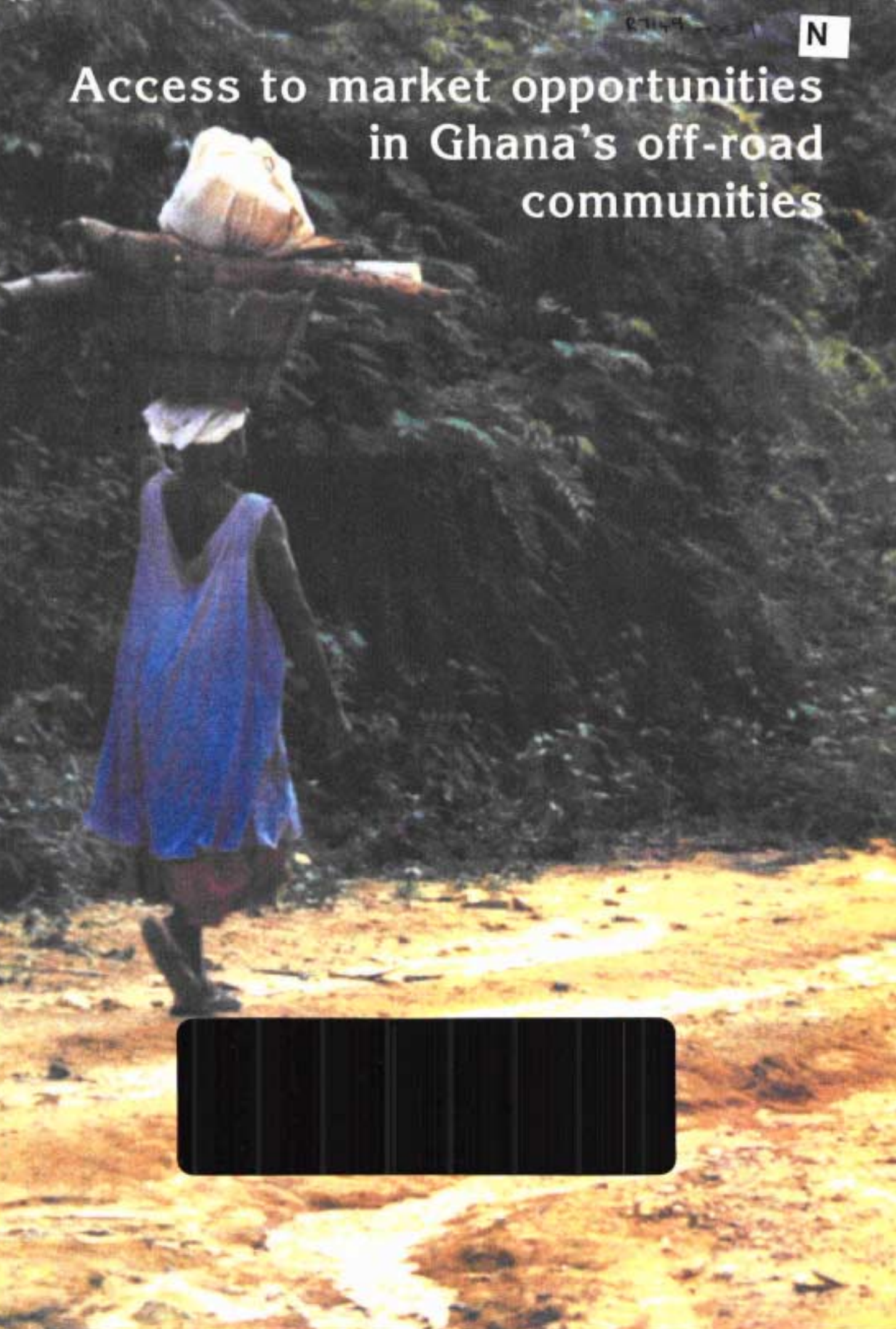
Access to market opportunities in Ghana's off-road communities



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

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Processing and Storage Issues

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DFID CROP POST-HARVEST RESEARCH PROGRAMME

ACCESS TO MARKET OPPORTUNITIES IN GHANA'S OFF-ROAD COMMUNITIES: PHASE 1

REPORT ON THE POST-HARVEST STORAGE AND PROCESSING SYSTEMS

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Contents

This report examines the post-harvest storage and processing systems for maize, with additional information on cassava, palm nuts and rice, in use in the off-road villages previously identified and studied by Dr Gina Porter in Gomoa and Assin districts (Porter, 1998a-d; 1999). The principal villages studied are Abora, Adabra, Lome and Sampa in Gomoa and Aworabo in Assin. Some information was also gathered from Apam, Apam Junction (Ankamoh), Winneba Junction, Akoti and Dawurampong in Gomoa and Assin Foso, Odumase Akropong and Akonfudi in Assin. Also, organisations were visited in both Cape Coast and Accra. Part of the justification for these micro-level studies may be seen in the paper by Risopoulos (1998), discussing the whole of sub-Saharan Africa and written at the

macro-level. As far as storage in Ghana is concerned he talks about the role of 'large-scale traders' and the rental of GFDC facilities. Thus while his paper, like many others (eg Coulter and Asante, 1993; Badu-Apraku and Soza, 1991; Tripp and Marfo, 1997), may be relevant at the national and macro scales in Ghana they fail to identify or seek to address the micro-level problems faced by the many off-road village communities in Ghana, particularly those outside the main maize producing regions.

MAIZE DRYING, STORAGE, PURCHASE AND SALE

Maize drying and storage

Nicol et al. (1997) (MOFA Post Harvest Management Division, Agricultural Engineering Services Department) discuss the drying and storage of maize noting that in the south of Ghana it is necessary to dry the maize after harvest. Whereas for drying larger quantities of maize, the use of a specially designed crib (allowing free passage of air) is suitable, for small quantities of grain, the simplest way is sun-drying - lay grain on a clean surface not deeper than 5cm when the weather is dry and sunny, stirring the grain frequently. Cribs, when they are required, should not be wider than 1.5m, the cobs not packed tight and the crib floor high off the ground to promote air circulation. Grain with 13-15% moisture will store well - higher moisture levels will lead to mould, germination and change of colour. The study includes the design of a simple solar drier.

Traditionally in Ghana the first post-harvest operation with maize has been to build the maize cobs into cribs for a combination of drying and storage. However, Nicol (personal communication) stressed that the crib should be regarded as a structure for maize drying and not for storage. If the farmers treat the cribs in this way, and dehusk and shell the maize as soon as it is dry, losses in the crib are quite low. However, the farmers, particularly the small farmers, tend to use the cribs also as long-term stores so that the losses from weevils and other grain borers can be much higher.

All the village informants are of the opinion that the new varieties advocated by the extension services (with the support of the banks and other organisations), although they will give higher yields are more susceptible in storage to weevils and other grain borers. The director of agriculture in Assin Foso recognises that the new maize varieties are less storable and they attract less market interest. However, some farmers do indeed grow them and perhaps grow a mixture of the local and improved varieties - so they have more faith in them than they sometimes admit.

The chief in Abora showed us a field in which is growing a mix of cassava and minor season maize. This latter was sown in August and September and was being harvested in January. Some is harvested green, for immediate domestic consumption, but most other cobs are left to mature. There is no problem drying these cobs because they mature in the dry season. Main season maize here is sown in the period March to end April and is harvested in August. The chief was very aware of the agricultural extension advice that harvesting must be undertaken at the right stage, not immature but not too mature because that will then have attracted weevils, which will later infest the crib. Some is stored in the cribs, but, he said, mainly the grain is shelled from the cobs, treated with actellic and then bagged. However, this information was contradicted when we spoke with the larger group of elders. They said most maize is stored in the cribs. They treat the new maize varieties while they are making the cribs, spraying each layer of cobs with actellic. However, they do not treat the local varieties, which are more resistant. The extension officers introduced improved varieties, which have

higher yields than the local varieties but which have to be sprayed. Thus the new varieties are more complex to deal with which inhibits some people from using them. Farmers build the cribs at the end of main season and keep the maize in the cribs to April and May. Because there is more sun the maize becomes drier and harder and stores for longer, but about one third is lost to weevils; the percentage lost depends in part on how long the mature cobs stayed in the field before harvesting. Length of storage depends also on the financial needs of the person. Note that harvesting, weeding and preparation for the minor season occur in the same months, therefore there is not enough time to treat the grain properly. Also, the cost of the treatment prevents some farmers using the recommended chemicals. They do, however, believe that if the maize is treated properly they will recoup the cost, but shortage of time, low prices at harvest and no money mean they do not do it.

In Abora the maize is dried in a traditional rectangular crib, made of poles with walls of maize stova, raised high off the ground. They used to make more cribs on the farms and not in village but in 1983 there were bad bush fires that burned the cribs on some of the farms. Also, it was a poor year and so some people stole from the cribs. Therefore, since then, they have made many cribs in the village, but this means they have to carry all the cobs to the village, and do this at a stage when the grain is still heavy with moisture. From the farm cribs they dehusk and shell the cobs in the field, just take the shelled maize to the village, headloaded by men and women.

In Adabra it was said that of the main maize harvest some is stored in cribs and the remainder is shelled and sold straight away. In the cribs, after long storage there will be 50% losses mainly from weevils, therefore it is advisable to shell and treat the maize with actellic and store in sacks. However, according to the chief, most farmers store in cribs, sometimes because of lack of knowledge about the use of bags. Like the chief in Abora, the chief in Adabra is aware that if the cobs fully dry on the plant this gives time for the weevils to get into the grain and therefore affect the cribs badly. Minor season maize suffers less from weevils because it receives enough sunshine to dry properly and farmers have sufficient time to work on it.

In the nearby village of Awukutor we sat by a crib with a group of farmers and talked about the drying and storage of maize. The crib was made 5 months previously, at the end of the main season in 1998. It is an Ewe crib, only raised slightly from the ground but sufficient to keep out rats. The crib is round, several meters in diameter and with maize cobs tightly packed in the wall, and solid in the interior, which will greatly reduce air circulation and slow the drying process. The crib has a thatched roof. The crib contains the whole harvest from one farm. Other farms usually have a crib each, sometimes larger. They start to take cobs from the cribs in February, to limit losses from weevils, and use the cobs gradually, some for consumption but more for sale. They try not to sell any before Christmas because they want to keep the grain like money in the bank. They shell the maize and take it in bags to Kasoa market. The weevils, the men estimated, take 20% of the grain. At harvest they employ no special treatment measures. They would like to store for long periods, up to May, but cannot because of the weevils.

