rotate their crops and after 2-3 years leave the land fallow for 2-3 years to allow the land to rest and regenerate. Those farming stool land can return to the same land every season but if the land is rented the tenant farmer cannot return.

Both traditional and improved varieties of most crops are grown here. The improved varieties yield better than the traditional but there are no records to show the differential yields. There is consensus here as elsewhere that the storage quality of the traditional variety is better than the improved variety. Pests include weevils, mice, cockroaches, squirrels and monkeys.

The settlement has a cocoa shed and the cocoa beans are taken there after sun-drying. Buyers come to the village regularly and they also buy cassava, maize, rice and plantain. The road condition during the rainy season is a major problem – it is impassable at times and truck owners do not want to subject their vehicles to such inhospitable conditions.

There are records of cocoa harvests here, but not of any other crop. The farmers have no means of comparing performance between years and have to rely on memory and a 'feel good' factor to distinguish between one year and another. They cited lack of management information as a constraint and would welcome assistance with farm recording, and other educational tools that could improve their performance.

3.2.3 Conclusion

It is clear that maize yields generally are very low and therefore there is potential for improvement. However unless post harvest losses, and access to markets is improved very little will be gained by improving or expanding production.

Of the settlements visited in Gomoa, Lome and Gomoa Sampa are the most interesting agronomically and most likely to benefit from improved access to market. Some of the farmlands of the former are remote. The land has been classified as a high potential area but constraints such as shortage of labour and general management issues (for example, keeping track of income and expenditure) make improvements difficult. The relationship between the

Agricultural Extension Service and both these communities is good and offer opportunities for participatory discussions on improvements with both farmers and the Agricultural Officers.

A study of Awrobe will provide a contrast. The settlement is much further off road than any settlement in Gomoa but the agricultural potential is also much greater. Rainfall is not as limiting here as it is in Gomoa and it has a diversity of tree crops and other crops that have a commercial value.

The main commercial interest is cocoa. There is a debate in Europe at the moment and huge divisions between European Chocolate manufactures about the moral, ethical and environmental implications of substituting cocoa for vegetable fat⁶. The pro-group led by U.K chocolate manufacturers and supported by their counterparts in Ireland, Denmark and Portugal have continued to advocate for the use of vegetable fat. The anti-group made up of manufacturers from the Benelux region consistently argues that the use of vegetable fat is unhealthy, deceitful to the consumer and in the case of Ghana, could deprive farmers of an income. Should the European cocoa market collapse then the off-road situation of settlements such as Awrobe could be even more isolated and a study of their production and marketing methods is very timely.

3.3 Summary and Recommendations

3.3.1. Activities:

Production cycles are dependent on rainfall. In Gomoa a bimodal pattern of rainfall exists with the main rainy season starting at any time from March until August. The soils are coarse to medium ferric and orthic Acrisols and the reddish colour is due to the iron content, which may cause problems regarding P availability. Although these soils can be sticky and plastic when moist they are porous when dry without any difficulties with permeability and aeration⁹.

The maize crop is harvested about a month after ripening. It is allowed to stand a) to dry and b) to save on storage space. The dried cobs are stored and threshed according to demand. If storage areas such as concrete rooms are available then the maize is more likely to be threshed, treated with fungicide and stored in sacks. Perishable produce such as tomatoes are harvested in sequence and largely depends on the availability of transport to market – either a lorry coming to the village or a person (usually a woman) head loading the produce to the market. Access to market is particularly limiting for perishable produce. The vegetables are usually harvested at dusk or dawn to minimise damage from overheating. Gomoa Sampa was an example of a settlement that had potential for vegetable production, which could not be fully exploited due to its problems with access. The settlement has access to a perennial river, whose banks are exploited for out of season production. However, during out of season periods transport is a problem and they are unable to capitalise fully on this potential.

The chain of production was similar in each settlement in Gomoa - land preparation for maize starting in January/February with sowing delayed until after the first rain. This coincides with harvesting of the minor season crop and

some harvesting of cassava, and vegetables. When asked, farmers claimed to focus on their maize crops.

Weeding is a major demand on labour and has to be done two or three times. The maize crop is harvested three and a half months after sowing, depending on the variety used. It is allowed to dry in the field and in many places in-field storage barns have been built. This allows the crop to be threshed in situ with the less bulky grain being head loaded back to the settlement for eventual sale or consumption.

June and July are considered to be a bottleneck for labour as the demands of weeding are labour intensive.

3.3.2 Location of fields/farms

Most of the settlements are positioned in the centre of the farmlands with some farmers having to walk considerable distances to their fields. In Lome in particular farmers had to stay overnight as the distance was too great to commute. Almost all the fields visited were inaccessible by road and were at the end of a footpath. Even if the road to the settlements are improved the access to the fields remains restricted. This lack of access can be a constraint if there was access to mechanised land clearance – most tractors in Gomoa are to be found in the area near the main road, where larger tracts of land can be cultivated. The locations of different crops vary from settlement to settlement. In some, the farmers cultivate only one area, in others, such as Sampa they grew crops, which were mostly suited to the soil conditions. For example, they grow sugarcane and vegetables on the aluvial plain of the river, cocoa in the forest areas.

It was not clear how it was decided who uses which areas of land and this may be an area for further study. Only the people of Lome identified some areas as being less productive than others, but they were the ones who had access to the most productive land in the district. Other settlements did not make distinctions.

Group farming is not common although some farmers come together for some activities such as land clearance. Neither are there families, clans or areas of land that specialise in one crop or another.

The land tenure arrangement is based on the stool or family land system with members of clans or families having access to the land and strangers having to pay. The complexity of land tenure is such that it is recommended that a separate study be commissioned. The position of women for example is not clear. In some areas they farm in their own right and in others they are allocated part of their husband's land. In cocoa growing areas and where tree crops are long term investments there is scope for investigating the land tenure arrangements on production and more especially on the influence of land tenure on women^{10,11}.

It is fairly clear that security of tenure is a constraint on 'outsiders' who wish to expand their holding. They normally have to return the land at the end of the season. Family members believe mostly that there is 'enough land' and after cultivating for two or three years leave the land fallow and move on to other areas. Very few people invest in the land and they are constrained by lack of labour and money from increasing the area under cultivation. They also face

problems of defending their plots from birds and other pests as well as, if they produce more, marketing and storing. Thieving as such does not seem to be a problem in most places, although crops such as pineapple growing in the bush seemed to be targeted by passers by.

3.3.3 Labour

Agricultural production is not mechanised and the farmer, his/her family and those he/she employs to help must undertake all the farming activities. All farmers interviewed cited labour shortage as a major constraint, especially during land clearance, weeding and harvest, especially if two harvests coincide.

There are two issues regarding labour:

- i) availability and
- ii) ability to pay.

In the settlements visited they did not have access to labour gangs or groups of people who focus on specific tasks – e.g. skilled yam mound makers who travel around in some areas. In the most remote settlement visited additional labour is limited although there are some people who aren't farmers themselves who come looking for work. Most of the people employed had farms of their own either in the settlement or elsewhere and were seeking additional employment to supplement their own farming activities. Land clearance, which is heavy physical work, is an exclusively male task, but men and women and children plant, maintain and harvest the crops.

3.3.4 Equipment

There is relatively little access to mechanisation in Gomoa even in on-road communities. In the off-road community of Assin visited there was no mechanisation either. Farmers' fields are usually accessed via footpaths even in more accessible settlements. Apart from access, size of cultivated plot and the cost (40,000 cedis per acre in 1998 in Gomoa) are constraints.

Hoes, cutlasses, axes and sharpened stones are the main pieces of equipment used. Most farmers will own at least one of these and they are also available for hire.

If the area under cultivation is to be expanded some form of mechanisation would be necessary. There is no tradition of animal traction in coastal Ghana (although the World Bank funded VORADEP made efforts to introduce it in the Volta Region in the 1980s). Farmers are not familiar with husbandry methods or handling of oxen or donkeys for manual work making introduction of animal traction difficult.

3.3.5 Production

Yields per unit area are low and consistent with that expected in a low input subsistence farming system. This field visit did not coincide with the maize harvest. However farmers generally agreed that they produce between 8-10 mini bags of maize per pole in Gomoa. Each mini bag contains 10 rubber buckets. There is some discrepancy regarding the volume of the rubber bucket. In Adabra one rubber bucket of maize weighed 9kg. According to the agricultural extension workers it should weigh 7kg and according to Dr Tetteh

at the Department of Agriculture, University of Cape Coast it should be a standard 5 kg.

Yield therefore varies between 0.5 – 0.9 t per pole or 1.6 – 2.9 t/ha. Official figures for maize yield produced by the regional PPMD office show the mean figures for maize production to fall consistently between 1 and 1.3 tonnes per hectare for both Assin and Gomoa districts. Official FAO figures¹² has a mean yield of 1.6 t/ha for Ghana as a whole. The global average for maize production is 3.6 t/ha with normal yields for well-cared-for maize, grown without irrigation in a warm country are 5-8 t/ha.

One man reported a 'bumper' crop of 20 bags/pole in the first season after land clearance, which would be an equivalent of 3-5.4 t/ha. As they keep no records, it is difficult to substantiate these figures. Assin farmers also mentioned 'bumper' crops but could not quote figures.

The Gomoa District Assembly target for the years 1996-2000 is 5t/ha¹³. Where a plentiful supply of water is available and the top priority is the production of basic foods, maize is very successfully grown with irrigation. If fertilisers and plant hygiene measures are taken then a harvest of more than 20 t/ha are possible.¹⁴

3.3.6 Seeds

Obatanpa a synthetic variety produced by CIMMYT. In a recent report¹⁵ An independent, international panel of experts appointed by the Canadian International Development Agency (CIDA) recently praised the efforts of Ghanaian maize researchers, in collaboration with CIMMYT, to develop and disseminate improved varieties and technologies for the country's farmers. According to the panel's draft report on the Ghana Grains Development Project (GGDP), "The maize improvement program has been very successful, with the release of nine open-pollinated varieties since 1984.... Surveys by the socio-economic group in 1991 indicated that the adoption of improved varieties by farmers was high, ranging from 60 to 85% in different areas of the country, and is possibly the single most important project output.". Knowledge of Obatanpa was disseminated with assistance from Sasakawa-Global 2000, an international organisation that works to spread improved agricultural technology in Africa. On this field visit only one village (Lome) had a Global 2000 presence, and the interest had dwindled to one woman, who remained a member.

Although Obatanpa is higher yielding than the local variety it does not store as well. Farmers therefore either invest in an insecticide such as Actellic or grow Obatanpa for immediate sale and a local variety for storage. The local varieties have a tighter sheath making it less easy for pests to enter.

The surplus produced depends on the season. As farm recording is not common farmers rely on memory for this information. In general, farmers keep 2/3 and sell the rest. In Assin, the tree crops were the main income generating crops. There is no evidence from the settlements visited that any crop attracts a premium (*c.f.* appellation controlle in Europe)

3.3.7 The Use of Inorganic Chemicals

Discussions with farmers about inputs such as pesticides, herbicides and inorganic fertilisers highlighted several issues:

- Farmers are aware of the possibilities of increased yield if inputs such as fertiliser and pesticides applied.
- Farmers are constrained in their use of these inputs by lack of access to credit.
- Farmers are limited by the lack of information surrounding the 'medicine' and the availability of the right product for their particular problem.
- Farmers are often tempted to apply any medicine in the hope that anything is better than nothing.

The impact of inorganic chemicals reaches further than the immediate farm environment. Pesticides can kill non-target species and impact on local flora and fauna, groundwater quality, soil biological processes and natural predators. There are also health impacts on farm workers, processors, consumers and communities living in areas where chemicals such as pesticides are used in agriculture. Pesticides are responsible for some 20,000 deaths and 3 million cases of acute poisoning annually - a burden borne, in particular, by agricultural workers and rural communities world-wide (Dinham 1993)¹⁶.

There is very limited awareness of dangers surrounding the use of toxic chemicals. The store staff, which sell the products, do not handle them with sufficient care and attention to safety. Although protective clothing – gloves, face mask and goggles were available they were obviously unused and the vendor handled the material unprotected. Furthermore, the same receptacle is used for dispensing small volumes required by the farmer and the water used to clean the measuring cylinders disposed into the local drain. It is unlikely that the measuring cylinders are cleaned between each chemical.

Farmers cannot afford to purchase whole bottles of any chemical and will bring un-marked bottles to the store. They do not have adequate storage facilities on the farm for their chemicals and they are often left lying around within reach of small children. When the farmer needs to identify the contents of the bottle he/she does so by inhalation of the fumes.

Farmers do not have access to spraying equipment and know very little about the recommended dilution rates. They have to rely on memory either from the store or from the agricultural extension service staff who have advised them. Consequently the application is haphazard.

3.3.7.1 Information on the chemicals available

It can be seen from Table 1 that the amount of chemical purchased at a time is relatively small and as such minimises the risk of widespread contamination even if the individual risk is small. However, inaccurately small dosages could conceivably allow pests, diseases and weeds to develop a resistance to the chemical.

Table 1**Chemicals for sale in a Fertiliser store in Gomoa district:**

		Price
Actellic Super	Actellic (pirimiphosmethyl) Can be used as either a protectant for seed corn against insect pests or top dress treatment, not both. It is effective on all stored grain insect pests.	20ml/1000 cedis
Diazion	Organophosphorus pesticide (OP ^h)	20ml/1000 cedis
Griffin	Copper based fungicide	
Karate	Karate Insecticide (RS)-alpha-Cyano-3-phenoxybenzyl (1RS)-cis-3-(Z)-2-chloro-3,3,3-	20ml/1000 cedis
Klerat pellets	Contains the active anticoagulant brodifacoum.	
Roundup	Glyphosate herbicide produced by Monsanto	500g/5,000 cedis
Sumicombi	Broad spectrum insecticide (OP) Seed dressing	20ml/1000 cedis
NPK 15:15:0	Inorganic fertiliser from South Africa	
Urea	From C'ote d'Ivoire	

There is increasing evidence that some if not all of these chemicals are very toxic, even when used in accordance with the manufacturer's recommendation:

3.3.7.1.1. Karate

In 1995 the American EPA received a voluntary request from the manufacturers of this product to remove it from the pesticide register¹⁷. Unless the provisions of an earlier order apply, existing stocks already in the hands of dealers or users could be distributed, sold or used legally until they are exhausted thereafter this product is no longer legal in the USA

3.3.7.1.2 Klerat

There is evidence that Klerat is acutely toxic. Sax & Lewis (1989)¹⁸ for example document poison by ingestion and skin contact. Hallenbeck & Cunningham's list (1986)¹⁹ describe the effects of acute exposure which include anaemia, abdominal pain, back pain, capillary wall destruction, dermal

^h OP or Organo-Phosphates: Organic compounds containing a Phosphorus Oxygen double bond

problems, hematologic disorders, haemorrhage of mucous membranes, lips, gums and nose, pallor, prothrombic depression, renal colic, weakness and paralysis due to cerebral haemorrhage. Chronic exposure effects are the same as for short-term effects. Symptoms may not appear for a few days or weeks. Repeated exposure is usually required for damage to occur. Numerous small exposures may be more damaging than one large exposure (Hallenbeck & Cunnigham 1986)²⁰.