In Lome the chief informed us that the maize is harvested in August and September and that most of the cobs are built into cribs. They hire labour; separate large cobs from small ones and store the large ones. Small ones are consumed or sold immediately. The cobs remain in the cribs until prices rise. They use the rectangular crib, and most are built on the farms. They may start to open the cribs in December and January, but continue to withdraw the cobs from them up to May. Some farmers use actellic in the cribs on the farm - taught how to do so by the extension officers but people now apply the actellic for themselves. They may

make up to three treatments: first dip the tip of the cob into actellic and also spray, second and perhaps third, spray on top of the maize. If the cobs are harvested late, losses are heavy but losses may be as little as 10% or less if the maize is shelled early. Loss rates depend on the farmer; when harvested, how treated, when shelled and how dried and stored.

In Sampa we saw an example of traditional maize storage in the chief's house; a high deep shelf built along one wall and filled with neat rows of maize cobs. Another tradition was to keep maize in a crib in a kitchen so that the smoke from the fires would keep the weevils away. Also in the village are the traditional Gomoa style cribs, but walled with split bamboo rather than maize stova as in Abora. They make very little use of actellic - they have no instructions about how to apply it. They may use ash or leaves of a plant - acheampong - to help protect the maize from weevils. The leaves of the plant are placed in a thin layer at different heights of the cobs in the crib. They use traditional varieties of maize because they keep for a long time. Hybrid varieties keep for only a short time. Very little maize is stored shelled. They like to sell the maize in April, but may sell sooner because of financial problems earlier in the year; even before Christmas because the festival requires money. Most cribs are in the village because of security problems on the farms. They can lose as much as 25% or 50% or even more of the maize in the cribs. If they sell before Christmas the price is low (need cash for Christmas) and losses may be only 10-20%. If they keep until April the losses rapidly rise - to 60 or even 75% in the case of the varieties recommended by the agricultural department. One lady farmer said that she produced 5 mini bags last year of local maize but lost one and a half. I commented that the losses seemed huge, and asked what action should be taken. They replied there is nothing to be done because they get no help from the agricultural extension officer. Because of the losses, they are short of money, and this means they cannot expand their crop area or even pay the required labour. The chief thought that if the extension officers would show them how to make an improved small silo/crib from local materials, the people would undertake the construction work.

A woman maize trader from Sampa owns a farm and stores her own maize in a crib at the farm without treatment because the quantity is too small to make treatment worthwhile. She withdraws cobs from the crib when she needs money, and she knows that the longer the maize stays in the crib the higher her losses will be.

In Odumase, according to the chief in discussion with a group of other farmers, they store the maize in cribs but they do not treat it. Traditionally they used to make the cribs indoors, above a fire in the kitchen, and it was only when they started to grow more maize that they started to construct the cribs outside. Those today with a little maize may still keep it in the kitchen above the fire. The maize lasts longer as a result of the combination of the fire's heat and smoke inhibiting the weevils. Outside, they make the cribs in the village, but when the farms are a longer distance away from the village the cribs are made on-farm because of the difficulty of carrying the whole maize cobs to the village. They don't know much about how to use chemicals to preserve maize. The extension officers talk to them about the use of chemicals but there is no money or else the production is too small to be worth treating. Other people said that the extension officers do not come often, and people do not follow their ideas and therefore there is no change. The young men are moving to the cities, which is also making it difficult to find workers to grow or store the maize properly.

Those people who are not forced to sell after harvest, make cribs. Having made the cribs, they start to take maize from them in January, February and March - by the end of March usually there is none left. The highest price is at the end April and May but a few people on wet land are able to sow early in January and therefore are able to compete with maize when it is taken from the cribs in April and May. One man estimated losses by saying that of 30

mini bags 10 would be lost by the end of March (though perhaps used for lesser purposes such as feeding poultry). They sometimes inspect the cribs early and then if they see that there is an infestation they withdraw the cobs early. But in the past two years the yield has been poor and therefore they have not stored much. Another speaker produced 10 mini bags and had a 10% loss because he took the grain early from the crib because it had been a poor harvest. A third man had 40 mini bags of the variety recommended by the agricultural extension officers - he said it is less resistant to the weevils and he lost 10 bags - which he had fed to his poultry. He had harvested as early as July and started to take the cobs from the crib in November and December because he knows that the recommended varieties do not keep very well.

In Aworabo, according to four young farmers, maize is kept in cribs in the village. All four of the informants have cribs. One said he has losses up to one-third of his crop, and the others said up to two-thirds. None of the four treats his maize in the crib. They say they allow the crop to spoil because no one comes to buy the maize. Nevertheless, although sounding so tolerant of this position, they said the losses were a big worry.

The director of agriculture at Assin Foso gave a useful overview of the area and its problems. Weevil infestation of maize starts in the field, and is due to untimely harvest; letting the maize dry in the field and thus allowing weevils to have access to the cobs. The extension officers say that early harvest is required to avoid pest infestation. The farmers adopt no effective strategies for increasing yields or improving storage. Apart from weevils, because the area is moist there are also problems from fungal attack. If people use cribs, the extension staff recommend the narrow crib (not more than a metre wide) to allow for good drying. The traditional crib varies greatly in width. Some people store the maize in the kitchen but smoke is not very effective against weevils. The farmers may also cut and leave the maize cobs in heaps in the field or the house and this also encourages infestation. The main advantage of drying properly is to avoid fungal problems, to which the farmers give little consideration. Fungal attack discolours the grain and then people are unlikely to buy it even though cooking will remove any possible toxins. The advice is to dry the shelled maize as much as possible, which is done on the floor before storage in bags. The extension department recommends the use of chemicals, mainly actellic against weevils and super actellic against the large grain borer. Usually the farmers should use both. They also advise using actellic at the rate of 5ml/100kg of maize (ie one teaspoonful or one fanta bottle top full) mixed with water in a small milk tin (100ml), sprinkled over the grain and then left to dry. He recognises that having to buy a whole litre of actellic will put off some people (a complaint made by a woman in Sampa), but he says it may be possible to obtain miniature bottles retail. He also said that actellic is not effective when the grain is still on the cob in the husk. Stacked cobs give easy access to the grain borers, therefore it is important to shell the maize at harvest and apply the chemicals. If because of time constraints it is not possible to shell the maize early, it must be done after a maximum of 3 months and chemicals then applied to the grain.

The main points contained within the above descriptions of local practice are:

1. If maize is placed into cribs it should be for drying and not for storage. When farmers regard cribs as a maize store, leaving the cobs for several months, losses from weevils and grain borers can be severe.

2. The village chiefs, elders, farmers and traders spoken with, tend to agree that the traditional varieties of maize are more resistant to predation by weevils and will fetch higher prices in the markets but give lower yields.

3. But in spite of problems with storage and sale, improved maize is grown by some farmers in the off-road villages, in part because the hybrid maize is promoted by the extension services and also matures earlier and gives a higher yield.

4. The workload for farmers in the months of September and October is severe; harvesting the main season maize, making the cribs, clearing land for the minor season maize and sowing the new crop. Under these circumstances, and given either a shortage of labour or shortage of money to employ labour, the timeliness of some of these operations tends to slip. Serious problems can be caused by harvesting the main season maize when it is very mature, because this will have given time for infestation of the cobs by weevils.

5. Losses after long storage due to weevils were variously estimated at up to 50% (Adabra), 20% (Awukutor), 10% (Lome, maize is shelled early), 25-50% (Sampa), 10-20% (Sampa, if they shell before Christmas), 10-33% (Odumase), 33-66% (Aworabo). Even if some of these reported losses are exaggerated, the losses when the crib is used as a long-term store are severe, even if some is used to lesser purposes.

6. Traditional methods for reducing losses in storage include smoke (storage above kitchen fires), ash in the crib, thin layers of the plant, acheampong, in the crib.

7. Actellic is promoted by the extension services to limit or eliminate predation by weevils. However, farmer knowledge of how to apply actellic is very variable. Some farmers use it in the cribs but (according to the director of agriculture in Assin Foso) it is ineffective in the cribs because of the maize husks.

8. Crib design appears to follow tradition (eg the difference between the Gomoa and the Ewe cribs) rather than advice by the extension services, which encourage narrow cribs with good air circulation.

9. According to the director of agriculture in Assin Foso, farmers give little consideration to the danger of losses due to fungal attack. Thus they will even heap fresh maize cobs in the field on the ground, thereby exposing the cobs to moisture and fungal attack.

The silo at Mprumem

In an attempt to improve and facilitate the storage of maize grain the government of Ghana arranged for a series of silos to be built in the late 1980s as a World Bank Project with the local Ghana Food Distribution Corporation, PO Box 4245, Accra. The silo at Mprumem is the only one in the central region. Accra has one and more were constructed in the Western Region, Ashanti and Brong-Ahafo because all three regions are important maize producers. We spoke to the local manager of the silo at Mprumem, Mr Benjamin Adu. The silo has 4 storage bins and 3 drying bins. Each storage bin holds up to 2500 mini bags (of 50kg). The bins have never been full and in fact the maximum ever stored here has been two of the four bins. Most grain arrives at the silo in September and October. Farmers bring their own maize and the silo dries and stores it for them. Normally the grain is kept loose, and when a bin contains grain of the same quality the silo just measures the amount of grain back to the farmer that he brought in. When they have different qualities they can tag and keep it in mini bags of 50kg. They like to keep one bin for good quality maize (the a grade); then there are b and c grades. If people bring the grain in bags it can be stored in bags. They can store it for up to 3 or 6 months or even a year. Most maize is taken back by the farmers in May and June, when the market price is high. The silo offers a comprehensive package of services (Table 1) allowing farmers to undertake some of the work themselves, before coming to the

silo, and therefore reducing the silo's charges. The most expensive single service is drying, which costs 2400[1]/mini bag when reducing from the 'normal' moisture level (in September, October) of 19-20% to 12.5%.

Table 1. Services offered by the Mprumem silo and charges for 98/99 season
(mb = mini bag = 50kg)

Shelling	600/mb
dehusking and shelling	700/mb
cleaning and rebagging	1000/mb
rebagging only	500/mb
drying (including cleaning) - they store at 12.5% moisture. Taking it down from 13.2-14.1% to 12.5% Taking it down from 26.2-27.1% to 12.5%	 1300/mb 3800/mb
Storage costs (pay each month, or before taking the grain from the silo)	200/mb/month
Fumigation and spraying through the maize*	180/treatment
Amixture (for the room)*	200/treatment

* (the above treatments are usually every 2.5 months; but fumigation and spraying is fumigation every 2.5 months and spraying every 2 weeks, at combined 180/2.5 months.

Losses in storage due to pests are almost none. The apparent losses, due to cleaning and drying, are less than 10%. Note that according to the silo manager's notes, 51kg drops to 50kg upon cleaning. Drying from 18.5% moisture to 12.5% entails a weight loss from 55.7kg to 50kg; 19% to 12.5%, 56.0 to 50kg; and 20.0% to 12.5%, 56.7 to 50kg.