There is some evidence that Klerat affects wildlife populations:

PESKEM (1995)²¹ describes it as "effective at such low rates that the risk of secondary poisoning to other animals is minimal. Relatively non-toxic to bird species. This product can be toxic to wildlife and can pose a secondary hazard to birds of prey and mammals. Extensive research with predatory animals, such as barn owls, has shown that such predators are not normally at risk when a product called Havoc, containing the same active ingredient is used according to label directions.

Roberts (1997)²² reports that rat poison used on sugarcane farms is the probable cause of recent dramatic declines in populations of rare and endangered owls and other wildlife in Australia. According to work by John Young and Leonie De Lap in the Herbert River region of North Queensland there has been a sharp decline in the numbers of several species of owls and hawks since 1992. The population of the endangered masked owl has fallen from 50 pairs in 1985 to 10 pairs in 1995, while eight pairs of the similarly endangered rufus owl have disappeared. Declines of between 75 and 85 per cent were recorded in populations of the spotted harrier, the barn owl and the rare grass owl, and numbers of barking owls have halved. It is believed that the declines coincided with the introduction of the rodenticide Klerat.

3.3.7.1.3 Roundup

Roundup is a post-emergence, broad-spectrum, non-selective herbicide used extensively world-wide. It is commonly used in agriculture, forestry, and nurseries for the control or destruction of most herbaceous plants including grasses, broad leaf and woody plants. Glyphosate, the active ingredient is absorbed mainly through the leaves and is transported around the whole plant. It acts by inhibiting the shikimic acid pathway as an inhibitor of 5-enolpyruvylshikimate-3-phosphate synthase. (Active Ingredient Fact Sheet, 1996²³, Lamb et al 1998²⁴, US-EPA 1993²⁵).

Glyphosate is one of the most toxic herbicides and although its direct toxicity to mammals and birds is low, its effect on flora can have a damaging effect through habitat destruction (US-EPA 1993)²⁶. However products containing glyphosate also contain surfacantsⁱⁱⁱ (polyoxyethyleneamines POEA and isopropylamine) which are much more toxic than the glyphosate. They are serious irritants of the respiratory tract, eyes and skin, can cause nausea and

ⁱⁱⁱ An abbreviation for Surface Active Agent. Any compound that reduces surface tension when dissolved in water or water solutions, or which reduces interfacial tension between two liquids or between a liquid and a solid. There are three categories of surface active agents: detergents, wetting agents and emulsifiers. All use the same basic chemical mechanism and differ chiefly in the nature of the surfaces involved. Hawley's Condensed Chemical Dictionary 11th Edition N. Irving Sax and Richard Lewis Sr.

diarrhoea and are contaminated by dioxane which is a suspected carcinogen (Carlisle and Trevors 1988)²⁷. Between 1984 and 1990 in California, glyphosate was the third most frequently reported cause of illness related to agricultural pesticide use. Although the volume used in Ghana is not so large, in view of the small amount needed (many species of wild plants can be damaged or killed by applications of less than 10 micrograms per plant). Lack of care during handling and storage exhibited by users should be a cause for concern.

3.3.7.2 Are there solutions to the problems associated with inorganic chemicals?

American Vice-President Al Gore²⁸, in an introduction to Rachel Carson's definitive book *Silent Spring* quotes from one of her few speeches, and one of her last, to the Garden Club of America. In it she acknowledged that things could get worse before they got better: "These are large problems, and there is no easy solution." Yet she also warned that the longer we wait, the more risks we run: "We are subjecting whole populations to exposure to chemicals which animal experiments have proved to be extremely poisonous and in many cases cumulative in their effect. These exposures now begin at or before birth and - unless we change our methods - will continue through the lifetime of those now living. No one knows what the results will be, because we have no previous experience to guide us." Since she made these remarks rates of cancer and other diseases that may be related to pesticide use have soared and although some important things have been done there is a need for more.

In the same introduction Al Gore elaborates on the American experience: "The Environmental Protection Agency was established in 1970, in large part because of the concerns and the consciousness that Rachel Carson had raised. Pesticide regulation and the Food Safety Inspection Service were moved to the new agency from the Agriculture Department, which naturally tended to see the advantages and not the dangers of using chemicals on crops. Since 1962, Congress has called for the establishment of review, registration, and information standards for pesticides - not once, but several times. But many of these standards have been ignored, postponed, and eroded. For example, *when the Clinton-Gore administration took office, standards for protecting farm workers from pesticides were still not in place, even though the EPA had been "working on them" since the early 1970s* [my italics]. Broad-spectrum pesticides such as DDT have been replaced by narrow-spectrum pesticides of even higher toxicity, which have not been adequately tested and present equal or even greater risks" The slowness of progress described here, in a country such as America is particularly alarming in the context of developing countries.

However, finding a solution is not an easy task. Dinham (1993)²⁹ argues that it is not yet clear whether tighter information disclosure requirements and trade controls on the export of banned or severely restricted pesticides can effectively reduce the hazards posed by powerful agro-chemicals in the South. Instead, research effort and financial resources ought to be switched from 'risk reduction' and 'safe use' procedures, towards developing more environmentally-friendly techniques of sustainable agricultural production.

This is essential if the health and environment of producers and consumers alike are to be protected.

One option might be the organic option. The Ghana Organic Agriculture Network (GOAN) has 70 member groups and organisations and interest is growing. GOAN has become a forum where farmers and groups can share their ideas and experiences and a number of workshops have been organised by international organisations such as IFOAM (International Federation of Organic Agriculture Movements). Such workshops are crucial to ensure that sustainable farming methods in Ghana are promoted and adopted (HDRA 1998³⁰).

3.3.8 Harvesting

At the time of this field work crops were not being harvested and therefore it was not possible to assess the quality.

Harvesting is a labour intensive activity and for maize at least, the crop is left to stand for about 1 month to dry in the field. Cassava is also stored in the ground. The crop is then harvested and can be stored unthreshed in field-site stores. The crop is often threshed in the field as the grain is less bulky to head-load to the settlement for immediate sale, domestic use or further storage and marketing at a later date.

3.3.9 Storage

Storage in Africa can be affected by various factors often combining to increase the detrimental effects. Insects for example can thrive in conditions of high humidity, causing grain loss, especially on the more susceptible HYVs. Some factors for consideration are: temperature, moisture, grain respiration, condensation, relative humidity, oxygen content of the store and the presence of micro-organisms, insects, rodents, birds and reduced availability of traditional building materials.

The information on on-farm storage in Africa is limited compared to that available on production and marketing³¹. The average cereal grain loss was estimated to be 5% or less³². In southern Africa it has been found that the recent liberalisation of grain markets has meant that farmers have to store more of the harvest than in the past and losses have increased.^{33,34}

In Ghana Maize is stored in a traditional barn or crib. The supporting posts are made of bamboo and the ventilated sides made from corn stalks. The roof is usually thatched but can be made of corrugated metal sheets. The floor is elevated at least 80cm from the ground. Picard and Proctor (1994)³⁵ comment on the design to optimise drying and storage of maize.

Traditional varieties store better than the HYV Obatanpa. If Obatanpa is to be stored then it must be treated with pirimiphosmethyl. Of course "Post-harvest treatment of any commodity is only undertaken where it will result in a reward to the owner"³⁶. Possible options include breeding improved storage qualities into HYVs, or further research into the biological control of the accidentally introduced Larger Grain Borer.^{37,38,39}

3.3.10 Processing

Food processing is very limited in most settlements. There may be one or two gari grinding machines, a few stills but mostly the product is sold unprocessed. This may be due to lack of capital to invest – often the equipment belonged to a person (usually a man) who had come to live in the settlement from elsewhere, such as an Ewe man in Gomoa Adabra.

There is scope for expansion in processing which could benefit women if they were given help with credit to establish themselves. It could contribute towards employment in settlements and add value to the product, which would also help the local economy.

3.3.11 Transport

The crop is invariably head loaded from the field to the settlement and then transported by vehicle to market. Some head-load produce to market as well when transport is not available.

In Assin and some parts of Gomoa (e.g. Gomoa Sampa), the cocoa production is linked to the Ghana Cocoa Board. Following liberalisation, the role of the board has changed and some of the roads, which were part of the cocoa lines, e.g. north of Sampa, have deteriorated.

3.3.12 Marketing

Marketing is a key factor in agricultural production. Unless there is an outlet for surplus production there is very little to be gained from increasing production above subsistence levels.

Women dominate marketing in Ghana: it is women who take the produce to market and groups of powerful women traders determine prices. In Gomoa Sampa for example 5 women were perceived as having control over the marketing.

Off-road communities are particularly disadvantaged when marketing their commodities, as vehicle owners are reluctant to leave tarred roads. Traders who visit remote communities can dictate prices as farmers have no access to their own transport and even if they did, the cost is prohibitive. The difference in price between that obtained from a trader and that obtained by direct selling in a market can be large, but the effort required to organise direct sale is too great.

In Assin the problems are acute – the district has soil and climate to support agricultural production but the infrastructure to support it is minimal. Awrobo is an excellent example of an isolated settlement that could benefit from improved access. Their market is moving further away – it is now based at Akropong Odumase 5 miles away. Their other market is along a forest track, and goods can only be head-loaded there. With the decline in the influence of the Cocoa Board, the problems could be exacerbated.

All settlements would benefit from some form of small processing industry that adds value to the product *in situ*. The processed product is often easier to transport (e.g. gari compared to fresh cassava).

3.3.13 Management

Farmers universally welcome the idea of improved management. They are the ones who know the land best and are currently following patterns set out by their traditions and their own experiences. However they are aware that there are technologies and inputs to which they have no access. They are also aware that they need to increase their production a) to keep pace with their own family requirement b) for income and c) to reduce the country's food deficit.

The contact that settlements have with the extension services varies. Some farmers have developed a close relationship and can call upon their extension agent regularly for advice. Others do not know who he/she is and find the journey to Apam or Foso too far.

The Agriculture Extension Service itself is facing a crisis following restructuring in 1997 (Figure 1). Under the previous structure, the Regional Director of Agriculture was a figure-head, with his Regional Officers controlling their own budgets and managing the districts.

Now, the Regional officers have no budget of their own, effectively, the 8 departments and the Regional Director's office now come out of the same budget with the ROs in an advisory capacity.

This change in status has led to the previous Regional Officers being moved to the Districts where their powers are much greater than those of the previous District Officers. At Regional Development Officer level, there is a lot of frustration at the reduced fiscal power.

Although the new structure looks impressive on paper, the reality is that it will take some time to implement properly. For example, the SMSCs should be running regular training courses for the extension agents, but so far very few are functioning.

There is awareness in the extension service that farmer participation and on farm trials are important and some OFTs are conducted. However, there is some doubt⁴⁰ whether the importance of accurate data collection is well understood by farmer and the extension officers alike and the accuracy of the information is difficult to ascertain.

In Ghana, as elsewhere the least qualified people are the people who regularly visit the farmers and who disseminate advice and information to those farmers. There is scope for more participatory work with farmers – farmers are demanding more information on fertilisers, seeds, pesticides, herbicides etc but in order to develop in a sustainable way there must be more communication in both directions. What is preventing farmers adopting the current recommendations? For example the FLS have been recommending that farmers have 30cm x20cm intra-inter row planting density for maize but many farmers still plant in the traditional way. The theory is that the recommended density allows for optimum plant stand per hectare, leading to an improved yield compared with traditional planting. However, this may not fit in well with the inter-cropping practices or some other reason.

Figure 1

The agricultural extension service past and present in Central Region^{iv}

Past	Present
<p>a) Regional Director of Agriculture (Figure Head)</p> <p style="text-align: center;"> </p> <p>b) 8 Regional Officers^v, autonomous from Accra, each with office and vehicle</p> <p style="text-align: center;"> </p> <p>c) 12 District Officers (some with vehicles). Each with 1 deputy and 15 Front Line Staff (FLS)</p>	<p>a) Regional Director of Agriculture (answerable to Accra)</p> <p style="text-align: center;"> </p> <p>b) 8 Regional Development Officers who now have no control over budget</p> <p style="text-align: center;"> </p> <p>c) 12 District Directors of Agriculture each have 32 Agricultural Extension Agents</p> <p>d) Each of the 12 Districts should have a Subject Matter Specialist Centre (SMSC). Each should have a full complement of specialists from the 8 former departments</p>

3.3.14 Credit and input supply

Access to credit and problems associated with cash flow are a major constraint on farmers, especially in a season following a bad season where most of the crop may have had to be kept for domestic consumption rather than sold. Converting surplus into cash in an off-road community is a problem.

In Assin, due to the production of export crops such as cocoa, the mechanism for accessing credit was in place. More people in Assin have bank accounts and although collateral is required they, despite their off-road status have some access to credit from the banks. In some of the settlements visited in Gomoa, access to banking and official credit sources were non-existent. Some loan-sharks were in operation. The interest on seed maize can be exorbitant in some places, where the farmer is forced to buy seed on credit in return for a portion of the harvest. In a bad year it can be difficult to meet the payment and the farmer is locked in a credit trap.

In other places, people did not borrow from others but would like to borrow from a bank. However, the banks are viewed with extreme suspicion. Credit is

^{iv} Dr JP Tetteh, Personal communication

^v Agricultural mechanisation, Animal Production, Crop Production, Fisheries, Plant Protection, Policy Planning Monitoring and Evaluation, Veterinary Medicine, Women in Agricultural Development (WIAD)

given reluctantly and only if the collateral is sufficient. Access to credit to the poorest section of the population and especially to women is limited.

High inflation is a disincentive to banking unless interest rates outstrip inflation. Farmers fear that their money will depreciate whilst their costs increase and prefer to store their crop as a security.

Small co-operative credit schemes would be useful, but there seems to be some resistance to co-operatives (women for example do not form co-operatives) as people want to retain their independence. An integrated approach to credit/banking, management and marketing could be an option.

4. Recommendations

- Gomoa Sampa, Gomoa Lome and Assin Awboro should be the focus for further detailed study.