Farmers who use the silo come from Swedru and surrounding area, Asamankesse, Cape Coast, and places in Brong-Ahafo. Last year only 7 farmers used the silo, and this year only 5. The highest quantity brought by a single farmer is about 5000 mini bags, down to 500 mini bags with an average perhaps of 900. They are big farmers or farmer cum traders. However, the smallest amount the silo would accept is one mini bag, therefore in principle the silo can work with small farmers. The local farmers, I said, know little about the silo. He replied that the extension officers should be informing them and in any case the GFDC advertises in the media. He says that although the silo is only part full, it does make a profit but the profits go to GFDC, not to the local community as stated by the Chief of Abora village.

He said that in order to increase the volume of grain coming into the silo he must link very closely with the extension officers. The government should give GFDC some funds for farmers so that they only pay their dues at the moment when they sell the grain. In a variant of this approach, he said that GFDC should allow the farmer to take and sell part of his maize, then pay the silo, then take the rest (he does this already for some big farmers). However, the manager of Akyempim Rural Bank Ltd, in Dawurampong town, said that the Bank had considered the possibility of supporting the small farmers so that they could use the silo but that it would not be profitable. However, under some circumstances this may not be the case. For example, taking the case of a farmer in Abora who has one hectare of land under maize, and obtains a yield of 1.2 ton/ha (or1200kg/ha), equivalent to 24mb[2]. If he sells

[1] Prices in cedi unless otherwise stated.

[2] According to the Director of Extension in Assin Foso farmers slash and burn without using the cut material as a mulch, they tend to use no fertiliser, they do not weed properly and they are reluctant to use the hybrid maize varieties. Therefore, they have a low yield of 4-6 bags/acre, equivalent to about 1.2 ton/ha. If the rains are good and the husbandry is good (notably the weeding) and if they sow early, in March, and weed well throughout the growing period then they could achieve a yield of 6-7 bags without the use of fertiliser. But it is possible to obtain 8-12 or even 15 bags if they use fertiliser. In practice, he said, the average yield is 1.2ton/ha, but that a good yield could be up to 5ton/ha with the use of fertilisers.

at harvest he receives 1917 per rubber or 19,170/mbag[3]. If he sell at the height of the market, in May, he receives 51,750/mb (see Table 2). But he loses one-third of the crop. If he takes the maize after initial drying to the silo, he loses none of the crop but the transport costs are 74,000 to the silo and then 74,000 from the silo to the market. The grain stays in the silo for 8months, Oct to May and is then sold at 51,750/mbag – though this year the price has been lower.

Based on the above assumptions (but ignoring the costs of providing credit to cover the silo costs) it would be profitable for the farmers to use the silo if their on-farm storage losses would have been one-third of the crop. The net benefit (Table 2) would be 28% of the value of the grain sold from the crib. But if their losses would have been 20% or less, they would have gained only 5%, which would have been a loss when taking any credit charges into account. It is interesting (Table 2) that over one-third of the total cost of using the silo is transport costs.

Table 2. Comparative costs of storing in a crib and using the Mprumem silo

Sell at harvest		Totals
Yield	1200kg	
Loss on farm	400kg	
Market values, farm		
Sell Oct, 19,170/mb	24*19,170	480,000
Sell May, 51,750/mb (loss 33%)	15.8*51,750	819,720
Sell May, 51,750/mb	19.2*51,750	993,600
Sell May, 51,750/mb	21.6*51,750	1,117,800
Market value, silo		
Sell May, 51,750	24*51,750	1,242,000
Silo costs:		
Transport to silo **		74,000
Transport from silo to market ***		0
Dehusk and shell ++	24*700	0
Clean and rebag	24*1000	24000
Dry (20% to 12.5%)	24*2400c	57600
Store	24*200*8	38400
Fumigation and spray	180*3	540
Amixture	200*3	600
		195,140

Net benefit of using the silo (comparing sales in May from silo and from farm:		
Store in silo (no losses)	1,242,000	
Costs of using silo	195,140	956,060
Net	1,046,960	1,046,960
Store in crib on farm (33% losses)	819,720	819,720
		227,140 (+28%)
Store in crib on farm (20% losses)	993,600	993,600

[3] A mini bag of maize weighs 50kg and the official weight of a maxi bag (which measures some 54" long by some 27" wide)is 100kg. However, people tend to overfill the maxi bag and they also have two weight variants of the maxi bag: a 'bush' weight of perhaps 110-120kg and a 'city' weight of up to 150kg or more. When the bags are completely filled an additional piece of material may be sewn across the top as a kind of lid, which partly explains the extra weight. Other local measures are also used. In Abora, for example, we saw the large olonka, which is a large tin can, while in the markets the traders use a small olonka (a smaller tin can), which creates the possibility of selling more olonkas than are bought and thereby increasing the return. The millers also use another measure, the 'rubber', which may be a plastic bucket measuring about 9" in diameter and about 9" in height. In Abora there are two and a bit large olonkas to a rubber. It is said that there are 10 rubbers to a mini bag, and therefore a rubber weighs 5kg. Rubbers are the 'standard' measure used by the millers in all the villages visited and in practice the few that were measured all approximated to the 9" by 9" size (tapering to 7"). However, in Odumase we also came across a rubber, made of plastic, which had a top diameter of about 13" and a height of about 6". It was said that two of these latter rubbers in Odumase equalled 3.5 of the bucket-shaped rubbers found in Winneba.

		53,260 (5%)
Store in crib on farm (10% losses)	1,117,800	1,117,800
		-70,940 (-6%)

** Based on the cost stated by a trader in Sampa for taking a 30 mini bags of maize from Sampa to the nearest market – 3000/mb plus 1000 each way for the person. Therefore, 24mb would cost 72,000 plus 2000.

*** Not counted because the farmer would have had to take the maize to the market from the village in any case.

++ Done by the farmer

It is instructive to note some of the comments made by farmers and traders when asked about the silo. A group of farmers at Awukutor, (a suburb of Adabra) had not heard of the silo. The people in Abora know of the silo but do not send maize there for a number of reasons: because they believe it can last as long in a crib, because of transport costs, because they must pay some dues there, and because it is time consuming. Some thought that the silo may have fewer losses but at higher costs.

The chief in Abora spoke at some length about the silo. He said the village had not been told by any extension officer about usage of the silo, or even if they can use it. If he could get information he would be interested to think about it. The silo was built, he falsely believed, by the District Secretary, for Mprumem Unit. He said therefore that any revenue collected would go to the people in that Unit. So, if the people of Abora use the silo the money will go to develop Mprumem. They have been encouraged to believe that each community should undertake responsibility for its own development under the community Unit Committee. He said that each Unit should have a small silo or other form of modern storage together with access to storage chemicals, and therefore any income generated would stay in the Unit.

In Sampa the village Chief said they know about the silo but they do not use it. They know that people can store maize there and that the produce will then last longer. However, they are subsistence farmers and do not have plantations and therefore use local methods. To get to the silo also requires a car, which is a big problem - they would have to pay the driver but then the storage would not be profitable. The village chief in Lome wondered whether a smaller silo could be built at Lome. He even said that if the agricultural extension officers showed them how to make an improved silo using locally available materials, the people of Lome would build it.

The District Chief Executive at Apam is aware of the problems faced by small farmers wanting to use the silo and believes that a support system being tested at the silo at Ejura would help. This appears to be an inventory credit scheme whereby the farmers can obtain a loan on the strength of having maize in storage as collateral – the rate of interest is 35%.

But farmers do not trust the management of the silo, fearing that they would lose part of their grain through pilfering.

The main points are:

1. The silo is very underused (has never been more than half full). Given the costs of building and operating the silo, more effort should be made to attract other users by a more imaginative pricing of its services, offering additional services, inventory credit and better promotion aimed at smaller producers.
2. Under current prices for the services offered, a small farmer would make a profit by using the silo of some 28% over long-term storage in a crib if this led to 33% losses. If it led to 20% losses, the gain by using the silo would be only 5% (which would be offset by credit charges). If it led to 10% losses, using the silo would lose more money (even before taking credit charges into account.

3. The figures given in point two, above, do not take into account the time-cost saving of not having to make the crib, if the silo is used. They also assume that the maize is dehusked and shelled by the farmer before taking the grain to the silo. But this is not costed either, because the work would have to do undertaken at some later stage in any case.

Maize traders and trading

Maize traders are found in each of the off-road villages. All those spoken to were women with the exception of one partially disabled man in Lome who also managed a tiny shop. Reportedly the number of traders is: 2 in Abora, 6 in Adabra, 20 in Lome, 7 in Sampa and 10 in Odumase (Annex 1).

The entrepreneurial qualities of the women traders are, perhaps, indicated by the different ways in which they operate:

- Abora: buys up to 60 bags at 1500/r, stores with actellic, and hopes to sell in Mankessim market at 5-6,000/r
- Adabra: The 6 traders buy using a large olonka and sell in the market using a smaller olonka and a difference of price per olonka. The mark up is about 50-100 cedi (price depending on quality and on the day). The mark up meets the fare of the driver. The smaller olonka gives the women their profit. Highest market price last year reached 1200 but can go up to 2000.
- Lome: buys 50-100 bags at 2000/r, stores with actellic, and sells at 4000/r in the markets at Mankessim, Bawjiase and Kasoa for cash though she is also prepared to take credit. She uses 5ml of actellic per mini bag. Transport to the market, for a load of 30mb cost 3000 per bag plus two one-way seats for herself at 1000; total 92,000 cedi.
- Sampa: the two women spoken to are busiest in September and October but also buy at other seasons though very little in May to July. They buy in Sampa and also Akropong, near Sampa. One woman buys up to 20 bags at a time but sells on the next market day, without storing. She sells maize to buyers from Winneba, Dago, Emmuna, Grafa, Arkra, Mankessim and Cape Coast.
- Odumase: she buys, treats and stores up to 15mb of main season maize and makes it into banku in March to May when the price is high. She also buys at other seasons a little at a time in order to keep her banku business going.
- Odumase: she buys, treats and stores, and take her bags of maize for sale as far as Winneba and Accra, partly profiting from differences in the size of the rubbers used for purchasing and sale.

If the woman trader in Lome, who described herself as average, buys 75mg at 2000/r, treats them with actellic (5ml per bag) for 16,875, takes the bags to market at the cost of 92,000/30mb, and sells in the market at 4000/r, her net income is 1.20mn cedi (Table 3), equivalent to £313 (£1 = 4000cedi). This annual income compares well with that of the average miller (Table 11a-b), though it assumes zero storage costs because the bags are kept in her house.

Table 3. Net annual income of the woman trader interviewed in Lome

Action	Bags	Rubbers equivalent	price	Total
Bag purchase	75		2000/bag over 3y	50,000
Purchase	75	750	2000/r	1,500,000

Actellic treatment	75		45,000/200mb	16,875
Transport	75		92,000/30mb	230,000
Total costs				-1,796,875
Sale	75	750	4000/r	3,000,000
Net income				1,203,125

In general, perhaps because the traders are small entrepreneurs with a knowledge of both their village and the markets, they give the impression of being better informed, or more pro-active, than the farmers not only about trading but also about storage. The trader in Abora, for example, not only knows that actellic reduces storage losses but is prepared to pay the extension officer to treat the maize for her. Both of the traders in Lome with whom we talked, treat their maize. And one of the traders in Odumase, and one in Lome, gave detailed descriptions, that might have been given by the extension officer himself, of exactly how they treat their maize before bagging it. The woman trader in Lome uses actellic but complains that she has to buy a whole litre for 45,000 when she only needs a smaller quantity.

Some of the traders said that they would buy more maize for treatment and storage, or store more of the maize they buy, if they had more working capital.

According to the manager of the silo, and Frank Owusu Acheampong, in the two previous years a mini bag of maize could be sold in the high season to wholesalers at 40-45,000 cedi but last year it was difficult to get 30,000. Poultry farmers buy direct from the mill, because they obtain the wholesale price. They have the transport because the need a lot of grain.

In the local markets the price of a mini bag maybe 14,000 in January (the time of the discussion), and 24,000 at Christmas. In Swedru in January the price was 33-35,000. Bawjiase was 26,000. Highest local wholesale prices are in April and May - maybe up to 40,000 and above this year. The large wholesalers may sell at 45,000 to the traders, and thus 50-55,000 to the retailers, and thus 55-60,000 to the consumers. Thus the local price obtained by local people in the market is about equivalent to the sale prices from the silo to wholesalers.

Information was also collected direct from a number of traders in the off-road villages (Annex 1). Inevitably their responses were generalisations but they do indicate (Table 4) the main local market movements. Some of the volume units used in Abora are expressed in terms of the large olonka (Table 4a) which means that they cannot be compared with the others buying and selling prices. Otherwise, the mean purchase prices (Tables 4b-4g), ie farmer to local woman trader, (in cedi per rubber) were: 1917 (low season), 3117 (mid season) and 5000 (high season). The mean sale prices, ie trader to purchaser in the market, were: 2200 (low), 3300 (mid) and 5175 (high).

Table 4. Maize buying and selling prices, by season and village

Table 4a. Abora – large and small olonka

Village	unit	Buy / Sell	Amount (cedi)	Season	Comment	Comments	See notes
Abora	LO	B (minor season)	800	Jan			
Abora	LO	B (major season)	1100	Jan			
Abora	SO	S	850-900	Jan	market		
Abora	SO	S	1150-1200	Jan	market		
Abora	SO	S	2000	High	market	highest	
Abora	SO	S	1200	High	market	1998	

Table 4b. Low season purchases

Village	unit	Buy / Sell	Amount (cedi)	Season	Comment	Comments	See notes
Odumase	R	B	2000	Jun-Aug			6
Abora	R	B	1500	Low		1998	1
Lome	R	B	2000	Low			2
Lome	R	B	2000	Low		1998	3
Sampa	R	B	2000	Low			4
Odumase	R	B	2000	Low			5
		MEAN	1917				

Table 4c. Mid season purchases

Village	unit	Buy / Sell	Amount (cedi)	Season	Comment	Comment	See notes
Odumase	R	B	3250	Dec			6
Abora	R	B	2700	Jan		1998	1
Sampa	R	B	3400	Jan-Feb			4
		MEAN	3117				

Table 4d. High season purchases

Village	unit	Buy / Sell	Amount (cedi)	Season	Comment	Comment	See notes
Sampa	R	B	5500	May			4
Odumase	R	B	4500	High			6
		MEAN	5000				

Table 4e. Low season sales (in market)

Village	unit	Buy / Sell	Amount (cedi)	Season	Comment	Comment	See notes
Sampa	R	S	2200	Low	Market		4
		MEAN	2200				

Table 4f. Mid season sales (in market)

Village	unit	Buy / Sell	Amount (cedi)	Season	Comment	Comment	See notes
Abora	R	S	3000	Jan	market	1998	1
Sampa	R	S	3600	Jan-Feb	Market		4
		MEAN	3300				

Table 4g. High season sales (in market)

Village	unit	Buy / Sell	Amount	Season	Comment	Comment	See notes
Abora	R	S	5500	High	market	1999	1
Lome	R	S	4000	High			2
Abora	R	S	5500	High	market	1999	3
Sampa	R	S	5700	May	Market		4
		MEAN	5175				

Notes:

1. Abora woman trader: now 15mb in store; agriculture treated for total of 12,000
2. Lome woman trader; 50-100mb each year; she is average of 40 traders. Actellic costs 45,000/l
3. Lome man trader; 23mg in 1997; 33 in 1998
4. Sampa market, woman trader, does not store, buys c20mb at a time
5. Odumase woman trader; makes banku with the maize
6. Odumase woman trader; she sells in Winneba Junction – but her selling prices are not clear

The main points are:

1. Almost all the traders are women and they give the general impression of being more aware of and responsive to advice given by the extension officers about treatment and storage than are the men farmers.
2. Different traders illustrate different patterns of purchasing, storage and usage or sale dependent in part on personal circumstances, working capital and response to differing market opportunities.

3. If the woman trader in Lome, who gave a full description of her annual activities, is indeed average, her net income of 1.25mn cedi compares well with that of the average miller in the off-road villages being studied. The profits of the traders depend on a knowledge of the markets and on the marked price seasonality of maize, from a low in September-October to a high in April-May.

MAIZE PROCESSING

Milling and grating costs

Information was obtained from 14 mills in 12 villages in the two districts of Gomoa and Assin about the crops with which they work, the kinds of processing undertaken and the amount charged for each of the different processes (Annex 2). The information is summarised in Table 5. Overall, maize is the main crop processed by the mills. Cassava graters were also used at some mills in Gomoa, palm nuts were ground in some mills in both Gomoa and Assin, and rice was polished in some mills in Assin. The main activity in all the mills is grinding soaked maize for making banku (Annex 3). Lesser quantities of dry maize are also ground, as is a small amount of fried maize. All mills therefore have a grinding machine, in which palm nuts are also ground. A few mills also have a maize polishing machine. In Gomoa several mills have cassava graters. In Assin, where more rice is grown, some of the mills have rice-polishing machines. As we have seen, to some extent, as far as milling is concerned, 'off-road' equates with 'off-electricity'. In the settlements along the tarred road that also have electric power, there is a general move away from the use of diesel engines for driving the grinders, polishers and graters in favour of the use of electric motors. In Abora we were told in group discussion that where in the off-road villages diesel engines are used, the price of grinding wet maize is 500 cedi/rubber and for polishing maize is 400 cedi/rubber. However, where electric motors are employed, the prices are 300 cedi and 200 cedi respectively. These price differentials are indeed suggested in the data in Table 5 where the mean charge for soaked maize is 467 cedi when diesel engines are used, and 410 where an electric motor is used. The differential for maize polishing is 400 and 250 respectively. If these differences are real, and attributable to the engine used, it will be due to the difference in costs of maintaining the engines; electric motors have very low maintenance costs. However, the differences may be due to off-road factors (rather than off-electricity factors). In some of the settlements on the road there is a concentration of the mills (7 in Ankamoh, reportedly 22 in Apam, 5 between Akoti and Ojobi) which presumably creates more competition. Larger numbers of mills are also found in the roadside settlements because some people living there process large quantities of maize for commercial food preparation. In some off-road settlements the mills can charge more because the alternative would be for the women to headload the grain to the road or incur transport costs, and perhaps the mills have to charge more because of higher machine service and repair costs.

The prices for milling dry and fried maize are much higher than for soaked maize (and with a far greater standard deviation). The higher price is related to the fact that the grain is milled more than once (Annex 3). The greater variability will be related to the fact that these are relatively minor operations, with less competition. The prices for grating cassava may not be at all meaningful – the unit of measure was sometimes a large pan or a mini bag or other container of unknown volume. Similarly, there is no evidence to suggest a significant difference of milling prices between Gomoa and Assin.

Table 5. Data on milling, grating and polishing charges

Total price data obtained (in cedi/rubber)

District	Village	Diesel / Electric	Maize wet	Maize dry	Maize fried	Maize polished	Palm nuts	Cassava	Rice
Gomoa	Adabra	Diesel	500	700				500	
Gomoa	George	Diesel	400	800				1000	
Gomoa	Akoti	Electric	350	1200					
Gomoa	Ankamoh	Electric	300			150			
Gomoa	Apam	Electric	500						
Gomoa	Ankamoh	Electric	300			200		300	
Gomoa	Villages*	Diesel	500			400			
Gomoa	Lome	Diesel	400	1200	600			500	
Gomoa	Sampa	Diesel	500	800	700		700		
Gomoa	Winneba	Electric	600	1000	1000		1000		
Assin	Odumase	Diesel	400	1000	1000		500		
Assin	Odumase	Diesel	400	1000	700	400			
Assin	Aworabo	Diesel	600	1200	600				1000
Assin	Akonfudi	Diesel	500	1500	1000		500		1000

* statement made about villages near Abora

Total cases, means and standard deviations

TOTAL			6250	10400	5600	1150	2700	2300	2000
CASES			14	10	7	4	4	4	2
MEAN			446	1040	800	288	675	575	1000
ST DEV			97	241	191	131	236	298	

Totals, cases and means, by whether the milling engine is diesel or electric

DIESEL:									
TTL			4200	8200	4600	800	1700	2000	2000
CASES			9	8	6	2	3	3	2
MEAN			467	1025	767	400	567	667	1000
ELECTRIC									
TTL			2050	2200	1000	350	1000	300	0
CASES			5	2	1	2	1	1	0
MEAN			410	1100	1000	175	1000	300	

Totals, cases and means by district – Gomoa or Assin

ASSIN									
TTL			1900	4700	3300	400	1000	0	2000
CASES			4	4	4	1	2	0	2
MEAN			475	1175	825	400	500		1000
GOMOA									
TTL			4350	5700	2300	750	1700	2300	0
CASES			10	6	3	3	2	2	0
MEAN			435	950	767	250	850	1150	

Economics of milling

It would require round-the-year monitoring to obtain an accurate costing and net income from the various milling, grating and polishing activities undertaken by the millers because of strong seasonal fluctuations in the quantity of the different crops processed and the unpredictability of costs of repairs to the machinery. However, it has been possible to obtain a first approximation of income and costs (Annex 2), and therefore net income, in the following way.