Possible topics for future consideration could include:

- Participatory research with farmers and extension services on the constraints to production focusing on management issues such as farm recording, organic farming and 'adding value'.
- Land tenure arrangements can be a disincentive to investment – a detailed study would be useful.
- A soils survey including analysis of nutrient status

BIBLIOGRAPHY

- ¹ Oduroafriye K. (1996) Rainfall erosivity map for Ghana; *Geoderma* 74 (1- 2) 161-166
- ² Rehm S and Epsig G (1991) *The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilisation*. CTA [Transl. by George Mc Namara; Christine Ernstsing] – Weikersheim: Margraf, 1991
- ³ *ibid.*
- ⁴ FAO/UNESCO Soils Map of the World Edition 1/1973 Published by UNESCO Paris 1973
- ⁵ From a map Compiled by JK Sonaya, Research Officer, Soils Research Institute. From Ochi-Nokwa Basin, Cape Coast Region and part of Ankobra Basin maps available in the Institute. Drawn by the staff of the Cartography section of the soils Research Institute, CSRI
- ⁶ JP Tetteh, Department of Agriculture, University of Cape Coast. Pers.comm.
- ⁷ Ghana Cocoa Board <http://www.tcol.co.uk/orgs/ghcoco/ghacobrd.htm>
- ⁸ "The EC Chocolate Directive and its effects on Ghana's economy". A workshop held in Milton Keynes on 27 March 1998, sponsored by Milton Keynes World Development Centre and the Christian Aid Chiltern Area office (Buckinghamshire).
- ⁹ Fertilizer Guide for the Tropics and Subtropics, Jan G De Geus. Published by Centre D'Etude de l'Azote, Bleicherweg 33, CH-8002 Zurich. First ed 1967, Second ed. 1973.
- ¹⁰ Quisumbing AR, Payongayong E, Aidoo JB, Otuska K (1998) *Women's Land Rights in the Transition to Individualised Ownership: Implications for Tree Resource management in Western Ghana* International Food Policy Research Institute, June 1998 (Mimeo)
- ¹¹ Fortmann Louise, Camille Antinori, and Nontokozo Nabane. 1997. *Fruits of their labors: Gender, property rights, and tree planting in two Zimbabwe villages*. *Rural Sociology* 62 (3): 295-314.
- ¹² FAOSTAT Database
- ¹³ THE GOMOA DISTRICT ASSEMBLY DEVELOPMENT PLAN 1996-2000, developed by CEDECOM District Development Plan Preparation team, Cape Coast.
- ¹⁴ op cit Ref. 2 (Rehm and Epsig)
- ¹⁵ Research Briefs Vol 3 No 2 Jun 1995 CIMMYT
- ¹⁶ Dinham B. (1993) *The pesticide hazard: A Global Health and Environmental Audit*. Compiled by Barbara Dinham January 1993, 240pp. Pesticide Trust Publication
- ¹⁷ Federal Register: November 8, 1995 (Volume 60, Number 216)) [Notices] [Page 56333-56335].

-
- ¹⁸ Sax, N.I. & Lewis, R.J. (1989) *Dangerous Properties of Industrial Materials*. 7th edition. Van Nostrand Reinhold, Melbourne
- ¹⁹ Hallenbeck, W.H. & Cunnigham, K.M. (1986) *Pesticides and Human Health*. Springer-Verlag.
- ²⁰ *ibid.*
- ²¹ PESKEM. (1995) *The Australian Directory of Registered Pesticides and their Uses*. Compiled by K. Hamilton, Centre for Pesticide Application and Safety, University of Queensland.
- ²² Roberts, G (1997) Sydney Morning Herald Thursday, December 11, 1997
- ²³ Active Ingredient Fact Sheet: Glyphosate. *Pesticide News* 33 pp28-29, September 1996.
- ²⁴ Lamb DC, Kelly DE, Hanley SZ, Mehmood Z, Kelly SL (1998) Glyphosate is an inhibitor of plant cytochrome P450: Functional expression of *Thlaspi arvensae* cytochrome P45071B1/Reductase fusion protein in *Escherichia coli* BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS, 1998, Vol.244, No.1, pp.110-114
- ²⁵ US-EPA RED Facts: Glyphosate, September 1993
- ²⁶ *ibid.*
- ²⁷ Carlisle S.M. & Trevors, J.T. (1988) Glyphosate in the environment. *Water Soil and Air Pollution*. 39: 409-420
- ²⁸ <http://www.whitehouse.gov/WH/EOP/OVP/24hours/carson.html>
- ²⁹ *Op cit.* Ref 1
- ³⁰ HDRA (1998) GOAN grows up pp 20-21 of Growing Organically - Henry Doubleday Research Association Magazine Issue152 Summer 1998
- ³¹ Griffiths MP (1997) A review of on-farm grain storage, techniques and problems, in African developing countries. MSc Thesis, UW Bangor.
- ³² Tyler PS, Boxall RA (1984) post-harvest loss and reduction programmes: a decade of activities; - what consequences?
- ³³ Tyler PS (1994) Grain market liberalisation; implications and options for on-farm storage by small-scale producers in Zambia. Natural Resources Institute Report R2143, x +33pp
- ³⁴ Tyler PS, Bennet (1993) Grain market liberalisation in southern Africa: opportunities for support to the small-scale sector. Natural Resources Institute Report R1971, vi +150pp
- ³⁵ Picard J, Proctor DL (1994) Storage at Farm/Village Level and in Warehouses. In Grain storage techniques. Evolution and trends in developing countries. FAO Agricultural Services Bullitin 109. Pp135-164 (Proctor, DL ed.) Rome: FAO
- ³⁶ FAO (1985) Prevention of post-harvest food losses a training manual. FAO Training Series No 10. Rome FAO

³⁷ Richter J, Biliwa A, Helbig J, Henning-Helbig S (1997) Impact of *Teretriosoma nigrescens* Lewis (Coleoptera: Histeridae) on *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) and Losses in Traditional Maize Stores in Southern Togo. *Journal of Stored Products Research* 33, 137-142

³⁸ Gwinner J, Harnisch R and Muck O (1996) *Manual on the Prevention of Post-harvest Grain Losses*. Eschborn, Germany: GTZ

³⁹ Compton JAF, Tyler PS, Hindmarch PS, Golob, P, Boxall RA and Haines C (1993) Reducing losses in small farm grain storage in the tropics. *Tropical Science* 33, 283-318

⁴⁰ op. cit. (Ref 2)

ANNEX 1
ITINIERARY

Date	Activity
May	
14	Depart UK – Arrive Accra Initial briefing at North Ridge Hotel
15	Travel to Gomoa Meeting with Mr Sakey, District Crops Officer Meeting at Gomoa Obiri with Nana Kua Ehuron and village elders
16	Aboro: General introductory meeting with chiefs and elders Farmers' meeting Visit to fields Obiri Farmers' meeting Visit to fields
17	Adabra General introductory meeting with chiefs and elders Farmers' meeting Visit to fields Sampa General introductory meeting with chiefs and elders Farmers' meeting Visit to fields
18	Meet Kitso Balans, District Co-ordinating Director who provided 4x4 vehicle and driver from District Assembly. Travelled with Mr Sakey, Crops Officer and Nana, Agric Extension officer to Lome and then by foot to an outpost 3 miles away. General meeting with farmers Walk through fields Visit to a Chemical store at Dawrampong
19	Travel to Cape Coast Meeting with: Sam Kyeremeh, Regional EPA Officer Mr Boateng, Deputy Regional EPA Officer Ahmed Bin-Salih, Regional Co-ordinating Director SSY Opoku Regional Agricultural Officer Mr Barr, Director, Regional PPMED

20	Travel to Assin with Mr Botaeng, Deputy Regional Director EPA Meeting at District Assembly, Travel in District Assembly 4x4 vehicle and Mr Hammond the Deputy District co-ordinating director. General introductory meeting with chiefs and elders Farmers' meeting
21	Meeting at PPMED Meeting at Department of Agriculture, University of Cape Coast Travel back to Accra
22	Consultative group meeting Lunchtime meeting with Benony Kortatsi, Senior Hydrogeologist, WRI Depart Ghana
23	Arrive UK

ANNEX 2

A list of people met during Field Visit

<p>ABORO Introductory meeting</p> <p>Farmers' group</p>	<p>Nana Kodjo Ninkyi (Head of family) Openya Kwame Amouri (elder) Openya Kofi Bentum (elder) Kwamena Ogoge (Regent) Kosi Amo (family spokesman)</p> <p>Kobra Manu Kwame Amouri Sam Addo (also a mechanic) Kofi Bentum Kwesi Ewusi</p>
<p>OBIRI</p>	<p>Nana Kua Ehuron X Augustus Akator</p>
<p>ADABRA Introductory meeting</p> <p>Farmers' group</p>	<p>Nana Kojo Saakura (Chief) Kwesi Beng (Okyame) Yaw Ninsi (Okyame) + 5 other villagers</p> <p>Kwesi Beng Kwame Botchwey Kobna Odoon Kweku Ata Kwesi Kranteng Kweku Yaw Yaw Ninsin Kojo Omega</p>
<p>GOMOA SAMPA</p> <p>Farmers group</p>	<p>Samuel Ackom-Mensha (Regent) Nana Kofi Cobbah (Obatan or 'father' of town) Nana Essel Bediako (Omakrado 'organiser') Teacher Eyiah Seysie (Secretary to chief) Kobna Andan (Acting linguist)</p> <p>Samuel Ackom-Mensha Teacher Eyiah Seysie</p>
<p>LOME</p>	<p>Group of 10 farmers</p>

CAPE COAST	<p>Samuel Kyeremeh Regional EPA Officer Boateng Deputy Regional EPA Ahmed Bin Salih Regional Co-ordinating Director (Central Region) Dr JP Tetteh, Lecturer, Plant Breeding and Crop production, University of Cape Coast SSY Opoku, Regional Agricultural Officer Mr Aboateng Department of Feeder Roads KA Barr, Director,PPMED Nickola Osei PPMED Credit and Marketing Division</p>
FOSO	<p>Honourable Mr Abraham, Assin District Chief Executive Mr Hammond, Deputy District Chief Executive JB Dankwa, Presiding Member of Assembly A Osei Agyeman District Co-ordinating Director</p>
AWROBE	<p>Nana JK Tandoh, Okyame and 4 elders Farmers' group: Comfort Dede Kofi Adu Margaret Penstil Grace Jack JK Opoku</p>
ACCRA	<p>Consultative group: Dr Renatu Al Hassan Mr Nicol Ernestina Armah Mr Senaco Mr Seth Afikorah Danquah Mr Aypong</p> <p>Others: Mr Benony Kortatsi WRI Ms Linda Fox, British Council</p>

Executive Summary

- If the physiological yield potential of a crop is to be realised attention must be paid to soil erosion, management of water resources, soil nutrient status, soil organic matter content and pH, crop rotation and methods of tillage. There is a close relationship between high yielding varieties, soil nutrient status and fertiliser application (especially Nitrogen), plant population density, soil moisture, early planting (i.e. at the start of the rains) and weed control.
- The farming system in Gomoa and Assin districts is a low-input one with virtually no mechanisation of activities from land clearance to harvest. Very little fertiliser is used and farmers move on to fallow land after 2-3 years. Maize yields of subsistence farmers of both districts, as recorded by the PPMED, are very low at 1.1t/ha, below the 1.6t/ha quoted for Ghana as a whole by FAO. Some farmers may be harvesting more than this in seasons immediately following land clearance after fallow. Yield can be improved with better management – use of HYV, addition of fertiliser especially N, following the planting density recommendations and good husbandry. Improving the yield however is futile unless the crop can be stored adequately, sent to market at the optimum time and the returns justify the expenditure on inputs (cash and labour).
- Constraints on farming activities were identified as:
 - rainfall, which is basically bimodal, but erratic;
 - limited access to inputs such as HYV, fertiliser, due to shortage of money;
 - lack of historic records on income and expenditure
 - storage –due to poor storage quality of the HYV in the absence of insecticide protection, lack of adequate storage facilities or having to sell due to cash flow problems
 - poor road conditions, which lead to problems of transport to market and of wholesale buyers to the settlement.
- Land tenure is a complex issue, which needs to be studied in greater detail. It seems that the current land tenure conditions do not encourage more investment in the land. Land shortage is not perceived as an issue and as the farmer can move on when yields begin to fall, there seems little incentive to improve the soil condition. It is unclear the extent to which women are disadvantaged. They have responsibilities other than farming. They cannot clear or produce as much and although they are responsible for marketing both their and their husband's surplus it is more likely that their produce is kept back to feed the family.
- There is a need for a coherent programme of sustainable development in these districts with an emphasis on participatory research and extension work with farmers working in partnership with the District Agricultural Director and his/her team to find sustainable solutions that are workable. Any solution must combine education with improved infrastructure and access to markets and the availability of a fair credit system. Emphasis must be placed on equity for women.
- It would be useful to combine agricultural development with the development of small industries that add value to the produce before it leaves the settlements. The emphasis should be on integrated development, with markets in Ghana and elsewhere identified and targeted. Organic farming should be a viable and attractive option, which needs to be further exploited. On no account should farmers be misled into believing that expansion and an increasing reliance on chemical inputs is the only answer.

1. Introduction

As increasing population pressure sharpens the focus on the need to intensify agricultural production, governments need to devise policies which can assist sustainable and equitable development of rural areas.

Road development is a focus for government and funding bodies alike, but despite this, substantial populations in Ghana as in other sub-Saharan communities live in off-road communities. Off-road communities are often disadvantaged compared to similar communities situated in roadside locations, with the movement of commodities in and out of such communities restricted.

The DFID funded project 'Access to market opportunities in Ghana's off-road communities' aims to assess the scale and nature of community access problems for men and women in off-road areas and to identify strategies for developing more effective market integration and market opportunities. A major factor associated with access to market is the marketable produce, which in the case of rural Ghana is mainly agricultural. There is very little to be gained in increasing yields of perishable products if they cannot be transported to market in time. Strategically it is better when resources are limited to improve the access to higher potential areas.

A team of two (agronomist and social scientist) conducted an evaluation in Gomoa and Assin Districts of the Central Region of Ghana, to select 2-3 settlements for further study. The field visit took place during May 1998. The following report presents the findings of the agronomist.

2. Terms of Reference and Methodology

2.1 The Terms of Reference are listed below

- i) Provide an overview of factors affecting yield with emphasis on maize
- ii) Select settlements for further study
- iii) Summary and recommendations

2.2 Methodology

The methodology adopted included the following activities

- i) Literature review
- ii) Field Visit to Gomoa and Assin Districts conducted by the members of the team involving:
 - a) Participatory appraisals with groups of farmers in 8 villages
 - b) Semi-structured interviews with MoA staff and others at district and regional level in Apam, Cape Coast and Foso
 - c) Field observations of farming practices

3. Progress on the Terms of Reference

3.1 Factors affecting yield, with emphasis on maize

3.1.1. Control of Soil erosion

Soil erosion is a serious problem in coastal Ghana. A rainfall erosivity map of Ghana (Oduroafriye 1996)¹ divides Ghana into five major erosion risk zones and the coastal sector is in the severe to extremely severe erosion risk zone. As the population pressure increases, so will the need to clear more land for food production and fuelwood supply and without proper management the erosion problems will be exacerbated.