a. Usage – income: Inevitably the informants were somewhat vague about the quantities they process in a year. They keep no records and there is big inter-seasonal variation. Also, even within maize there are different types and costs of processing for soaked maize, dry maize and fried maize. Then there are other uncertainties about the income earned from cassava grating (kokonte) and palm nut grinding. Concerning maize, grinding soaked maize is always the commonest work, and fried maize the least common. Here it is assumed 60% soaked, 25% dry and 15% fried; or 70% soaked and 30% dry when no fried maize is milled. I obtained no coherent information about income earned from palm nuts – but it always seemed to be a minor task. Some people gave clear indications about their busy months, their semi busy months and their leaner months. Everyone was fairly precise about the rate charged per rubber of maize, and some people gave good indications about the number of rubbers they handle on a busy day. On the basis of this information the data and calculations in Table 6 were compiled and analysed, giving a mean gross income per mill of 2,855,500 cedi per year.

b. Engine and processing machinery purchase: Information was obtained from nine millers about the cost of their machinery (Table 7). Almost everyone obtained their machinery at a cheap rate, through family or other connections or by buying second-hand. People either purchased with their own money or used family loans with no interest. Only two people had to pay interest: the miller in Adabra who purchased his maize grinder with a susu loan and had to repay 50,000 on every 200,000 borrowed, over three months, and the man with the new mill in Odumase who had borrowed part of the money from the Social Security Bank. Amortising over 5 years (for those machines purchased less than five years ago) produced a mean annual cost of about 225,000 cedi. To this should be added the cost of building the shed (two newish sheds were priced, respectively, at 385,000 and 700,000) and installing the drums and pipework of the water cooling system. One man estimated cost of cooling system at 250,000. Another man said his engines cost 1.6mn but he had to pay a further 900,000 for installation. The cost of installation and shed, again amortised over five years, is estimated at up to 200,000.

c. Operating costs: The mean estimated annual cost of diesel (Table 8) is 989,400 cedi. A miller in Ankamoh (with an electric motor) estimated his annual costs (excluding electricity) at 200,000 cedi. Other operating cost estimate means (Table 9) were 146,000 cedi. An overall mean may be 160,000 cedi.

d. Repair and maintenance costs (spare parts): The regular cost is for new plates. Other costs are very unpredictable (Table 9). They are here estimated at 150,000 cedi.

e. Other costs: It is assumed that a mill requires one day of specialist's time per year at 20,000 cedi; that the plates are sharpened once a month at 8,000 cedi (total 96,000 cedi) (Table 10).

Table 6. Mill usage / Income

(Smz = soaked maize; Dmz = dry maize; Fmz = fried maize; Lbowl = large bowl; Mb = mini bag; Pmz = polished maize)

	Crop/process	Charge/rubber	Rubber/unit time	Other rate info	Other rate info	Other rate info	Crop/season inc.	Ttl annual income
Adabra1	smz	500	13r/1.25hr	Mean 1.25hr/day	Up to 6day/week	500x13x52x6x.7	1,419,600	0
	dmz	700				700x13x52x6x.3	851,760	0
	Cass - gari	500/lbowl	10mb/1.25hr	Mean 1.25hr/day	Up to 6day/week	500x10x52x6	1,560,000	3,832,000
Akoti J	smz	350		Sep-Dec busy 350x3x25x40x.7	Jan-Feb half 350x2x25x30x.7	Mar-Aug slow 350x6x25x10x.7	 1,470,000	0
	dmz	1200		1200x3x25x40x.3	1200x2x25x30x.3	1200x6x25x10x.3	2,160,000	3,630,000
Ankamoh	Smz	300	40smz/4hr	Oct-Dec busy 3hr am; 3hrpm	Jan-Sep – fewer hr	300x40x25x3 + 300x10x25x9	900,000 675,000	0
	pmz	150	20pmz/2hr	Oct-Dec busy 3hr am; 3hrpm	Jan-Sep – fewer hr	150x20x25x3 + 150x5x25x9	225,000 168,450	1,969,000
Apam	Smz	500	16r/dy; 6dy/wk 6r/dy; 6dy/wk			200,000/mn Jul-Sep 75,000/mn Oct-Jun	600,000 675,000	1,275,000
Lome				15-20,000/dy, Aug-Oct 3000/day, Nov-July		17,000x25x3 3000x25x9	1,275,000 675,000	1,950,000
Odumase-1	smz	400 60%		Common	3.6r/dy; 6dy/wk	260x3.6	374,400	0
	dmz	1000 25%			1.5r/dy; 6dy/wk	260x1.5	390,000	0
	fmz	1000 15%		rare	0.9r/dy; 6dy/wk	260x0.9	234,000	0
	P kernel	500					?	998,000
Odumase-2	Rice pol	1000	7r/mb	c. half of value	Up to 10r/dy rice	1000x6x52x6	1,872,000	0
	Smz	400 - most	Jun-Aug busy 60r/dy – 60%	Oct 40r/dy	Rest: + min 4r/dy mz	400x3x25x60x.6 400x1x25x40x.6 400x8x25x10x.6	1,080,000 240,000 480,000	0
	Dmz	1000 – some	25%			1000x3x25x60x.25 1000x1x25x40x.25 1000x8x25x10x.25	1,125,000 250,000 500,000	0
	Fmz	700 - least	15%			700x3x25x60x.15 700x1x25x40x.15 700x8x25x10x.15	472,500 105,000 210,000	6,334,500
	P nuts	400					?	0
							TOTAL	19,988,500
							MEAN	2,855,500

Table 7. Engine / grinder purchase

Village	Machine	Cost	Years	Cost 1998 *	Total cost		Install / shed
Adabra1	Engine/grater	250,000 no loan	3	50,000			
	Grinder	270,000 ***	3	67,500	117,500		
George	Eng + grind + grat	Given by father		0	0		0
Kuma-Akura	Eng + grind + grat	1.5mn loan no int	1	300,000	300,000		
Akoti J	Eng + grind	1mn loan no int	4	200,000	200,000		77,000
Ankamoh	Electric motor	900,000 no loan	1.5	180,000			
	Grinder	600,000 no loan	4	120,000			
	Polisher	200,000 no loan	4	40,000	340,000		
Apam	Diesel engine	Bought	20yr	0			0
	Electric motor	Bought	10yr	0	0		0
Lome	Eng + grinder	600,000 no loan	10yr	0			
	Cassava	450,000 no loan	2yr	90,000	90,000		
Odumase-1	Eng + grinder	1.6mn	1 month	320,000			190,000
	Rice polisher	800,000	1 month	160,000	480,000		
Odumase-2	Eng + grinder	1.6mn **	2 yr	320,000			180,000
	Rice polisher			160,000	480,000		
				TOTAL	2,007,500		
				MEAN	223,055		Up to 200,000

* over 5 years

** by the time fully installed, total cost was 2.5mn

*** with susu loan; 200,000 to repay 250,000 after 3 months

Table 8. Operating costs

	Diesel fuel details	Diesel costs (yr)	Engine oil	Grease	Grinder oil	Gen repair costs	Electricity
Adabra1	1g/2.5hr @ 3300 (1dy)	1,030,000					
Kuma-Akura	3g/week – busy (3mn) @ 3200 (=374,000)						
	1g/week – slow (9 mn) @ 3200 (=374,000)	748,000					
Ankamoh							Oct 98, 160,000 Nov 98, 103,000
Apam					1mn @ 3000		Nov 98 75,000 *
Ankamoh						100,000/4mn busy 100,000/rest of yr	
Lome	1g/dy busy (3mn), 3300 1g/3dy slow (9mn)	1,029,000	1g/3wk, 16,000	2000/wk			
Odumase-1	1g/dy busy (3mn), 3200 1g/4dy slow (9mn)	430,000	1g/3wk, 12,000	1-2000, 3dy			
Odumase-2	4g/dy (3mn) 1g/dy (9mn)	1,710,000	1g/500hr	1000, 1wk			
	TOTAL	4,947,000	3mn @ 14,000 9mn @ 6000	1000 per 2wk	9000 14,500		
	MEAN	989,400					
	Other estimated costs:		96,000	26,000	24,000	(200,000)	

* inc electricity for freezer

Table 9. Repair and maintenance costs (parts)

	Nozzles	Injector	Belts	Piston rings	Crankshaft	Gaskets	Maize plates	Cass grater	Bearings	Oil sealing
Adabra1	6/yr @ 10,000	3yr ago	3yr and 2yr old	1/yr @7000	12mn	1/8mn @ 7000	2-12mn @ 35,000	3-6mn		
							1-12mn @ 50,000			
Lome	3yr ago, 15,000				-5yr, 95,000	1-5yr, 15,000	70,000, 6-12mn			
Odumase-2				6000, 6mn		7,500, 3mn	30-65,000, 1yr		10,000, 6mn	3,000, 1yr
Means:	10,000			8,000	25,000	10,000	51,000 **		20,000	3,000

Mn = month

** assume set of plates lasts 9 months

Table 10. Repair and maintenance costs (expertise), and other costs

	Repair specialist	Shed building	Plate sharpening
Adabra1	1dy @ 15-20,000		
George	1dy @ 10,000		
Kuma- Akura	Xdy @		
Akoti J		385,000	
Ankamoh			
Apam			2wk @ 4000
Lome			3wk, 8000
Odumase-1		700,000 + 250,000*	1-2mn, 8000
Odumase-2	Use spec	900,000**	2wk, 8000

Smz = soaked maize

* installation of cooling system of drums and pipework

** total installation costs

The above information is summarised in Table 11a, showing that the mean annual income of the millers is in the order of 1mn cedi, which in January 1999 was equivalent to about £250, if the mill works six days per week. However, if the mills work on average three days per week the net income is only 260,000 cedi or about £65 per year. Table 11b indicates that because of fixed costs, the profit margin increases with the number of days/week worked. A guesstimate might be that a reasonably active mill would work 4days/week with a net annual income equivalent to £126.

Table 11a. Summary of income, expenditure and net income

Item	Estimate	Sub-total, and net income	Estimate	Sub-total, and net income
	Assumes work 6 dys/wk		Assumes work 3dys/wk	
Annual income	2,855,500	2,855,500	1,427,750	1,427,750
Expenditure:				0
Machine purchase	250,000		250,000	0
Installation & shed	200,000		200,000	0
Diesel	989,400		494,700	0
Other operating costs	160,000		80,000	0
Repair & maintenance	150,000		75,000	0
Specialist repair time	20,000		20,000	0
Sharpening plates	96,000		48,000	0
	1,865,400	-1,865,400	1,167,700	-1,167,700
Net income (cedi)		990,100		260,050
Net income (£) £1=4000c)		£247.59		£65.01

Table 11b. Summary of income, expenditure and net income (£)

Days/week	7	6	5	4	3	2	1
Net income	308	248	187	126	65	4	-56

Grinding, grating and polishing equipment found in the off-road villages

From Table 12 (and Annex 2) it is clear that the older diesel engines and grinders being used in the off-road villages came from the UK but that in more recent years India has become the main supplier of both. At least some of the electric motors are made in China. A number of the rice polishers and cassava graters did not bear a manufacturer's label and were said to come from Ghana. But the owners of these machines knew little if anything about their places of manufacture, and typically had obtained them from an intermediary or second hand. No one had a Rajan diesel engine (or other Rajan machinery) though the agent in Accra is importing them in considerable numbers. Also, no one had any machinery made by the local manufacturers, Larkai Motor and Engineering Co and ITTU (Gratis).

Table 12. Types of processing machinery being used in the off-road villages

Village	Machine	Place of origin
Adabra	Solac diesel engine	UK (?)
	Hunt grinder	UK
	Cassava grater	Ghana (?)
George	Lister engine	UK
	Hunt grinder	UK
Akoti Junction	Lombardini diesel engine	Italy
	Bentall Super Mill	UK

Ankamoh	Wonder Electric Co motor	China
	Rex N02A grinder	India (Madras)
Lome	Rex diesel engine	India
	Rex grinder	India
	Rex, Tirose International diesel	India
	Rex No2A grinder	India
	Cassava grater	Ghana
Sampa	Adico diesel engine	India (Rajkot)
	Adico grinder	India
	Lister diesel engine	UK
	Hunt grinder	UK
Winneba Junction	Very old electric motor	
	Rex No2A grinder	India
Odumase	Indo Agro International diesel	India (Delhi)
	No2A Venus grinder	India
	Agro Industries diesel engine	India (Delhi)
	Agro Industries grinder	India
	Rice polisher	Ghana (Akim-Oda)

Engine repair specialists and grinder plate sharpening

Buying grinder plates is one of the main spare parts costs for the village millers. Plates, normally obtained in Accra, vary in price from about 35,000 to about 90,000 cedi, depending on quality. However, most people buy the cheap plates, which last perhaps 6-12 months. But the cheap plates wear more quickly and need to be re-sharpened, in busy seasons, as often as every 2-3 weeks. Most people, including a plate-sharpening specialist in Winneba Junction, said this costs 8000 cedi. Sharpeners also work in Swedru, Apam and Oda. At Winneba Junction there is also a vocational training school that is teaching plate-sharpening skills, and they also offer a cheaper plate sharpening service. When we talked with the sharpener at Winneba Junction he stated that he has too many customers to count. They come from Apam, Winneba and Akoti and all the villages in the area. How often they come depends on the work, for example poultry feed mills do not sharpen their grinder plates often because they coarse grind only. If the grinders are being used to grind maize for domestic usage, he sharpens the plates once in 2 weeks. The cost is 8000 cedi. He has a special set up with electric motor and sharpening tools for this work in addition to an old electric motor being used for maize grinding.

One engine and grinder repair specialist, known as 'Osam the fitter', lives at Ankamoh. He repairs his own mill, and those of other people, especially the engines and grinders. He operates a system whereby the owners either bring money to him, and he buys the parts, or he will use his own money to buy and then charge the owners. He sometimes prefers the owner to come with him, so that both can see that the price for the parts is fair, thus avoiding disputes. He services machines in Ankamoh, Abonko, Nkoranza, Enyeme, Gomoa-Obuasi, Brofoyedur, Asiebu and Apam. His main repair work concerns: crankshaft replacement, and piston rings, head gasket, fuel pump, and grinding plate changes. The parts are usually from Accra, though sometimes from Swedru.

Local sources of processing equipment, and spare parts

All the mill owners mentioned Accra as being the main source of spare parts for the diesel engines, the maize grinding machines and the polishers and cassava graters. Some in Gomoa also mentioned buying parts in Swedru whilst people in Odumase and Aworabo may look to the town of Oda. One mill owner in Adabra said that parts are easy to find. He normally

buys them from one of two places: (a) Akwei shop and (b) Azagolo shop both near Goil Station at UTC. The miller at Akoti Junction said he used to buy from Aquip near Circle and GMTC motors near Farisco but they do not operate now, so he buys from the open market, exercising great care in order to be sure of obtaining good quality parts, and not being cheated.

According to the Director of Agriculture in Assin Foso, both wooden and metal maize shellers exist but very few people use them. He said that in Cape Coast, ITTU (Gratis), make a sheller, as does AgriCo Engineering in Accra.

The DCE in Assin Foso gave me leaflets produced by the Larkai Motor and Engineering Company (PO Box 8388, C7 Tema tel/fax 022 206809), which manufactures and sells cassava and maize processing machinery. He has good reports of their machinery and is keen to purchase some on behalf of the district assembly to assist the post-harvest work. In Accra we visited Devcourt which is the marketing arm for Larkai (and perhaps for other companies too) and spoke to the marketing manager. They sell a composite grinding machine (engine plus mill); the engine is an 8.8hp Acme from Italy with a short drive so that it can be mounted with the mill. The engine also generates 12v and 120w electric power and so doubles as a source of lighting. The grinding plates are made of tensile steel - not cast iron - and last longer. The cost is 8.5mn cedi including some basic tools, which is far more expensive than the Rajan engines, presumably justified by quality and rate of output. But because this maize mill set is new on the market he could not give me any sales figures. They also make a gari machine: you peel the cassava, and the machine separates the dough (for the gari) from the starch in a way that enables the operator to collect the starch, which has wide usage in Ghana. The dough is ready in 1-2 hours maximum, and the same machine also sieves it so that it is then ready for roasting. It will process 8 sacks of cassava (some 900kg) in an 8-hour day. The machine is portable and therefore can be taken to the community. It also uses the Acme engine 8.8hp and the cost is 8.5mn cedi. One gallon of diesel lasts 4 days, so it is very efficient. The machine came on the market in June and -July 1988, and they sold 6-7 units last year. They could demonstrate the machine to us in Tema. He says that FAO have put it on the internet in other countries and that the machine is supported by the Minister of Trade and Industries and by the National Board for Small Scale Industries (NBSSI, behind the FAO office). ASIP, the Agriculture Sector Investment Project of the World Bank has bought two, and has put them in villages near Accra. The same company also makes a cassava chip machine, which has been in use for 5-6 years. He said that an organisation called Transport and Commodities General (TCNG) - tel 228578 - has organised Ghanaian farmers into groups for obtaining and using this machine. The machine has been sold attached to a Chinese 5.5hp diesel engine and in the period 1993-8 they sold some 200 only 10 of which had serious problems, which in fact were due to misuse. Now they are advocating the larger Italian Acme engine with this machine also. He does not know the price. They do not have a maize sheller, but he says that the Ministry of Food and Agriculture, Department of Agricultural Mechanisation, near Airforce Mess, have one.

He also mentioned the Hunger Project under Prof Sefa Deddey (who is also the Chairman of the Food Distribution Corporation), as a source of information. Prof Deddey is also head of Food Science at the University of Ghana. Other people we should meet to discuss processing include Dr Ofori, Director of Crops at MOFA. Finally, he also mentioned that as women are involved a lot in food processing we should visit the Institute for Statistical, Social and Economic Research at the University of Ghana (ISSER) which is looking at women's roles in food processing.

Mr Nicol at MOFA, showed us a large group of small machines for post harvest work with maize, palm nuts and cassava. The machinery was originally mainly designed in Nigeria at IITA, Ibadan. The Ministry brought the designs across to Ghana and the machines are now made by ENTESEL (Plot L1/11 A/a, Light Industrial Area, PO Box 8071 at Tema). The machines we saw (all painted a distinctive dark blue) were: cassava chipper / slicer, drying rack, press and grater. He also showed us a palm oil press, a two-wheel cycle trailer, another oil press, a rice polisher, a palm nutcracker (multi purpose) and a simple hand-turned maize sheller. Interestingly enough, I had not seen any ENTESEL products in any of the villages visited.

We visited the central market in Accra, looking for sellers of post-harvest machinery and spare parts. We talked with the owner of 'Sam Famous Ent.' in Amunakwa Road. Their sign says they sell Lister and Petter engines and grinding mills. However, the sign is completely out of date, in practice the shop sells diesel engines and a maize grinder in a set, complete, at a cost of 1.8mn cedi. The machines are made in India and are obtained from (or made by) Rajan Universal Exports (MFRS) PVT LTD of Madras, India. The mill is the Rajan Amuda grinding mill: 2A is the model, with 12" plates and needs to be used with the 8hp engine or could use a 10hp electric motor. The output is rated at 600 pounds/hr. and it will work for maize, rice, wheat, cassava, coffee, cocoa and spices etc. In the shop were many crated engines and mills. They also sell a Rajan Amuda rice huller, though there were none in stock - they will obtain more. They used also to sell the spare parts, but this is complex because the villagers will object to taking a part even if the colour of the paper in which it is wrapped changes! So, the family sells the parts in a shop run by his brother (which we visited later). The engines are of different types, but they mostly sell the 8hp engine. They supply some direct to villagers (perhaps one-sixth of the total) but they sell more to other stores. They are the main agent, and import direct from India. They sold 108 engine-grinder sets last year in total.

Agro is another Indian engine, and the second most popular after Rajan, according to the Rajan agent. The engine, he says, is good but not as good as the Rajan. The Agro agent is in the same building, top floor, but not present on the day we visited.

At the brother's shop, in a nearby part of the market, I was given a card: Kofi Twum, Managing Director, Koft Enterprises, Office Knutsford Ave, PO Box 13058, Accra, Ghana tel 666197. In the shop are one or two crates containing engines and mills, but the shop is mostly for selling spare parts. They sell spares for Lister (for all the old engines) and for Rajan, and for other types of machinery. They also sell parts of Agro Navin but Rajan is the most popular. He listed and priced some of the more commonly used spares (Table 13):

Table 13. Selected spare parts and prices (cedi) for diesel engines and grinders

Item	Price (cedi)
Crankshaft	80,000
Cylinder head	80,000
Engine block	80,000
Grinding plates *	38,000 per pair 'BIN' and Banford
Engine bearing	6,000
Side bushing	10,000 or 20,000 for two
Mill bearing imported	15,000
Mill bearing local	8,500
Nozzles	10,000
Gasket	5,000
Rings	6,000
Piston and rings	28,000
Valves	8,000

Tappet and foot	6,000
Push rod	20,000
Oil pump	25,000
Injector	28,000
Fuel pump	28,000

* (there are higher quality plates, but they are rarely requested because they are more expensive - called Premier Plate)

They are probably the largest importer of corn milling machines. They have four shops in Accra, but none elsewhere in Ghana. People come to them from all over Ghana. They have 5-6 mechanics and will service the machines and make repairs. They also sell the Amuda Huller that is suitable for maize and rice, and sells for 1.6mn. They import up to four containers a year of these, each containing 35 pieces.