The soils of coastal Ghana in the Gomoa area are Ferric Acrisols of coarse to medium texture on level to undulating topography. In Assin the soils are orthic Acrisols. These broad categories have been further classified as shown in Box 1.

3.1.2. Management of water resources

Water availability and usage is a major factor in the production of food. In rainfed situations water is at a premium and distribution is as important as total amount. The mean annual rainfall can be similar from year to year but farmers have to contend with many variations such as unseasonal downpours. Ideally water conservation methods or irrigation would alleviate some of the risk. Irrigation is confined to the dam area in Eastern Gomoa. Assin district has a tropical rainfall pattern from February to November.

The agricultural extension services are promoting contour planting to reduce run-off, but many farmers find that it takes too long to mark out the rows and continue with traditional random planting.

3.1.3. Nutrient status and crop rotation

Crop rotation is dependent on the crops grown. The nutrient requirements of maize are greater than cassava. To produce one ton of corn, the plants take from the soil 24kg N, 4kg P and 23kg K². For the production of 1t of fresh roots of cassava, the whole plant will remove from the soil about 3kg N, 1 kg P and 7kg K³. Therefore, when the land is first cleared, maize is grown for a year or two and then maize cassava are inter-cropped. The maize is then harvested and the cassava allowed to grow into the next season. After cassava, the land is left fallow.

3.1.4. Methods of soil tillage

The cultivation method is basically slash and burn. It depends on the population pressure and the availability of land whether the same land is cultivated for two or three years. The land is left fallow for 2 years at least before being cultivated again.

The land is cleared with a cutlass and hoe and the vegetation burnt prior to planting. Some farmers wait until after the first rain to minimise the risk of bush fires, others burn before the rain. The ash is a source of potassium hence the recommended fertiliser NPK 15:15:0

Box 1.

The main characteristics of the soils of Gomoa and Assin Districts

SOILS^{4,5}

The soils of coastal Ghana in the Gomoa area are Ferric Acrisols of coarse to medium texture on level to undulating topography. In Assin the soils are orthic Acrisols. These broad categories have been further classified:

ASSIN DISTRICT

The main soil type found in Assin District is the G2 type:

G2 Nsaba-Swedru/ Nta Ofin Compound

- i. Deep, red, well drained, gravelly and concretionary clay loam on summits and upper slopes (Swedru Series)
- ii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on upper to middle slopes (Nsaba Series).
- iii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on lower to middle slopes (Akroso series).
- iv. Deep brown, imperfectly drained colluvial-alluvial sandy loams to sandy on lower slopes (Nta Series).
- v. Valley bottoms consist of deep, grey poorly drained transported sands and clays. (Ofin series).

This soil is also the predominant type in the 'Potential agricultural region' of Gomoa district.

GOMOA

Gomoa district has a patchwork of different soil types. The most predominant are:

LB1 Bekwai-Nzema/Oda Compound (found in Gomoa Sampa)

- i. Red well drained (Bekwai Series) and yellowish red, moderately drained (Nzema series) quartz gravelly and ironstone concretionary silty clay loams and clays found on summits, upper and middle slopes. Sometimes deep, red, well drained, gravel-free clays (Akumadan Series) may be encountered on summits.
- ii. Yellowish brown imperfectly drained, deep, non-gravelly clays and silty clay loams (Kokofu series) developed from colluvium on middle and lower slopes
- iii. Grey, poorly drained, deep, non-gravelly alluvial silty clays and silty clay loams (Oda Series) and fine sandy loams (Temang Series) found on valley bottoms.

G1 Asuansi-Kumasi/Nta-Ofin Compound

- i. Deep, red, well drained, gravelly and concretionary gritty clays on summits and upper slopes (Kumasi series)

- ii. Deep, yellowish red, gravelly and concretionary clay loams and clays on middle to upper slopes (Asunasi Series)
- iii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on lower to middle slopes (Akroso series).
- iv. Deep brown, imperfectly drained colluvial alluvial sandy loams to sandy on lower slopes (Nta series)
- v. Valley bottoms consist of deep grey poorly drained transported sands and clays (Ofin series).

G2 Nsaba-Swedru/ Nta Ofin Compound

- vi. Deep, red, well drained, gravelly and concretionary clay loam on summits and upper slopes (Swedru Series)
- vii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on upper to middle slopes (Nsaba Series).
- viii. Deep, yellowish brown, moderately well drained colluvial gritty clay loams on lower to middle slopes (Akroso series).
- ix. Deep brown, imperfectly drained colluvial-alluvial sandy loams to sandy on lower slopes (Nta Series).
- x. Valley bottoms consist of deep, grey poorly drained transported sands and clays. (Ofin series).

G3 Adwaso-Bawjiase/Nta-Ofn Compound

- i. Deep, yellowish red to red, well drained, very gravelly and droughty sandy clay loams and clays on summits to uppers slope sites.
- ii. Deep, yellowish brown, moderately well drained colluvoial gritty clay loams on lower to middle slopes (Akroso Series).
- iii. Deep brown, imperfectly drained colluvial alluvial sandy loams to sandy on lower slopes (Nta Series).
- iv. Valley bottoms consist of deep, grey, poorly drained transported sands and clays (Ofin Series)

GNS 1 Simpa-Agotaw Simple

Pale coloured sands overlying gravelly sandy loam to sandy clay on uplands and slopes, grey-brown compact calcareous clays on lowlands.

3.1.5. Organic matter content and pH

Application of organic manure is not common. There are a number of reasons for this. i) Not many people keep animals on a large scale and therefore access to manure is limited. ii) Transport of bulky material such as manure from its production site to the settlement is expensive. The farmers then have the added problem of ferrying the material to their farms along footpaths. Labour and access to cash are both limiting factors.

There is no tradition of making compost from household waste either, and this is a potential area for development. Household compost heaps could be used to produce manure for vegetable crops such as tomatoes, pepper and garden eggs.

There is very little information available on soil composition, nutrient status or pH. Farmers do not adjust the pH.

3.2. Selection of settlements for further study

3.2.1. GOMOA DISTRICT

Following discussions with the District Crops Officer and the District Assembly a number of settlements of varying distances from the tarred road were selected and visited. Semi-structured interviews and farm visits were conducted with farmers.

3.2.1.1. ABORA

Abora is 2 miles south of the main tarred road. It has around 500 inhabitants consisting of the Tuidan and four other family groups. Farming is the main economic activity with all men and women participating to some degree. The women also engage in trading and there are some small artisans. The village has no fishermen and none of the women process fish. There are no matt or basket weaving activities or gin distilling, although they sell gin. There is some charcoal burning activity with men producing the charcoal and the women selling it. The farming and charcoal producing activities coincide as they make charcoal with the material cleared from the farm land.

Maize is the major crop grown and is grown on a larger scale than the other crops – tomato, pepper, cassava, onion and okra.

There is no shortage of land and people come here from surrounding villages such as Ankamu, Apam, Brofuedor and Abutsia to farm. A sum of money is paid to the landlord and following harvest, the land is returned. Although most people have small parcels of land 1-3 acres, some individuals cultivate up to 10 acres and employ labour to assist them with the cultivation activities.

Family land tenure system is practised with the land belonging to the Tuidan family. Other Abora families obtain their land from the Tuidan, but it is only non-Abora people/non-family members who have to pay for the right to farm on a piece of land. The payment of 5000 cedis is a nominal sum to indicate the relationship between 'landlord' and 'tenant'. This fee is not paid by the Tuidan or by other Abora families. Allocation of land is on a first come first serve basis for seasonal farming. Long term commitments are rare.

There is no tradition of livestock rearing on a large scale in this village. Small ruminants and fowl are kept for domestic consumption.

There are no crop processing facilities and all crops are sold un-processed. Maize is taken to Apam Junction (Ankamu) for grinding and then brought back.

The road to Aboro is untarred and during the rainy season the village can be marooned for several days in three directions. This has prompted the inhabitants to seek an alternative location nearer the tarred road beyond the area prone to flooding. A site has been identified and the migration will slowly take place as more and more people can afford to build their houses at the new site.

Maize is the most important economic crop grown by farmers in Aboro with pepper, cassava, okro and tomatoes also being grown. The soil is described as a black clayey soil and considered a fertile soil.

Agricultural production is entirely dependent on rainfall and the rainfall pattern is erratic. Generally the rainfall is bimodal with the main rainy season in the spring with a second shorter rainy season in September. Farmers clear the land in anticipation of the rain, beginning in January. Most farmers delay burning until after the first rain to minimise the risk of bush fires. However, some farmers burn before it rains. In 1998 the first rain came on May 1st and the crops sown 3 days later.

The village is situated roughly in the centre of the farming lands with varying distances to the fields. Most farmers have a single parcel of land and 2-3 acres or 3-4 poles is the average size of a holding¹.

May and June are the busiest months with planting, weeding and maintenance of fields labour intensive activities. There is a taboo on farming on Fridays for Moslems and on Sundays for Christians. It is not easy to find labour to work on the farms. At times gangs come to the village from Brofyeda and Ankamu to earn money to supplement their own farming activities.

All crops grown are sold – they generally sell 2/3 and keep 1/3. Farmers harvest the crops themselves, but if they have money they will hire labour, if available. Men are mostly responsible for harvesting whilst women are exclusively responsible for marketing. Costs per pole for maize production is currently in the region of 100,000 cedis (Table 1).

¹ 1 hectare = 10,000 m²

1 hectare = 2.471 acres

1 acre = 4047m² or 4840 yd²

Pole = the square of the distance (approx 56.7 m) between two (old type) telephone poles or the equivalent of 90 times the length of a crocodile machete. Area of one pole = 3315m²

1 pole = 3.02 ha or 0.82 acres

Table 1

Costs per pole for maize production

Land clearing	25,000 cedis
Seed maize	6,000 cedis per bag x 3
Food for labourers (chop)	40,000 cedis
Maintenance	25,000 cedis
Equipment:	
Cutlass	7,000 cedis
Sharpened stone	3,000 cedis
Axe	20,000 cedis (everyone cannot afford an axe – hire for 2,500 cedis/day)
Hoe	3,000 cedis
Tractor	40,000 cedis per acre (30,000 cedis per acre last year)

1 mini bag of maize at the time of the visit was selling for 50,000 cedis.

It was claimed that 10 mini bags which consisting of 10 rubber buckets could be harvested from one pole of land. There is some discrepancy regarding the size of the rubber bucket. In Adabra one rubber bucket of maize weighed 9kg. According to the agricultural extension workers it should weigh 7kg and according to Dr Tetteh⁶ at Cape Coast it weighs 5 kg. The merchants who come to buy the maize have different buckets for different activities. They modify their rubber bucket to hold more maize by immersing it in hot water and stretching it to increase the volume. Unmodified buckets are used for selling on to customers.

One farmer reported a harvest of 20 bags per pole in the first season after clearing the land. Last year he harvested 8 bags per pole on the same land (see section 4.5) and 'didn't do to well'. He didn't have much recollection as to the differences in conditions but thought that it might have rained too much at the wrong time last year. The rain is expected to start at any time from March onwards and the early rain is lighter and more conducive to seedling growth than the very heavy downpours that occur later.

Most farmers in Aboro store their grain at home. The price of maize fluctuates with season. The goal is to store as much as possible until May, when prices peak just before the maize harvest which begins in June (normally).

Credit is a major problem for the farmers. They have a cash flow problem and have no access to reasonable, reputable source of credit. It is possible to obtain money for a bag of maize at the time of planting. However a farmer will receive 8,000 cedis from a creditor at the time of planting and have to pay one mini bag of maize at harvest. This can cause some farmers to fall into a credit trap.

None of the farmers interviewed kept any form of records of their farming activities and their perceptions of how good or bad they had done were anecdotal. However, this year ADRA had organised a seminar to encourage some form of farm recording. 8 farmers from Aboro and 4 from elsewhere had attended the seminar and one had started recording his activities. A secretary had been appointed to assist illiterate farmers.

Unfortunately, the farmers were not entirely clear as to what needed to be done. The instructions had been written on a blackboard during the seminar, but they had not received a template or guidance to take home with them.

3.2.1.2 OBIRI

Obiri is a small community of about 500 people situated about 3 miles inland on the Dago road, and about 4 miles from the tarred Accra to Cape Coast road. The population, both male and female engage in farming activities and there are is no interest in fishing – catching or processing. Obiri is a major charcoal-producing centre, with the charcoal production providing income in the dry season when the farming activities are over. This is in contrast to Aboro where the charcoal production was a by-product of the land clearance activities and took place during the cropping season.

In the last 2-3 years major road improvements have taken place on the Dago road and the community is benefiting from easier access to larger towns. The negative aspect of the road development is water related – the contractor cut through the mains water pipe 2 years ago and the water supply to the stand pipes are yet to be restored. The community depends on a single, brackish bore hole and a 300-400 gallon reservoir, which collects rainwater, for their water supply. The village does not enjoy an electricity supply or a clinic. The hospital is at Apam, about 13 miles away and the schools (primary and JSS) are overflowing.

Land availability is not a problem in Obiri, and no-one rents. Farming in Obiri is for subsistence. The land is considered to be fertile and very few people apply fertiliser to their crops. Erratic and unpredictable rainfall is the major constraint on the farming activities. They expect the first rain to fall in March but this year it did not start until 30th of April. Last year, maize was sown on April 16th but sowing was delayed until May 4th this year. Maize is the major crop grown but they consume more than they sell, they also consume more maize than any other food. Cassava is also grown - mainly for home consumption. Pepper, water yam, plantain, tomatoes and garden eggs are also grown and some people are increasingly involved with planting trees under the auspices of ADRA.

Land clearance starts in early January but most people postpone the burning until after the first rain in order to minimise the risk of bush fires. The land is cleared using cutlass and hoe – access for a tractor even if one was available could be a problem. The cultivated areas surround the settlement and fields can be 1-2 miles away.

Local varieties are used mainly. ADRA have supplied seeds of Obatanpa, an improved, short duration variety in the past but despite being higher yielding there is some resistance to its adoption because it doesn't store well without chemical treatment (see section 4.6). Some farmers have kept their own

seeds of this variety and have planted small areas, the grain from which they will sell immediately, keeping the local varieties for storage. Obatanpa is reputed to be drought tolerant, which can be an advantage in drier years.

Farmers in Obiri very rarely use fertiliser. The agriculture extension service recommends that they apply a teaspoon of fertiliser (e.g. ammonia top-dressing 2 weeks after emergence) to each plant. This is time consuming and farmers are unsure as to the cost effectiveness of this as they perceive the land to be fairly fertile.

Late planting causes pest problems, in particular weevils because the crop ripens later when the weevils are endemic. Plants are left in the field to dry for 3-4 weeks after and are then hand picked. The stalks are used for roofing and barn building.

Farmers build the barns for storing the cobs both in a convenient position near the field and close to their houses. Men build the barns but space is allocated for the women's crops. The barns are raised at least one metre from the ground and if necessary a fire is lit to deter mice and other pests. The grain is stored, unthreshed, in regular layers. The cobs are threshed by hand at the field site and then head loaded back to the village by the farmers and members of their families, for sale or consumption.

Shortage of labour is cited as a major constraint in Obiri. They do not form groups to assist each other but one or two farmers often combine their activities. Those who can afford to do so sometimes employ members of other families to work on their farms.

The produce is taken to Kyrien-nkwanta market at Dago junction. People from Dago and on some occasions, traders come to the village to purchase maize. There has been a serious improvement in access since the road was improved 2-3 years ago. The effects are only beginning to be felt, but already people are beginning to consider purchasing vehicles whereas previously only one person (the then Director of Education) owned a car. More traders are coming down to the village to purchase produce than in the past and when they come they bring consumables to sell as well.

Access to Credit is a major problem here as elsewhere. Those who have the means bank at the Rural bank in Durampong, however, it is very difficult to get credit from the bank even if an account is held there. There is some suspicion of corruption regarding this matter.

Unlike Aboro where farmers sold mini-bags of maize at sowing time in order to obtain credit, this does not happen in Obiri. However there is credit available from individuals on the charcoal business where a bag of charcoal is bought for 3,000 cedis and delivered about 3 weeks later. The interest on the transaction is 1000 cedis.

3.2.1.3 ADABRA

Adabra is 5 miles from the nearest tarred road. The main occupation of the citizens is farming and they grow maize, cassava, pepper, yam, tomatoes and groundnut. Some men from the settlement are drivers or learning a trade but all are involved in some form of farming. Women also farm, some exclusively and others combine it with trading activities. There are no fishermen here but

about 6 women fry and smoke fish and about 4 men make baskets to sell. Some men distil apatache. No families or individuals specialise in one crop over others

Land is available for anyone who wants it and all the families have family land. If strangers come to farm they must pay a 'knocking fee' of 100,000 cedis (which is subject to negotiation) and then pay 30,000 per hectare. If the knocking fee has been paid then there is no obligation to share the crop with the landlord.

Men and women farm together on the same piece of land and women here do not have separate pieces of land.

There is a significant Ewe population in this settlement and they have to pay for farming. The first settler arrived about 10 years ago from the Akatsi – it is suspected that some may have come from Togo but this is not confirmed. The Ewe people are considered to be very good farmers and have taught the local farmers how to cultivate groundnuts.

Generally the livestock kept is for domestic purposes, fowls, sheep and goats, with one man who keeps goats on a larger scale. He grazes them in the bush and no problems were reported of trampling or eating of crops by the animals. The men and women who rear livestock on a small scale have pens to keep them from roaming onto the crops.

There is some crop processing activity – one diesel powered machine to grind cassava for gari production, another for corn grinding. An Ewe man who has lived here for some time bought both about two years ago.

The soil is described as a sandy/clay (G3 – see Box 1). The settlement is central in relation to the cultivated fields and there did not seem to be any premium attached to any piece of land or location.

From the beginning of January farmers clear and burn the land (they are not as concerned to wait for the rain before burning here). The land is cleared manually with cutlasses and hoes – there is no access to a tractor.

In the month that the rain starts (May this year) maize, cassava, groundnuts, garden eggs and tomatoes are planted. The cassava stays in the ground for 12 months, the maize is harvested three and a half months or so after planting, groundnuts and garden eggs take about 3 months to mature. July/August are the busiest harvesting month. In September during the second, shorter rainy season maize and tomatoes are planted.

Maize and cassava are inter-cropped and if cassava is grown then the following year, new land is cleared for the maize. They claim not to have any land fallow, but during the farm walk there were many areas of uncultivated land that had obviously been cultivated previously.

Labour in itself is not a problem in this village, the farmers either do the work themselves or recruit labour from surrounding villages. They do not generally farm together except during land clearance, when they work in groups on each others' farms. It is not difficult to attract labour but paying for it is more problematic. It costs 40,000 cedis per acre for weeding and 4,000 cedis per day for planting if the area is too large for the individual to plant alone. June

and July are the busiest months, with the rains making weeding and crop maintenance a chore.

Men, women and children are involved in the harvesting of the crops. During the harvesting months people come to the village which to offer their services. School children are also heavily relied upon to do this work.

Obatanpa the synthetic variety promoted by the agriculture extension service is grown here. It gives a better yield than Abasa the local variety, which is also grown, but does not store as well and requires chemicals to preserve it.

A similar yield - around 8 mini bags per acre with 10 bags in a good year was reported here as at Aboro. They do not apply chemical fertilisers, as they cannot afford it but would like to do so if they had the funds. They were not specific in their description of pests and diseases but apply 'medicine'. The chemicals are kept in unlabelled bottles in small sheds in the fields with scant regard to safety in storage or application. Chemicals are freely passed from bottle to bottle regardless of what was in the bottle previously and there is little or no knowledge of dilution or safety procedures. It seems as any 'medicine' is better than none and applied in the hope that it will cure the problem. Advice is sought on these issues from the Agriculture Extension Services. A herbicide (probably Round-up) is applied in August and a sprayer is hired for this task from Amwanda, one farmer in the village has his own sprayer but no protective clothing is worn at all. The lack of such clothing was not considered to be an issue. The dilution used is one milk-tin of chemical in one bucket of water and poured into the sprayer.

Karate, an insecticide from ICI was the only chemical referred to by name and this was stored in an old chloroquine bottle (see section 4.7 and 4.7.1.1).

3.2.1.4 GOMOA SAMPA

Gomoa Sampa has a population of around 350 people most of whom are farmers, with some masons and carpenters. Both women and men farm with most of the women involved in trading. Some 10 or so women buy fish a Mankessim market and smoke them in clay ovens. Some youths weave baskets to sell at Kyrien-nkwanta market and some men distil local gin.

Men and women farm maize, cassava, tomatoes, oranges, palm oil, sugarcane and pepper. Pepper is considered a crop for women in this village.

The land is family land and there is sufficient land for all that wish to farm, some families have more land than others. There are no farmers from outside the settlement (such as the Ewes of Adabra or farmers from neighbouring villages as in Aboro). There is no reason for this - if people wish to come they would be welcome.

The Regent has the most cultivated land and farms 3 acres of cocoa, 4 acres of oranges, 1 acre of sugarcane, 6 acres of palm oil, 4 acres of maize, 2 acres of cassava and 2 acres of tomatoes at 3 different sites. Most people have scattered plots rather than one holding. Women do not have separate land, but farm parts of their husband's fields.

Most people have livestock, which are owned by both men and women. Sheep, goats and hens are kept on a small scale for consumption and selling. One person can have as much as 20-30 animals and are responsible for their

care. Children take the animals to their grazing in the morning and to collect them in the evening. They do not stray onto crop lands.

Some gari processing takes place in the village. There are 2 maize grinders owned by men and powered by gas oil. One man owns a mechanical sprayer for cocoa, oranges and tomatoes.

The soil is a red soil (LB1 Bekwai-Nzema/Oda compound – Box 1) and considered to be quite fertile. To the west of the settlement there is a river and the land adjacent to the river is available for cultivation in the dry season, initially from the draw down as the flooding recedes and by irrigation from the river. Cash crops such as palm oil, garden eggs, okra, sugar cane, tomatoes are concentrated along the river banks whilst maize and cassava are grown further away from the river where flooding is not a risk.

The soil is considered to be fertile. They apply little or no fertiliser and leave the land fallow. The farmers interviewed did not use fertiliser due to the expense (including difficulties transporting fertiliser to the village)

Normally, the rains are expected at the end of February but this year the first rain did not fall until April 28.

In January the main activity is weeding new land for cultivation and maintaining the old farms. In February the cassava fields are prepared in anticipation of rains at the end of the month. In March the land is cleared for maize in preparation of the major season. Maize, pepper, okra, tomatoes are planted in early April if the rains have started in May the oranges are harvested and sugar cane planted. The small season cocoa is harvested in May and June and the cocoa farm is expanded during June as well. New cocoa bushes take 3 years to mature, whilst old bushes can last up to 30 years. Maize and the other crops are harvested around the end of July, beginning of August and the sugarcane in October. Plantain and cocoyam are inter-cropped initially and then the plantain is allowed to grow on from about 9 months to 6 years.

The main cocoa season is between October-December. Pods are harvested with a long hook when they are yellow. They are then covered with leaves until they are red - for about 5 days before being carried home to dry. Drying takes about 2 weeks if there is enough sunshine. They are then sacked and sent to the Cocoa Marketing Board in Akropong (2.5 km North of the village). From there they are sent to Accra and Tema for export.

Oranges are harvested from October-January. Traders come to the village from Accra. During the peak of the season there are more oranges than can be managed.

The Agricultural Extension Officers visit frequently and can be contacted at any time for advice.

Cassava and maize are inter-cropped and if maize is grown by itself on a piece of land it is then left fallow for two years. Maize and cassava are the most important crop, and the maize is mostly harvested dry rather than fresh. The maize is left to dry as much as possible in the field before harvested and then it is stored. However, if people request fresh cobs then it is possible to buy them.

Crops are head-loaded in baskets from the fields into barns near the town. This was the only town where thieving from the bush was cited as a problem. One farmer had given up growing pineapple because they were stolen – not maliciously in his opinion, but as people walk past they take the opportunity to help themselves.

During the major season a lorry comes to the village although the road is rather bad. During the other times of the year traffic is very sporadic and they have to walk to the main road.

Labour is not much of a problem, they help each other with communal labour to harvest. If people help with harvesting cassava for example they are given some cassava in return.

Weeding 1 acre here costs 20,000 cedis and they employ only the young people from the town – they do not bring in labour from outside.

Tomatoes are harvested in the evening before the lorry is expected. If the road is particularly bad and the lorry does not turn up then someone has to be employed to carry the fruit to market. It is a particular problem in the off-season when lorries do not make the trip so regularly.

The major constraint on expansion here is the lack of a tractor to clear the land. The rough grassland is particularly difficult for people to clear because the grass has very sharp blades.

May and June are the busiest time and planting and maintaining are more difficult tasks than harvesting.

Both the synthetic variety Obatanpa and a local variety 'Eburow tsin' are planted. Obatanpa matures in about 2.5 months and the local variety in 3 months. Obatanpa, which has a higher yield, is sold as soon as possible due to its poor storing quality. If they apply an insecticide it could be stored longer, however, they cannot afford this 'medicine'.

Maize production is similar here to elsewhere at about 10 minibags per acre. Of the ten bags produced about 4 are kept for home consumption and 6 are sold. Weeding the cassava and sugar cane clashes with the maize harvest causing a labour bottleneck.

Maize is sold during January, February and March but ideally if the farmer is not in financial difficulties, it is kept until May. Women are responsible for taking the maize to the market

Estimating cassava production is more complex as the number of baskets gathered depends on the neatness of the person stacking the cassava. The farmers reckon that they invest about 120,000 cedis and expect to make a gross of 480,000 cedis (around 8,000 cedis per basket) which is a net profit of 360,000 cedis.

People outside the village come to buy cassava in the field. The purchaser is responsible for lifting and transporting the cassava. One reason for the popularity of this arrangement is the tradition that people lifting cassava can take the damaged roots home. Farmers believe that the damage is unnecessarily high and prefer not to have to deal with it.

More cassava is sold fresh than processed although there is some gari processing activities in the village. Maize is also mostly sold as grain (not fresh cobs). Inaccessibility to market reduced their income – a rubber bucket of maize in Sampa can be sold for 4,000 cedis and in the market the same volume would be sold for 6,500. However, since transport to the market costs money many farmers prefer to sell directly to the traders either one of the 5 big resident women traders or to those who come from elsewhere. The women determine prices.

The calculations of profit made by farmers on all of their crops are based on guesswork and estimates. Farm recording is not practised in this village but the farmers considered that the idea would be a useful management tool.

Credit is not available in the town – the farmers interviewed did not know of anyone who has credit or where exactly to access such a facility. About 8-10 people have a bank account at Durampong.

3.2.1.5 LOME

Lome is 3.5 miles from the tarred road in the area designated by the District Assembly as a 'Potential Agricultural Region'. The soils are G3 Adawso-Bawjiase/Nta-Ofin compound (Box 1), which is also the main soil type found in Assin.

The settlement is about 3 miles away from the furthest farming lands and the farmers spend most of the week in the bush on their farms, returning home at weekends. Both men and women go to the remote sites, although men stay there for longer periods of time. Women tend to carry the food and fuelwood for their husbands and stay only if the workload is heavy. The women carry their babies with them and children who can walk also make the journey. The other children who are in school go up at weekends. At times, parents request that children be allowed to work instead of attending school.

Vegetables and cassava are grown on the fields nearest to the settlement for ease of access to food supply and because vegetables are perishable and need to be shipped out as soon as possible after harvesting. They work on these crops on their days at home.

Ten farmers were interviewed at Ahemakwaa, which is currently a temporary settlement 3 miles away from the settlement along a footpath. Previous attempts at settling permanently at the site were thwarted by a shortage of water.

Lome people exclusively farm the surrounding land. The land nearest the forest reserve, and towards Dahame is considered the best land whilst the land towards Ogudan village is less rich and the land along the Abonko road the poorest. The quality of the land is judged according to texture (loamy soil preferred) from the yields and from the indigenous vegetation. In some places a hard laterite stratum occurs at 4ft from the surface. The land is family land and clan members do not have to pay for their holdings. People who are not clan members pay 10,000 cedis with some heads of family fixing a price for a piece of land and if more land is cleared then extra money must be paid.

The track to the temporary settlement, which is near some of the best agricultural land, used to be passable by vehicle until about 8 years ago when

the river, about a mile from the settlement, cut through the road. Cars were never able to traverse the route, which was used mainly by tractors.

Maize is the main crop grown but they also grow tomatoes, pepper and garden eggs as a sideline – there is nothing much else to do. Women from surrounding settlements such as Onyadze come on foot to buy maize from men and women at the temporary settlement between September and May. The time chosen by each individual to sell depends on their financial situation at the time.

The tomatoes are sold at Lome. They are harvested every four days whilst garden eggs are harvested once a week. Pepper is at its most fresh a day after harvesting but can be kept for up to 4 days. It is sold fresh and dried.

The farmers and their families harvest the maize themselves, however, at times they sell their cassava crops *in situ*. The main reason for this is similar to that mentioned by Sampa farmers i.e. labourers are invited to take the discards home, and rogue labourers ensure that an unacceptable amount of the crop becomes unmarketable so that they can claim it for themselves.

There are times when there is no one at the temporary settlement but thieving is not a problem due to the distance from the settlements and the difficulty in transporting the stolen goods. Some stealing occurs from the vegetable fields nearer the town.