In Cape Coast we visited ITTU (Gratis). There are similar places (funded by EU) in many different regions of Ghana. In Cape Coast they have many lathes and other machine tools. They make a lot of post harvest equipment, but the informant did not know how much they sell each year (the papers were in the managers office and he was not present). However, they make to order and carry no stock, which may indicate limited sales and also suggests that spare parts would be difficult to obtain. He had a long list of equipment (including quite a lot not to do with post harvest work), and gave names and prices of al the post-harvest equipment they make for maize, cassava and palm nuts. (Table 14).

Table 14. Equipment produced by ITTU (Gratis) in Cape Coast, and prices

For cassava:	cedi
Cassava grater	750,000
Bagging stand	50,000
Double screw press (this will take three sacks at a time and takes four hours to dry)	500,000
Cassava chipping machine (slices into chips and therefore dries easily)	800,000
Gari sifter (after roasting)	250,000
Fermenting rack	250,000

For palm oil:	cedi
Palm fruit digester (or pounder)	2,000,000
Boiling tank	500,000
Oil press	750,000
Nut cracker	1,000,000
Press for kernel oil (bridge press)	500,000

For maize:	cedi
Maize huller (polishing)	800,000
Corn mill	1,000,000
Thresher - multi-crop (corn, millet, rice)	1,800,000

The organisation undertakes the installation of the processing machines, not including the engines; engine purchase has to be made separately. They teach people to operate the machinery, and like feedback. According to the spokesman, those who buy include: communities, churches, schools and NGOs, in the Central Region and other places. ITTU Cape Coast is noted for food processing / post harvest equipment (along with Tamale in the north where the needs are rather different). They have been making their machines for 6

years or so. At the Sasakawa Centre at the University of Cape Coast (UCC) they have examples of the equipment for demonstrating to students etc.

Processing and cooking: maize and cassava

The long list of dishes made from maize and cassava and details of their preparation given in Annex 3 indicate that this phase of the 'post-harvest' work is not only skilled and arduous but also inter-linked with milling and grating the raw materials. In some cases (eg making adibi nkokoa) part of the food preparation is undertaken before milling and in other cases (eg etew) the maize is first polished and, at a later stage, ground. When the mill is at a distance from the village this further increases the workload for the women.

PROCESSING OTHER CROP: CASSAVA, PALM NUTS AND RICE

Cassava

In Adabra we saw some cassava being processed into gari. First, a long stick was attached to the neck of a sack full of newly grated cassava. The stick was being regularly tightened, by a woman, over 1-2 days, to squeeze the water and starch out of the grated cassava. The nearly dry gari was then sieved into a bowl and roasted in a large wide bowl lined with oil to prevent sticking, while constantly being stirred until completely dry. Again, all this is processing being undertaken by women. The resultant gari keeps for over a year and is, therefore, perhaps the best way to store cassava. However, to grate cassava in quantity and then process it into gari is very labour demanding if done by hand. Therefore, there is an opportunity to mechanise, at village scale, all parts of the process. If successful this would give growers more confidence that production surplus to current demand would not rot, and it would give confidence to village traders that they would not be forced to accept low prices in the markets because the susceptibility to rotting creates a buyers market.

Cassava otherwise has to be stored in other ways after drying (eg as cassava chips) or stored in the ground. In fact cassava is more flexible than maize in that it can be planted over a much longer time period and it can be left in the ground, some people stated, for up to one and half years before it starts rotting. Its rate of growth is dependent on rainfall. After good rains the tubers may be large enough for harvesting after eight months but otherwise it may take a year or longer to achieve a large size. The date of harvesting also depends on demand. However, once taken from the ground, cassava is very prone to fungal attack and will start to rot after a few days.

The DCE in Assin Foso clearly stated that there is no way to preserve or store cassava other than processing it into gari. He also said that a lot of cassava is grown around Assin Foso and that there was a gari factory there (started by a politician from a previous government), which went out of commission and the machinery was stolen. He does not see a future role for such a factory but he would like to be able to buy smaller-scale gari processing machines for the farmers. On his desk were leaflets about the Laakai Cassava Processing Machine (for gari) and for the Laakai Cassava Slicing Machine; they would cost about 6.5 cedi. His aim is to buy such machines and place them in private ownership using the Poverty Alleviation Fund money provided by the government for the District Assembly for such purposes.

A visit to Aworabo made clear the local need for cassava slicing, chipping and gari making machines. Their cassava is sold raw to traders from Ashiama, near Accra. They don't even

have a grater in the village and therefore for domestic consumption all grating is done by hand.

Antwi (1994 and 1997) discusses at macro-scale the production of cassava chips and other cassava products for national and international markets. However, the experience of trying to link small producers in the off-road villages into these larger schemes (DCE, Gomoa - personal communication) was not successful. The DCE made an effort to encourage the local cassava industry by linking local farmers with a company that makes cassava chips. However, he said, the farmers did not want to participate because the chipmakers refused to tolerate any mould. Therefore, the farmers on the harvest day had also to chip and dry the cassava, but they were not prepared to do this. The company said the quality of their chips was not good enough. They also offered a price that the farmers thought too low. However, the company seems to be successful - last year it exported US$2mn of cassava chips - so it has proved itself able to reach agreement with other farming communities. The DCE felt that in Gomoa the farmers did not respond because they have a ready market in Accra and Cape Coast whereas the regions where the company operates are more remote from large markets. The people here would like the company to buy land and hire the local labour to make the chips - but not follow the system the company would like because it would mean extra work. This experience indicates that the off-road villages are faced with a set of production and processing problems, which differs from those in the major production areas where entry into larger-scale drying, processing and marketing schemes is easier.

Palm nuts

The chief of Abora village explained their palm nut situation by taking us to see a thin cluster of palms. No palms are cultivated in the village, but these trees had grown naturally. The farmers, however, have thinned the trees to encourage fruiting, but there is not enough rain in Abora for full fruiting though the palms will give some fruit after even moderate rain. It is necessary to boil the nuts on picking which preserves them for three or more months. In Abora separating the flesh from the nuts is done by hand, using a mortar and pestle, and the shell of the nut is also broken by hand using stones. Water is then used to separate the kernel from the shell fragments. The kernels are then fried and taken to one of the mills in Ankamoh to be ground, after which they are boiled to release the 'brown oil' from the kernel

In Adabra we were informed that palm nuts are cultivated but that it is a new crop and so they have no harvest or post-harvest experience of it.

In Ankamoh the millers confirmed that they grind palm nuts using the standard maize grinding machines. But even here there is no machine for cracking the nuts. Indeed we witnessed a woman laboriously cracking nuts with a stone. Possibly this work was providing her with a valued role within the village – or possibly it was a further burden in an already busy life. If a nut-cracking machine were to be introduced here, the likelihood is that the machine would be owned and operated by a man.

Palm nuts are cultivated in Lome. Some of them are cracked open using a small machine (which we did not see), whilst others are cracked by hand. As elsewhere, they are ground in the same machine used to grind the maize.

In Sampa the village chief spoke of growing new hybrid varieties of palm nuts. Farmers themselves used to trade, he said, in Kyiren-Nkwanta but now there are a few specialised traders. Nuts are also processed in the village, including grinding them in the maize grinding machines.

In Odumase cocoa is the main cash crop, according to the chief and a group of elders and farmers. Then, in order of importance, they grow maize, cassava, rice, vegetables and some palm nuts. So, palm nuts are only a minor crop. The oils from the nuts are used locally for cooking. Also, some traders buy the nuts and sell them in Accra and the other cities. In Aworabo also, palm nuts were said to be a minor crop.

However, the most detailed information about palm nut post-harvest activities was obtained from Akonfudi (on a graded road not far from Assin Foso). Palm nuts are a significant crop here. Many of the trees were planted long ago, and are now being uprooted for making palm wine because the yield has declined. But the farmers are also replanting. We spoke at length to a woman palm nut trader and processor who is also a palm nut farmer. She described the post-harvest work as being hard but good business and said that there are 15 palm nut traders in the village. She may buy bunches of nuts from the trees, or else buy them by the rubber after the nuts have been stripped from the bunch. She showed us a rubber, which measured about 13" in diameter and about 9" high and is said to be two times the size of the maize bucket rubber. Someone else cuts the bunches for her, or else the farmers pay someone to cut them. The villages she buys from include Brofoyedur, Aponsie, Endwa and hamlets around Akonfudi. The buying price of a rubber is currently 4-5000. Last year the highest price was 8000 and the lowest 3000, and the average about 5-6000. She can buy throughout the year, and will go to a farm about every two weeks (she therefore deals with half her farmers every second week). She is now buying many rubbers of palm nuts - up to 52 rubbers/day or over 200 per week in the peak, in March and April. When there are few nuts she buys 7 rubbers/day as a minimum in the off season, which is October to January. She may sell some nuts fresh, and not processed, in the market in Accra (Kantamanto). The fresh selling price is 40-45,000 in a sack, which is equivalent to 5.5 rubbers. If a car comes from Foso it charges 3000 from here to Accra. But if she has first to take her nuts by local transport to Foso the journey to Foso costs 500-1000 and loading is 500. This makes the total cost of getting the nuts to Accra some 4,500 per sack. She also processes the nuts to yield oil, the red oil, work which involves boiling the nuts, pounding the flesh from the nuts, adding water and seiving and then boiling the flesh in water in order to separate the oil. There is now an alternative method of extracting the oil, hiring a small press from a local mill for 1000/day. People from Techiman and Tamale come and buy the red oil. The amount of oil from a rubber of fruit depends on the variety. The Dura has a large kernel and relatively little flesh and so there is less red oil. The Tenera variety has a small kernel and relatively more flesh and gives more oil. From the Tenera 15-16 rubbers will fill a round tank measuring about 23" tall by about 15" diameter. This will sell for 150,000. She will then sell the kernels to other people to make brown oil, selling at 1500/rubber. But now she has heard that there are mechanical nutcrackers in the town so she may use them and make brown oil herself in the future. We visited the mill in the village and saw the palm nut flesh press (heavy screw) which they have for hire at 1000 cedi per day.

According to the Director of Agriculture in Assin Foso, marketing of palm nuts does not cause a problem and is done at different scales. Traditional are the women traders and processors, such as we had spoken with in Akonfudi. Also, TechnoServe (in Accra and Cape Coast) have grouped farmers into societies to facilitate their palm nut enterprises, and they may provide an oil press on credit. After the harvest the farmers send the nuts to the mills for preparing the oil. At a larger scale of organisation, an entity called the Oil Palm Plantation has an outgrower scheme, and will purchase nuts and involve itself in the production of oil. There is also a company from Ashanti called Oil Palm Mills, which comes here to purchase.

The District Chief Executive in Assin Foso said he is very keen to increase the level of palm nut processing in the District by establishing a soap plant.