The farmers and their families are the main source of labour. All the farmers in the group would hire labour if the funds were available. It costs 15,000 per pole for weeding and land clearing here.

Access to Credit is a constraint. It is impossible to obtain credit without some form of collateral. There are banks in Durampong and Nyakrom which are used by some especially those who have migrated to the cocoa growing areas.

Some of the farmers interviewed had areas of cocoa which they visited for the main cocoa harvest in August/September. One man had inherited the cocoa farm from his family who bought the land for £20 in 1967.

There are absentee farmers in this high production potential area – some from Accra and other urban areas. Some of these farmers are people from elsewhere and others are local people who have migrated to the city.

Sasakwa-Global 2000, an international organisation that works to spread improved agricultural technology in Africa has worked with three communities in the district since 1987 and in Lome since 1989. Initially a group of about 10 farmers (including 4 women farmers) were conducting extension plot trials. A group meeting was held and some farmers, with the help of the extension officer filled in application forms. They are given inputs for 1 acre (Obatanpa 9kg/acre, 1 50kg bag each of 20:20:0 fertiliser and ammonia top dressing and sumicombi fungicide for storage). Only one farmer, a woman, has persisted with the scheme since its inception.

3.2.2 ASSIN DISTRICT

Following discussions with the District Chief Executive it was decided to visit Awrobo, a town 15 miles from the tarred road. A 4x4 vehicle was provided by the DCE, without which access would have been impossible.

3.2.2.1 AWBORO

The population of Awrobo is 600-800, which together with the population of the surrounding villages is about 1000. Cocoa, oil palm, rice, maize and cassava are the main crops grown and farming is the main economic activity.

The rainfall pattern is tropical and it rains from February to November. The natural vegetation is secondary tropical rainforest and the general soil type is G2 Nsaba-Swedru/ Nta Ofin Compound (Box 1). Local variations are exploited for different crops – loamy soil for cocoa, sandy soil for oil palm, and riverine swamp land for rice. The soil is considered fertile and very little fertiliser is used.

Accessibility is a major problem here. Akonfaidi, the third largest town in the district can only be reached by walking 3 km through the forest – a problem for reaching the hospital in particular. All the traffic accessing the town do so via Eastern Region roads, with the Central Region side not well connected. The nearest market along the road is 5 miles away at Akropong Odumase, 10 miles from the tarred road.

Every man and woman is a farmer and they keep livestock on a small scale as well. Although there is a river nearby, they do not fish. Some men weave baskets of palm fronds and palm rafia and women make brooms from palm fronds. Local apatache is distilled from palm but this is an activity undertaken by men only.

Land is readily available and people settle from other areas such as Gomoa, Ewe, Acrobos etc. However the indigenous population outnumbers the settlers. The settlers are almost permanent residents, going 'home' for festivals only.

The amount of money paid for land depends on the acreage. Previously there was two systems, either where money was paid for the use of the land or abusan (1:2 share cropping). The share cropping has been suspended for the time being as there is a court case pending.

The land is owned by the Akoti stool and the Chief is the custodian. Individual families do not own land. The women farmers are given land by their husbands and are involved in all aspects of farming including cocoa. However, not all men and women own cocoa plants.

There are some crop processing activities – gari, palm oil, palm kernel oil. They do not have a machine for gari production in the settlement only a grater.

The Ghana Cocoa Industry has been important for a long time, earning a substantial amount of foreign exchange. However, in the late 1970s and early 1980s production fell and Ghana is no longer the world leader in cocoa production. The Ghana Cocoa Board (COCOBOD) has been revamped in line with the government's liberalisation policy and has resumed a new role

monitoring and regulating the Cocoa Industry in Ghana⁷. The farmers of Awrobe reported a decline in the involvement of the Cocoa Board. In the past they supplied pesticides such as DDT and information on production. Now their access to inputs and information is very limited. It is difficult for them to get inorganic chemicals and the information regarding their use.

The settlement here, as elsewhere is central to the fields but land holdings here are larger than in the settlements visited in Gomoa with many farmers owning between 10-15 poles. They have a wide range of crops – maize, rice, cassava, cocoa, oil palm, pineapple, plantain, yam, groundnut and vegetables (tomatoes, garden eggs, pepper). The tree crops are the main cash crops with maize grown for subsistence and the surplus sold. All the people are involved in commercial and subsistence farming.

There is some group farming activities here with farmers coming together to clear the land for maize and rice production. They also have group sowings and share the harvest according to the proportion of input they contributed.

They practice shifting cultivation and mixed cropping. They rotate their crops and after 2-3 years leave the land fallow for 2-3 years to allow the land to rest and regenerate. Those farming stool land can return to the same land every season but if the land is rented the tenant farmer cannot return.

Both traditional and improved varieties of most crops are grown here. The improved varieties yield better than the traditional but there are no records to show the differential yields. There is consensus here as elsewhere that the storage quality of the traditional variety is better than the improved variety. Pests include weevils, mice, cockroaches, squirrels and monkeys.

The settlement has a cocoa shed and the cocoa beans are taken there after sun-drying. Buyers come to the village regularly and they also buy cassava, maize, rice and plantain. The road condition during the rainy season is a major problem – it is impassable at times and truck owners do not want to subject their vehicles to such inhospitable conditions.

There are records of cocoa harvests here, but not of any other crop. The farmers have no means of comparing performance between years and have to rely on memory and a 'feel good' factor to distinguish between one year and another. They cited lack of management information as a constraint and would welcome assistance with farm recording, and other educational tools that could improve their performance.

3.2.3 Conclusion

It is clear that maize yields generally are very low and therefore there is potential for improvement. However unless post harvest losses, and access to markets is improved very little will be gained by improving or expanding production.

Of the settlements visited in Gomoa, Lome and Gomoa Sampa are the most interesting agronomically and most likely to benefit from improved access to market. Some of the farmlands of the former are remote. The land has been classified as a high potential area but constraints such as shortage of labour and general management issues (for example, keeping track of income and expenditure) make improvements difficult. The relationship between the

Agricultural Extension Service and both these communities is good and offer opportunities for participatory discussions on improvements with both farmers and the Agricultural Officers.

A study of Awrobe will provide a contrast. The settlement is much further off road than any settlement in Gomoa but the agricultural potential is also much greater. Rainfall is not as limiting here as it is in Gomoa and it has a diversity of tree crops and other crops that have a commercial value.

The main commercial interest is cocoa. There is a debate in Europe at the moment and huge divisions between European Chocolate manufactures about the moral, ethical and environmental implications of substituting cocoa for vegetable fat⁸. The pro-group led by U.K chocolate manufacturers and supported by their counterparts in Ireland, Denmark and Portugal have continued to advocate for the use of vegetable fat. The anti-group made up of manufacturers from the Benelux region consistently argues that the use of vegetable fat is unhealthy, deceitful to the consumer and in the case of Ghana, could deprive farmers of an income. Should the European cocoa market collapse then the off-road situation of settlements such as Awrobe could be even more isolated and a study of their production and marketing methods is very timely.

3.3 Summary and Recommendations

3.3.1. Activities:

Production cycles are dependent on rainfall. In Gomoa a bimodal pattern of rainfall exists with the main rainy season starting at any time from March until August. The soils are coarse to medium ferric and orthic acrisols and the reddish colour is due to the iron content, which may cause problems regarding P availability. Although these soils can be sticky and plastic when moist they are porous when dry without any difficulties with permeability and aeration⁹.

The maize crop is harvested about a month after ripening. It is allowed to stand a) to dry and b) to save on storage space. The dried cobs are stored and threshed according to demand. If storage areas such as concrete rooms are available then the maize is more likely to be threshed, treated with fungicide and stored in sacks. Perishable produce such as tomatoes are harvested in sequence and largely depends on the availability of transport to market – either a lorry coming to the village or a person (usually a woman) head loading the produce to the market. Access to market is particularly limiting for perishable produce. The vegetables are usually harvested at dusk or dawn to minimise damage from overheating. Gomoa Sampa was an example of a settlement that had potential for vegetable production, which could not be fully exploited due to its problems with access. The settlement has access to a perennial river, whose banks are exploited for out of season production. However, during out of season periods transport is a problem and they are unable to capitalise fully on this potential.

The chain of production was similar in each settlement in Gomoa - land preparation for maize starting in January/February with sowing delayed until after the first rain. This coincides with harvesting of the minor season crop and

some harvesting of cassava, and vegetables. When asked, farmers claimed to focus on their maize crops.

Weeding is a major demand on labour and has to be done two or three times. The maize crop is harvested three and a half months after sowing, depending on the variety used. It is allowed to dry in the field and in many places in-field storage barns have been built. This allows the crop to be threshed in situ with the less bulky grain being head loaded back to the settlement for eventual sale or consumption.

June and July are considered to be a bottleneck for labour as the demands of weeding are labour intensive.

3.3.2 Location of fields/farms

Most of the settlements are positioned in the centre of the farmlands with some farmers having to walk considerable distances to their fields. In Lome in particular farmers had to stay overnight as the distance was too great to commute. Almost all the fields visited were inaccessible by road and were at the end of a footpath. Even if the road to the settlements are improved the access to the fields remains restricted. This lack of access can be a constraint if there was access to mechanised land clearance – most tractors in Gomoa are to be found in the area near the main road, where larger tracts of land can be cultivated. The locations of different crops vary from settlement to settlement. In some, the farmers cultivate only one area, in others, such as Sampa they grew crops, which were mostly suited to the soil conditions. For example, they grow sugarcane and vegetables on the aluvial plain of the river, cocoa in the forest areas.

It was not clear how it was decided who uses which areas of land and this may be an area for further study. Only the people of Lome identified some areas as being less productive than others, but they were the ones who had access to the most productive land in the district. Other settlements did not make distinctions.

Group farming is not common although some farmers come together for some activities such as land clearance. Neither are there families, clans or areas of land that specialise in one crop or another.

The land tenure arrangement is based on the stool or family land system with members of clans or families having access to the land and strangers having to pay. The complexity of land tenure is such that it is recommended that a separate study be commissioned. The position of women for example is not clear. In some areas they farm in their own right and in others they are allocated part of their husband's land. In cocoa growing areas and where tree crops are long term investments there is scope for investigating the land tenure arrangements on production and more especially on the influence of land tenure on women^{10,11}.

It is fairly clear that security of tenure is a constraint on 'outsiders' who wish to expand their holding. They normally have to return the land at the end of the season. Family members believe mostly that there is 'enough land' and after cultivating for two or three years leave the land fallow and move on to other areas. Very few people invest in the land and they are constrained by lack of labour and money from increasing the area under cultivation. They also face

problems of defending their plots from birds and other pests as well as, if they produce more, marketing and storing. Thieving as such does not seem to be a problem in most places, although crops such as pineapple growing in the bush seemed to be targeted by passers by.

3.3.3 Labour

Agricultural production is not mechanised and the farmer, his/her family and those he/she employs to help must undertake all the farming activities. All farmers interviewed cited labour shortage as a major constraint, especially during land clearance, weeding and harvest, especially if two harvests coincide.

There are two issues regarding labour:

- i) availability and
- ii) ability to pay.

In the settlements visited they did not have access to labour gangs or groups of people who focus on specific tasks – e.g. skilled yam mound makers who travel around in some areas. In the most remote settlement visited additional labour is limited although there are some people who aren't farmers themselves who come looking for work. Most of the people employed had farms of their own either in the settlement or elsewhere and were seeking additional employment to supplement their own farming activities. Land clearance, which is heavy physical work, is an exclusively male task, but men and women and children plant, maintain and harvest the crops.

3.3.4 Equipment

There is relatively little access to mechanisation in Gomoa even in on-road communities. In the off-road community of Assin visited there was no mechanisation either. Farmers' fields are usually accessed via footpaths even in more accessible settlements. Apart from access, size of cultivated plot and the cost (40,000 cedis per acre in 1998 in Gomoa) are constraints.

Hoes, cutlasses, axes and sharpened stones are the main pieces of equipment used. Most farmers will own at least one of these and they are also available for hire.

If the area under cultivation is to be expanded some form of mechanisation would be necessary. There is no tradition of animal traction in coastal Ghana (although the World Bank funded VORADEP made efforts to introduce it in the Volta Region in the 1980s). Farmers are not familiar with husbandry methods or handling of oxen or donkeys for manual work making introduction of animal traction difficult.

3.3.5 Production

Yields per unit area are low and consistent with that expected in a low input subsistence farming system. This field visit did not coincide with the maize harvest. However farmers generally agreed that they produce between 8-10 mini bags of maize per pole in Gomoa. Each mini bag contains 10 rubber buckets. There is some discrepancy regarding the volume of the rubber bucket. In Adabra one rubber bucket of maize weighed 9kg. According to the agricultural extension workers it should weigh 7kg and according to Dr Tetteh

at the Department of Agriculture, University of Cape Coast it should be a standard 5 kg.

Yield therefore varies between 0.5 – 0.9 t per pole or 1.6 – 2.9 t/ha. Official figures for maize yield produced by the regional PPMED office show the mean figures for maize production to fall consistently between 1 and 1.3 tonnes per hectare for both Assin and Gomoa districts. Official FAO figures¹² has a mean yield of 1.6 t/ha for Ghana as a whole. The global average for maize production is 3.6 t/ha with normal yields for well-cared-for maize, grown without irrigation in a warm country are 5-8 t/ha.

One man reported a 'bumper' crop of 20 bags/pole in the first season after land clearance, which would be an equivalent of 3-5.4 t/ha. As they keep no records, it is difficult to substantiate these figures. Assin farmers also mentioned 'bumper' crops but could not quote figures.

The Gomoa District Assembly target for the years 1996-2000 is 5t/ha¹³. Where a plentiful supply of water is available and the top priority is the production of basic foods, maize is very successfully grown with irrigation. If fertilisers and plant hygiene measures are taken then a harvest of more than 20 t/ha are possible.¹⁴

3.3.6 Seeds

Obatanpa a synthetic variety produced by CIMMYT. In a recent report¹⁵ An independent, international panel of experts appointed by the Canadian International Development Agency (CIDA) recently praised the efforts of Ghanaian maize researchers, in collaboration with CIMMYT, to develop and disseminate improved varieties and technologies for the country's farmers. According to the panel's draft report on the Ghana Grains Development Project (GGDP), "The maize improvement program has been very successful, with the release of nine open-pollinated varieties since 1984.... Surveys by the socio-economic group in 1991 indicated that the adoption of improved varieties by farmers was high, ranging from 60 to 85% in different areas of the country, and is possibly the single most important project output." Knowledge of Obatanpa was disseminated with assistance from Sasakawa-Global 2000, an international organisation that works to spread improved agricultural technology in Africa. On this field visit only one village (Lome) had a Global 2000 presence, and the interest had dwindled to one woman, who remained a member.

Although Obatanpa is higher yielding than the local variety it does not store as well. Farmers therefore either invest in an insecticide such as Actellic or grow Obatanpa for immediate sale and a local variety for storage. The local varieties have a tighter sheath making it less easy for pests to enter.

The surplus produced depends on the season. As farm recording is not common farmers rely on memory for this information. In general, farmers keep 2/3 and sell the rest. In Assin, the tree crops were the main income generating crops. There is no evidence from the settlements visited that any crop attracts a premium (*c.f.* appellation controlee in Europe)

3.3.7 The Use of Inorganic Chemicals

Discussions with farmers about inputs such as pesticides, herbicides and inorganic fertilisers highlighted several issues:

- Farmers are aware of the possibilities of increased yield if inputs such as fertiliser and pesticides applied.
- Farmers are constrained in their use of these inputs by lack of access to credit.
- Farmers are limited by the lack of information surrounding the 'medicine' and the availability of the right product for their particular problem.
- Farmers are often tempted to apply any medicine in the hope that anything is better than nothing.

The impact of inorganic chemicals reaches further than the immediate farm environment. Pesticides can kill non-target species and impact on local flora and fauna, groundwater quality, soil biological processes and natural predators. There are also health impacts on farm workers, processors, consumers and communities living in areas where chemicals such as pesticides are used in agriculture. Pesticides are responsible for some 20,000 deaths and 3 million cases of acute poisoning annually - a burden borne, in particular, by agricultural workers and rural communities world-wide (Dinham 1993)¹⁶.

There is very limited awareness of dangers surrounding the use of toxic chemicals. The store staff, which sell the products, do not handle them with sufficient care and attention to safety. Although protective clothing – gloves, face mask and goggles were available they were obviously unused and the vendor handled the material unprotected. Furthermore, the same receptacle is used for dispensing small volumes required by the farmer and the water used to clean the measuring cylinders disposed into the local drain. It is unlikely that the measuring cylinders are cleaned between each chemical.

Farmers cannot afford to purchase whole bottles of any chemical and will bring un-marked bottles to the store. They do not have adequate storage facilities on the farm for their chemicals and they are often left lying around within reach of small children. When the farmer needs to identify the contents of the bottle he/she does so by inhalation of the fumes.

Farmers do not have access to spraying equipment and know very little about the recommended dilution rates. They have to rely on memory either from the store or from the agricultural extension service staff who have advised them. Consequently the application is haphazard.

3.3.7.1 Information on the chemicals available

It can be seen from Table 1 that the amount of chemical purchased at a time is relatively small and as such minimises the risk of widespread contamination even if the individual risk is small. However, inaccurately small dosages could conceivably allow pests, diseases and weeds to develop a resistance to the chemical.

Table 1**Chemicals for sale in a Fertiliser store in Gomoa district:**

		Price
Actellic Super	Actellic (pirimiphosmethyl) Can be used as either a protectant for seed corn against insect pests or top dress treatment, not both. It is effective on all stored grain insect pests.	20ml/1000 cedis
Diazion	Organophosphorus pesticide (OP ¹¹)	20ml/1000 cedis
Griffin	Copper based fungicide	
Karate	Karate Insecticide (RS)-alpha-Cyano-3-phenoxybenzyl (1RS)-cis-3-(Z)-2-chloro-3,3,3-	20ml/1000 cedis
Klerat pellets	Contains the active anticoagulant brodifacoum.	
Roundup	Glyphosate herbicide produced by Monsanto	500g/5,000 cedis
Sumicombi	Broad spectrum insecticide (OP) Seed dressing	20ml/1000 cedis
NPK 15:15:0	Inorganic fertiliser from South Africa	
Urea	From C'ote d'Ivoire	

There is increasing evidence that some if not all of these chemicals are very toxic, even when used in accordance with the manufacturer's recommendation:

3.3.7.1.1. Karate

In 1995 the American EPA received a voluntary request from the manufacturers of this product to remove it from the pesticide register¹⁷. Unless the provisions of an earlier order apply, existing stocks already in the hands of dealers or users could be distributed, sold or used legally until they are exhausted thereafter this product is no longer legal in the USA

3.3.7.1.2 Klerat

There is evidence that Klerat is acutely toxic. Sax & Lewis (1989)¹⁸ for example document poison by ingestion and skin contact. Hallenbeck & Cunningham's list (1986)¹⁹ describe the effects of acute exposure which include anaemia, abdominal pain, back pain, capillary wall destruction, dermal

¹¹ OP or Organo-Phosphates: Organic compounds containing a Phosphorus Oxygen double bond

problems, hematologic disorders, haemorrhage of mucous membranes, lips, gums and nose, pallor, prothrombic depression, renal colic, weakness and paralysis due to cerebral haemorrhage. Chronic exposure effects are the same as for short-term effects. Symptoms may not appear for a few days or weeks. Repeated exposure is usually required for damage to occur. Numerous small exposures may be more damaging than one large exposure (Hallenbeck & Cunningham 1986)²⁰.

There is some evidence that Klerat affects wildlife populations:

PESKEM (1995)²¹ describes it as "effective at such low rates that the risk of secondary poisoning to other animals is minimal. Relatively non-toxic to bird species. This product can be toxic to wildlife and can pose a secondary hazard to birds of prey and mammals. Extensive research with predatory animals, such as barn owls, has shown that such predators are not normally at risk when a product called Havoc, containing the same active ingredient is used according to label directions.

Roberts (1997)²² reports that rat poison used on sugarcane farms is the probable cause of recent dramatic declines in populations of rare and endangered owls and other wildlife in Australia. According to work by John Young and Leonie De Lap in the Herbert River region of North Queensland there has been a sharp decline in the numbers of several species of owls and hawks since 1992. The population of the endangered masked owl has fallen from 50 pairs in 1985 to 10 pairs in 1995, while eight pairs of the similarly endangered rufus owl have disappeared. Declines of between 75 and 85 per cent were recorded in populations of the spotted harrier, the barn owl and the rare grass owl, and numbers of barking owls have halved. It is believed that the declines coincided with the introduction of the rodenticide Klerat.

3.3.7.1.3 Roundup

Roundup is a post-emergence, broad-spectrum, non-selective herbicide used extensively world-wide. It is commonly used in agriculture, forestry, and nurseries for the control or destruction of most herbaceous plants including grasses, broad leaf and woody plants. Glyphosate, the active ingredient is absorbed mainly through the leaves and is transported around the whole plant. It acts by inhibiting the shikimic acid pathway as an inhibitor of 5-enolpyruvylshikimate-3-phosphate synthase. (Active Ingredient Fact Sheet, 1996²³, Lamb et al 1998²⁴, US-EPA 1993²⁵).

Glyphosate is one of the most toxic herbicides and although its direct toxicity to mammals and birds is low, its effect on flora can have a damaging effect through habitat destruction (US-EPA 1993)²⁶. However products containing glyphosate also contain surfactantsⁱⁱⁱ (polyoxyethyleneamines POEA and isopropylamine) which are much more toxic than the glyphosate. They are serious irritants of the respiratory tract, eyes and skin, can cause nausea and

ⁱⁱⁱ An abbreviation for Surface Active Agent. Any compound that reduces surface tension when dissolved in water or water solutions, or which reduces interfacial tension between two liquids or between a liquid and a solid. There are three categories of surface active agents: detergents, wetting agents and emulsifiers. All use the same basic chemical mechanism and differ chiefly in the nature of the surfaces involved. Hawley's Condensed Chemical Dictionary 11th Edition N. Irving Sax and Richard Lewis Sr.

diarrhoea and are contaminated by dioxane which is a suspected carcinogen (Carlisle and Trevors 1988)²⁷. Between 1984 and 1990 in California, glyphosate was the third most frequently reported cause of illness related to agricultural pesticide use. Although the volume used in Ghana is not so large, in view of the small amount needed (many species of wild plants can be damaged or killed by applications of less than 10 micrograms per plant). Lack of care during handling and storage exhibited by users should be a cause for concern.

3.3.7.2 Are there solutions to the problems associated with inorganic chemicals?

American Vice-President Al Gore²⁸, in an introduction to Rachel Carson's definitive book *Silent Spring* quotes from one of her few speeches, and one of her last, to the Garden Club of America. In it she acknowledged that things could get worse before they got better: "These are large problems, and there is no easy solution." Yet she also warned that the longer we wait, the more risks we run: "We are subjecting whole populations to exposure to chemicals which animal experiments have proved to be extremely poisonous and in many cases cumulative in their effect. These exposures now begin at or before birth and - unless we change our methods - will continue through the lifetime of those now living. No one knows what the results will be, because we have no previous experience to guide us." Since she made these remarks rates of cancer and other diseases that may be related to pesticide use have soared and although some important things have been done there is a need for more.

In the same introduction Al Gore elaborates on the American experience: "The Environmental Protection Agency was established in 1970, in large part because of the concerns and the consciousness that Rachel Carson had raised. Pesticide regulation and the Food Safety Inspection Service were moved to the new agency from the Agriculture Department, which naturally tended to see the advantages and not the dangers of using chemicals on crops. Since 1962, Congress has called for the establishment of review, registration, and information standards for pesticides - not once, but several times. But many of these standards have been ignored, postponed, and eroded. For example, *when the Clinton-Gore administration took office, standards for protecting farm workers from pesticides were still not in place, even though the EPA had been "working on them" since the early 1970s* [my italics]. Broad-spectrum pesticides such as DDT have been replaced by narrow-spectrum pesticides of even higher toxicity, which have not been adequately tested and present equal or even greater risks" The slowness of progress described here, in a country such as America is particularly alarming in the context of developing countries.

However, finding a solution is not an easy task. Dinham (1993)²⁹ argues that it is not yet clear whether tighter information disclosure requirements and trade controls on the export of banned or severely restricted pesticides can effectively reduce the hazards posed by powerful agro-chemicals in the South. Instead, research effort and financial resources ought to be switched from 'risk reduction' and 'safe use' procedures, towards developing more environmentally-friendly techniques of sustainable agricultural production.

This is essential if the health and environment of producers and consumers alike are to be protected.

One option might be the organic option. The Ghana Organic Agriculture Network (GOAN) has 70 member groups and organisations and interest is growing. GOAN has become a forum where farmers and groups can share their ideas and experiences and a number of workshops have been organised by international organisations such as IFOAM (International Federation of Organic Agriculture Movements). Such workshops are crucial to ensure that sustainable farming methods in Ghana are promoted and adopted (HDRA 1998³⁰).

3.3.8 Harvesting

At the time of this field work crops were not being harvested and therefore it was not possible to assess the quality.

Harvesting is a labour intensive activity and for maize at least, the crop is left to stand for about 1 month to dry in the field. Cassava is also stored in the ground. The crop is then harvested and can be stored unthreshed in field-site stores. The crop is often threshed in the field as the grain is less bulky to head-load to the settlement for immediate sale, domestic use or further storage and marketing at a later date.

3.3.9 Storage

Storage in Africa can be affected by various factors often combining to increase the detrimental effects. Insects for example can thrive in conditions of high humidity, causing grain loss, especially on the more susceptible HYVs. Some factors for consideration are: temperature, moisture, grain respiration, condensation, relative humidity, oxygen content of the store and the presence of micro-organisms, insects, rodents, birds and reduced availability of traditional building materials.

The information on on-farm storage in Africa is limited compared to that available on production and marketing³¹. The average cereal grain loss was estimated to be 5% or less³². In southern Africa it has been found that the recent liberalisation of grain markets has meant that farmers have to store more of the harvest than in the past and losses have increased.^{33,34}

In Ghana Maize is stored in a traditional barn or crib. The supporting posts are made of bamboo and the ventilated sides made from corn stalks. The roof is usually thatched but can be made of corrugated metal sheets. The floor is elevated at least 80cm from the ground. Picard and Proctor (1994)³⁵ comment on the design to optimise drying and storage of maize.

Traditional varieties store better than the HYV Obatanpa. If Obatanpa is to be stored then it must be treated with pirimiphosmethyl. Of course "Post-harvest treatment of any commodity is only undertaken where it will result in a reward to the owner"³⁶. Possible options include breeding improved storage qualities into HYVs, or further research into the biological control of the accidentally introduced Larger Grain Borer.^{37,38,39}

3.3.10 Processing

Food processing is very limited in most settlements. There may be one or two gari grinding machines, a few stills but mostly the product is sold unprocessed. This may be due to lack of capital to invest – often the equipment belonged to a person (usually a man) who had come to live in the settlement from elsewhere, such as an Ewe man in Gomoa Adabra.

There is scope for expansion in processing which could benefit women if they were given help with credit to establish themselves. It could contribute towards employment in settlements and add value to the product, which would also help the local economy.

3.3.11 Transport

The crop is invariably head loaded from the field to the settlement and then transported by vehicle to market. Some head-load produce to market as well when transport is not available.

In Assin and some parts of Gomoa (e.g. Gomoa Sampa), the cocoa production is linked to the Ghana Cocoa Board. Following liberalisation, the role of the board has changed and some of the roads, which were part of the cocoa lines, e.g. north of Sampa, have deteriorated.

3.3.12 Marketing

Marketing is a key factor in agricultural production. Unless there is an outlet for surplus production there is very little to be gained from increasing production above subsistence levels.

Women dominate marketing in Ghana: it is women who take the produce to market and groups of powerful women traders determine prices. In Gomoa Sampa for example 5 women were perceived as having control over the marketing.

Off-road communities are particularly disadvantaged when marketing their commodities, as vehicle owners are reluctant to leave tarred roads. Traders who visit remote communities can dictate prices as farmers have no access to their own transport and even if they did, the cost is prohibitive. The difference in price between that obtained from a trader and that obtained by direct selling in a market can be large, but the effort required to organise direct sale is too great.

In Assin the problems are acute – the district has soil and climate to support agricultural production but the infrastructure to support it is minimal. Awrobo is an excellent example of an isolated settlement that could benefit from improved access. Their market is moving further away – it is now based at Akropong Odumase 5 miles away. Their other market is along a forest track, and goods can only be head-loaded there. With the decline in the influence of the Cocoa Board, the problems could be exacerbated.

All settlements would benefit from some form of small processing industry that adds value to the product *in situ*. The processed product is often easier to transport (e.g. gari compared to fresh cassava).

3.3.13 Management.

Farmers universally welcome the idea of improved management. They are the ones who know the land best and are currently following patterns set out by their traditions and their own experiences. However they are aware that there are technologies and inputs to which they have no access. They are also aware that they need to increase their production a) to keep pace with their own family requirement b) for income and c) to reduce the country's food deficit.

The contact that settlements have with the extension services varies. Some farmers have developed a close relationship and can call upon their extension agent regularly for advice. Others do not know who he/she is and find the journey to Apam or Foso too far.

The Agriculture Extension Service itself is facing a crisis following restructuring in 1997 (Figure 1). Under the previous structure, the Regional Director of Agriculture was a figure-head, with his Regional Officers controlling their own budgets and managing the districts.

Now, the Regional officers have no budget of their own, effectively, the 8 departments and the Regional Director's office now come out of the same budget with the ROs in an advisory capacity.

This change in status has led to the previous Regional Officers being moved to the Districts where their powers are much greater than those of the previous District Officers. At Regional Development Officer level, there is a lot of frustration at the reduced fiscal power.

Although the new structure looks impressive on paper, the reality is that it will take some time to implement properly. For example, the SMSCs should be running regular training courses for the extension agents, but so far very few are functioning.

There is awareness in the extension service that farmer participation and on farm trials are important and some OFTs are conducted. However, there is some doubt⁴⁰ whether the importance of accurate data collection is well understood by farmer and the extension officers alike and the accuracy of the information is difficult to ascertain.

In Ghana, as elsewhere the least qualified people are the people who regularly visit the farmers and who disseminate advice and information to those farmers. There is scope for more participatory work with farmers – farmers are demanding more information on fertilisers, seeds, pesticides, herbicides etc but in order to develop in a sustainable way there must be more communication in both directions. What is preventing farmers adopting the current recommendations? For example the FLS have been recommending that farmers have 30cm x20cm intra-inter row planting density for maize but many farmers still plant in the traditional way. The theory is that the recommended density allows for optimum plant stand per hectare, leading to an improved yield compared with traditional planting. However, this may not fit in well with the inter-cropping practices or some other reason.

Figure 1

The agricultural extension service past and present in Central Region^{iv}

Past	Present
<p>a) Regional Director of Agriculture (Figure Head)</p> <p style="text-align: center;"> </p> <p>b) 8 Regional Officers^v, autonomous from Accra, each with office and vehicle</p> <p style="text-align: center;"> </p> <p>c) 12 District Officers (some with vehicles). Each with 1 deputy and 15 Front Line Staff (FLS)</p>	<p>a) Regional Director of Agriculture (answerable to Accra)</p> <p style="text-align: center;"> </p> <p>b) 8 Regional Development Officers who now have no control over budget</p> <p style="text-align: center;"> </p> <p>c) 12 District Directors of Agriculture each have 32 Agricultural Extension Agents</p> <p>d) Each of the 12 Districts should have a Subject Matter Specialist Centre (SMSC). Each should have a full complement of specialists from the 8 former departments</p>

3.3.14 Credit and input supply

Access to credit and problems associated with cash flow are a major constraint on farmers, especially in a season following a bad season where most of the crop may have had to be kept for domestic consumption rather than sold. Converting surplus into cash in an off-road community is a problem.

In Assin, due to the production of export crops such as cocoa, the mechanism for accessing credit was in place. More people in Assin have bank accounts and although collateral is required they, despite their off-road status have some access to credit from the banks. In some of the settlements visited in Gomoa, access to banking and official credit sources were non-existent. Some loan-sharks were in operation. The interest on seed maize can be exorbitant in some places, where the farmer is forced to buy seed on credit in return for a portion of the harvest. In a bad year it can be difficult to meet the payment and the farmer is locked in a credit trap.

In other places, people did not borrow from others but would like to borrow from a bank. However, the banks are viewed with extreme suspicion. Credit is

^{iv} Dr JP Tetteh, Personal communication

^v Agricultural mechanisation, Animal Production, Crop Production, Fisheries, Plant Protection, Policy Planning Monitoring and Evaluation, Veterinary Medicine, Women in Agricultural Development (WIAD)

given reluctantly and only if the collateral is sufficient. Access to credit to the poorest section of the population and especially to women is limited.

High inflation is a disincentive to banking unless interest rates outstrip inflation. Farmers fear that their money will depreciate whilst their costs increase and prefer to store their crop as a security.

Small co-operative credit schemes would be useful, but there seems to be some resistance to co-operatives (women for example do not form co-operatives) as people want to retain their independence. An integrated approach to credit/banking, management and marketing could be an option.

4. Recommendations

- Gomoa Sampa, Gomoa Lome and Assin Awboro should be the focus for further detailed study.

Possible topics for future consideration could include:

- Participatory research with farmers and extension services on the constraints to production focusing on management issues such as farm recording, organic farming and 'adding value'.
- Land tenure arrangements can be a disincentive to investment – a detailed study would be useful.
- A soils survey including analysis of nutrient status

BIBLIOGRAPHY

- ¹ Oduroafriyie K. (1996) Rainfall erosivity map for Ghana; *Geoderma* 74 (1- 2) 161-166
- ² Rehm S and Epsig G (1991) *The Cultivated Plants of the Tropics and Subtropics: Cultivation, Economic Value, Utilisation*. CTA [Transl. by George Mc Namara; Christine Ernstsing] – Weikersheim: Margraf, 1991
- ³ *ibid.*
- ⁴ FAO/UNESCO Soils Map of the World Edition 1/1973 Published by UNESCO Paris 1973
- ⁵ From a map Compiled by JK Sonaya, Research Officer, Soils Research Institute. From Ochi-Nokwa Basin, Cape Coast Region and part of Ankobra Basin maps available in the Institute. Drawn by the staff of the Cartography section of the soils Research Institute, CSRI
- ⁶ JP Tetteh, Department of Agriculture, University of Cape Coast. Pers.comm.
- ⁷ Ghana Cocoa Board <http://www.tcol.co.uk/orgs/ghcoco/ghacobrd.htm>
- ⁸ "The EC Chocolate Directive and its effects on Ghana's economy". A workshop held in Milton Keynes on 27 March 1998, sponsored by Milton Keynes World Development Centre and the Christian Aid Chiltern Area office (Buckinghamshire).
- ⁹ Fertilizer Guide for the Tropics and Subtropics, Jan G De Geus. Published by Centre D'Etude de l'Azote, Bleicherweg 33, CH-8002 Zurich. First ed 1967, Second ed. 1973.
- ¹⁰ Quisumbing AR, Payongayong E, Aidoo JB, Otuska K (1998) *Women's Land Rights in the Transition to Individualised Ownership: Implications for Tree Resource management in Western Ghana* International Food Policy Research Institute, June 1998 (Mimeo)
- ¹¹ Fortmann Louise, Camille Antinori, and Nontokozo Nabane. 1997. *Fruits of their labors: Gender, property rights, and tree planting in two Zimbabwe villages*. *Rural Sociology* 62 (3): 295-314.
- ¹² FAOSTAT Database
- ¹³ THE GOMOA DISTRICT ASSEMBLY DEVELOPMENT PLAN 1996-2000, developed by CEDECOM District Development Plan Preparation team, Cape Coast.
- ¹⁴ op cit Ref. 2 (Rehm and Epsig)
- ¹⁵ Research Briefs Vol 3 No 2 Jun 1995 CIMMYT
- ¹⁶ Dinham B. (1993) *The pesticide hazard: A Global Health and Environmental Audit*. Compiled by Barbara Dinham January 1993, 240pp. Pesticide Trust Publication
- ¹⁷ Federal Register: November 8, 1995 (Volume 60, Number 216)] [Notices] [Page 56333-56335].

-
- ¹⁸ Sax, N.I. & Lewis, R.J. (1989) *Dangerous Properties of Industrial Materials*. 7th edition. Van Nostrand Reinhold, Melbourne
- ¹⁹ Hallenbeck, W.H. & Cunnigham, K.M. (1986) *Pesticides and Human Health*. Springer-Verlag.
- ²⁰ *ibid.*
- ²¹ PESKEM. (1995) *The Australian Directory of Registered Pesticides and their Uses*. Compiled by K. Hamilton, Centre for Pesticide Application and Safety, University of Queensland.
- ²² Roberts, G (1997) Sydney Morning Herald Thursday, December 11, 1997
- ²³ Active Ingredient Fact Sheet: Glyphosate. *Pesticide News* 33 pp28-29, September 1996.
- ²⁴ Lamb DC, Kelly DE, Hanley SZ, Mehmood Z, Kelly SL (1998) Glyphosate is an inhibitor of plant cytochrome P450: Functional expression of *Thlaspi arvensae* cytochrome P45071B1/Reductase fusion protein in *Escherichia coli* BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS, 1998, Vol.244, No.1, pp.110-114
- ²⁵ US-EPA RED Facts: Glyphosate, September 1993
- ²⁶ *ibid.*
- ²⁷ Carlisle S.M. & Trevors, J.T. (1988) Glyphosate in the environment. *Water Soil and Air Pollution*. 39: 409-420
- ²⁸ <http://www.whitehouse.gov/WH/EOP/OVP/24hours/carson.html>
- ²⁹ *Op cit.* Ref 1
- ³⁰ HDRA (1998) GOAN grows up pp 20-21 of Growing Organically - Henry Doubleday Research Association Magazine Issue152 Summer 1998
- ³¹ Griffiths MP (1997) A review of on-farm grain storage, techniques and problems, in African developing countries. MSc Thesis, UW Bangor.
- ³² Tyler PS, Boxall RA (1984) post-harvest loss and reduction programmes: a decade of activities; - what consequences?
- ³³ Tyler PS (1994) Grain market liberalisation; implications and options for on-farm storage by small-scale producers in Zambia. Natural Resources Institute Report R2143, x +33pp
- ³⁴ Tyler PS, Bennet (1993) Grain market liberalisation in southern Africa: opportunities for support to the small-scale sector. Natural Resources Institute Report R1971, vi +150pp
- ³⁵ Picard J, Proctor DL (1994) Storage at Farm/Village Level and in Warehouses. In Grain storage techniques. Evolution and trends in developing countries. FAO Agricultural Services Bullitin 109. Pp135-164 (Proctor, DL ed.) Rome: FAO
- ³⁶ FAO (1985) Prevention of post-harvest food losses a training manual. FAO Training Series No 10. Rome FAO

-
- ³⁷ Richter J, Biliwa A, Helbig J, Henning-Helbig S (1997) Impact of *Teretriosoma nigrescens* Lewis (Coleoptera: Histeridae) on *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) and Losses in Traditional Maize Stores in Southern Togo. *Journal of Stored Products Research* 33, 137-142
- ³⁸ Gwinner J, Harnisch R and Muck O (1996) *Manual on the Prevention of Post-harvest Grain Losses*. Eschborn, Germany: GTZ
- ³⁹ Compton JAF, Tyler PS, Hindmarch PS, Golob, P, Boxall RA and Haines C (1993) Reducing losses in small farm grain storage in the tropics. *Tropical Science* 33, 283-318
- ⁴⁰ op. cit. (Ref 2)

ANNEX 1
ITINIERARY

Date	Activity
May	
14	Depart UK – Arrive Accra Initial briefing at North Ridge Hotel
15	Travel to Gomoa Meeting with Mr Sakey, District Crops Officer Meeting at Gomoa Obiri with Nana Kua Ehuron and village elders
16	Aboro: General introductory meeting with chiefs and elders Farmers' meeting Visit to fields Obiri Farmers' meeting Visit to fields
17	Adabra General introductory meeting with chiefs and elders Farmers' meeting Visit to fields Sampa General introductory meeting with chiefs and elders Farmers' meeting Visit to fields
18	Meet Kitso Balans, District Co-ordinating Director who provided 4x4 vehicle and driver from District Assembly. Travelled with Mr Sakey, Crops Officer and Nana, Agric Extension officer to Lome and then by foot to an outpost 3 miles away. General meeting with farmers Walk through fields Visit to a Chemical store at Dawrampong
19	Travel to Cape Coast Meeting with: Sam Kyeremeh, Regional EPA Officer Mr Boateng, Deputy Regional EPA Officer Ahmed Bin-Salih, Regional Co-ordinating Director SSY Opoku Regional Agricultural Officer Mr Barr, Director, Regional PPMED

20	<p>Travel to Assin with Mr Botaeng, Deputy Regional Director EPA Meeting at District Assembly, Travel in District Assembly 4x4 vehicle and Mr Hammond the Deputy District co-ordinating director. General introductory meeting with chiefs and elders Farmers' meeting</p>
21	<p>Meeting at PPMED Meeting at Department of Agriculture, University of Cape Coast Travel back to Accra</p>
22	<p>Consultative group meeting Lunchtime meeting with Benony Kortatsi, Senior Hydrogeologist, WRI Depart Ghana</p>
23	<p>Arrive UK</p>

ANNEX 2

A list of people met during Field Visit

<p>ABORO Introductory meeting</p> <p>Farmers' group</p>	<p>Nana Kodjo Ninkyi (Head of family) Openya Kwame Amouri (elder) Openya Kofi Bentum (elder) Kwamena Ogoge (Regent) Kosi Amo (family spokesman)</p> <p>Kobra Manu Kwame Amouri Sam Addo (also a mechanic) Kofi Bentum Kwesi Ewusi</p>
<p>OBIRI</p>	<p>Nana Kua Ehuron X Augustus Akator</p>
<p>ADABRA Introductory meeting</p> <p>Farmers' group</p>	<p>Nana Kojo Saakura (Chief) Kwesi Beng (Okyame) Yaw Ninsi (Okyame) + 5 other villagers</p> <p>Kwesi Beng Kwame Botchwey Kobna Odoon Kweku Ata Kwesi Kranteng Kweku Yaw Yaw Ninsin Kojo Omega</p>
<p>GOMOA SAMPA</p> <p>Farmers group</p>	<p>Samuel Ackom-Mensha (Regent) Nana Kofi Cobbah (Obatan or 'father' of town) Nana Essel Bediako (Omakrado 'organiser') Teacher Eyiah Seysie (Secretary to chief) Kobna Andan (Acting linguist)</p> <p>Samuel Ackom-Mensha Teacher Eyiah Seysie</p>
<p>LOME</p>	<p>Group of 10 farmers</p>

CAPE COAST	<p>Samuel Kyeremeh Regional EPA Officer Boateng Deputy Regional EPA Ahmed Bin Salih Regional Co-ordinating Director (Central Region) Dr JP Tetteh, Lecturer, Plant Breeding and Crop production, University of Cape Coast SSY Opoku, Regional Agricultural Officer Mr Aboateng Department of Feeder Roads KA Barr, Director,PPMED Nickola Osei PPMED Credit and Marketing Division</p>
FOSO	<p>Honourable Mr Abraham, Assin District Chief Executive Mr Hammond, Deputy District Chief Executive JB Dankwa, Presiding Member of Assembly A Osei Agyeman District Co-ordinating Director</p>
AWROBE	<p>Nana JK Tandoh, Okyame and 4 elders Farmers' group: Comfort Dede Kofi Adu Margaret Penstil Grace Jack JK Opoku</p>
ACCRA	<p>Consultative group: Dr Renatu Al Hassan Mr Nicol Ernestina Armah Mr Senaco Mr Seth Afikorah Danquah Mr Aypong</p> <p>Others: Mr Benony Kortatsi WRI Ms Linda Fox, British Council</p>