A few miles from Assin Foso, on the main road, we were shown a part installed set of machinery for processing palm nuts. The machines have been paid for by the Methodists (locally and in Ireland), and are being installed at a site owned by them. The machines are part of an enterprise development project for women being organised by TechnoServe. When complete the unit will undertake all phases of palm nut processing to produce the oil.

Rice

Rice polishers were seen in Sampa, Odumase (both of the mills visited; one was bought in Akim-Oda, where it was made)

They produce quite a lot of rice in Odumase, and traders come from the cities to buy polished rice. They have a special rice rubber, wide at the top but steeply narrowing - about 13" top diameter and about 6" high. For polishing rice they charge 1000/rubber (7 rubbers in a mini bag of 50kg), and rice polishing forms about half their milling business by value.

Rice causes some problems in Aworabo. There is no thresher in the village and the polishing machine is low capacity. Therefore they have to bring a big thresher from Oda. They then bag the grain and take it to Oda to polish, and then they also sell it in Oda. For what they in the village eat, they put the rice in sacks and beat it with sticks to thresh it.

In Akonfudi the mill (the largest seen) has two rice polishers.

According to the director of agriculture in Assin Foso, rice presents no significant post harvest storage problems. But he also said that an important limit on production is that the farmers think it a tedious job. They have to sleep with the crop when the grain is forming in order to keep the birds away and there is need to fence the rice to stop the grass cutters eating the growing crop. It is also prone to fire.

Locally made machines

In Odumase we were shown two small-scale processing machines, one for cracking palm nuts and the other for grating cassava. In both cases a small two-stroke engine had been mounted on a semi-portable, locally made machine which was cheap and could readily be transported from house to house, or from village to village in a pick up truck. These machines appeared to be examples of truly local initiatives, employing simple but competent woodworking and metalworking skills and some entrepreneurial initiative.

THE RURAL BANKS AND CREDIT

The indications from the field research suggest that the members of the off-road village communities are, in terms of physical distance and also knowledge and understanding, remote from the banking system – even from the Rural Banks which were established especially to assist them. For example, the miller in Adabra said that he could not find a bank to help with a loan to buy his maize grinder. He was able to borrow from his community susu fund, but also said that no one would deposit a susu fund in a bank, because of remoteness. He would not even deposit his milling income at a bank because it would be too far to travel if he needed cash for machine repairs.

We visited the manager of the Akyempim Rural Bank Ltd, in Dawurampong town. The area covered by the bank extends to Apam junction and has sub-agencies at, Gomoa Enyiresi, Agona Abourso and Winneba Junction and in the University Collage of Education at Winneba. We spoke with the Manager, Mr KK Owusu Ansah. He told us that the rural

banking concept dates back to 1976 and is for provision of medium term credit to farmers and other rural producers, because the commercial banks were in the cities and therefore in practice not accessible to the farming communities. The first Rural Bank was in the Central Region. They wanted local participation; people contributing to their own bank. They hoped to mobilise local savings and then give loans to local people to expand farm activities, and raise their standard of living. In practice, most loans are for farming and fishing. The interest rate for farmers is lower than for other sectors, because the period of repayment is extended longer than a year (up to about 16 months) to allow commodity prices to rise. The bank likes to support the farmers and family labour that are on family land. The farmer must show commitment by owning and working his own land, and preparing the land perhaps prior to taking the loan. Loan size ranges from a minimum of about 200,000 cedi to a maximum of perhaps 1mn cedi and the bank looks for a guarantor who is credit worthy. But they also know the hard-working farmers and will support them on the basis of past performance. Reasons for loans include labour for clearing and maintenance, buying seedlings and fertiliser, and meeting storage costs. The bank also encourages the use of the improved maize varieties. They prefer that farmers whose land is remote from their villages bring the maize to the village for storage, and to use actellic and generally respond to the advice offered by the extension services. The bank has considered encouraging the use of the silo at Mprumem but thinks that it is not economic for use by small farmers. To make its usage feasible there would have to be a subsidy from MOFA to help meet the transport costs and high price for treatment and storage.

Interest on bank loans used to be as high as 45%. It is now 33% and is likely to be on a downward trend. The bank works closely with the agricultural extension officers, of whom there are two in the town. For example, if the extension officers can agree, with the farmers, a good system for the use of chemicals for maize storage, the bank will provide the officers with the chemicals at no interest so long as the officers do not charge high prices to the farmers. The two local extension officers, employed by MOFA, are responsible for 8 villages near the bank.

The manager strongly stated his belief that the bank is helping to increase crop productivity. This is partly because their interest rates are low (relatively) and because they are efficient, taking a maximum of 28 days to process a loan. In 1997 they helped 123 farmers from this office with a total of 44,780,000 cedi. This year they have loaned 57mn to 140 farmers. He believes that the way to involve more small farmers is for MOFA to educate the farmers to make them aware of the options. His work is facilitated by the fact that his chairman is very interested and committed. The government has also introduced revolving credit via the District Rural Assemblies. Some is for medium term credit for farmers, fishermen and rural industries. By the end of the year they had also given out 57mn to farmers grouped into 24 different societies (a society may have 15-25 members).

We met no traders who had obtained a loan from any Rural Bank. A woman trader in Lome said that none of the 40 traders there had obtained a loan (or perhaps ever tried to obtain a loan) but that she herself is considering applying to the bank for a loan so that she can buy larger quantities of maize for storage.

In Apam the DCE is aware of problems due to shortage of credit, and is obviously interested in finding practicable ways of helping. The DCE also mentioned the loan scheme that they (the District Assembly?) operate through the Rural Banks in Gomoa. He said that as an incentive they charge only 70% of 'normal' interest rates but the farmers must show solid proof of commitment. [He said normal rates were 35% and that their special rate was 25%]. The DCE stated that shortage of capital is the major constraint on agricultural development.

Other factors, however, include the fact that labour is in short supply and that people with capital are not prepared to invest because of the unreliability of the rainfall. Information, he said, is not a major constraint – the extension service has the information and is free of charge.

The Director of Agriculture in Assin Foso placed more of the onus on the farmers for limited use of loans. He said that if the members of the community co-operated together and saved money then the extension staff would act as facilitators and talk with the banks on their behalf about obtaining loans. But although the farmers always say they want credit, they rarely commit themselves to saving. Also in the past they knew that they might get away without repaying credit, though now the credit contracts are more firmly drawn up and people have been prosecuted for non payment. He stressed, people must be seen to be saving a little money first before they will be considered for a loan - it is more the principle than the exact amount saved.

At the Akoti Rural Bank, in Assin Foso, we spoke with the chief accountant and the manager, Mr WK Owusu. There are three Rural Banks in the district, each with different names (this one is one of five branches of the Akoti group of Rural Banks with its head office in Akropong), and each has a number of branch offices. Echoing the words of the local director of agriculture, the chief accountant said that loans depend on a person making regular savings with the bank; not a minimum amount saved but a minimum period of regular deposits over six months. A typical farmer might borrow 500,000 - for clearing his land etc. The bank will make an agreement for 6 or 10 months with an interest rate of 33%. One of their main client groups is the cocoa farmers. The bank lends to groups of farmers (perhaps 5-10 in a group), but reach the formal agreement with the cocoa-purchasing clerk as the guarantor. They give most of the loans in July, for 'maintaining' the cocoa farms - not for planting the cocoa but for protecting it against pests or other maintenance actions. In effect the cocoa is the guarantee because it is a reliable cash crop. The role of the purchasing clerk is to buy the crop for the big companies. The manager said that the bank also lends money to teachers who want to invest in agriculture. The bank can deduct repayment direct from the teachers' salaries. In this way they are working with some 5000 teachers in the district.

The DCE in Assin Foso, when asked about the possibility of traders obtaining loans, thought that the traders could constitute a kind of co-operative between themselves and thus obtain a bank loan to store maize, which would be guaranteed by the district assembly.

Mr Nicol, of MOFA in Accra, is less confident about the role of the Rural Banks, saying that they are always looking for ways of not supporting agriculture because it is too risky (in significant part because of the unreliable rainfall). They will make every effort to support other types of enterprise instead.

But there may be a role for inventory credit, if a suitable delivery mechanism for small farmers in off-road villages can be devised. Inventory credit schemes supported by TechnoServe (Londner et al., 1998) have had mixed success in Brong-Ahafo, a major maize growing area. Initial problems included existing farmer debt burdens, length of time needed for promotion and training and the shortage of mechanical drying and improved grain storage facilities at the village level. The third problem remains, but as farmers now have more money they have expanded their grain production and no longer have to sell their grain after harvest but can wait until it dries. Two storage-related problems that TechnoServe identify as constraints on expansion of their inventory credit scheme apply in the off-road villages studied in the present project. They are: first, cash needs of farmers after harvest and their inability to wait months until the grain is dry enough for formal storage and, second, an acute shortage of appropriate community-level warehouses and storage facilities coupled with

farmers' unwillingness to use government-managed grain stores. It is very unlikely that the latter problem will be eased by government investment in the medium term, in part because this is not a major maize growing region. Therefore it may be more appropriate to support the village traders to expand the drying and storage work that they already undertake.

One source of support may be the Village Infrastructure Project (World Bank, 1996) one part of which will deal with post-harvest infrastructure. Of relevance to maize, this will include 'drying floors and platforms, cribs and crop processing' (p.18) for communities and small farmers. It will also include some forms of post-harvest treatment for processing, including financing the 'procurement of eligible processing equipment and facilities such as grinding mills, digesters, extractors and presses and other miscellaneous equipment where the need is adequately demonstrated' (p.18). But the World Bank report goes on to say that the support will be provided where the communities have organised themselves into manageable groups. These groups will be expected to take the ownership risks, meet all eligibility criteria, including the savings of required down payments, and acquire the skills to manage the investment on a commercial basis for the benefit of members and other users. It may be difficult for the off-road village communities to meet these criteria.

PROCEEDINGS OF THE DISTRICT WORKSHOP GROUPS

On 9th and 11th February district workshops were held to give the opportunity for a wide selection of officials and villagers to discuss a series of questions related to transport to market, storage and processing (Porter 1999b). In both the Gomoa and Assin workshops (Porter, 1999b) two groups each stated that early shelling can reduce maize losses and eliminate storage problems but that it must be undertaken with appropriate preservation methods. People also confirmed that access to credit for small farmers and millers was difficult or impossible and that the banks should help. Also, that small-farmers do not have money to buy processing equipment, though some people blamed the lack of electricity, a preference for trading or access to urban resources. In general people saw the need for village crop processing equipment. Machines mentioned included: maize shellers (hand and motor operated), corn mills, cassava grater for gari, cassava chippers and graters, maize drying machines and oil palm and rice mills (in Assin District). Processing, according to one group, would minimise post-harvest losses, particularly a palm fruit oil extractor. Processing adds value, diversifies usage, creates employment and saves time and energy (human energy).

Thus problems of maize storage are well recognised and at least some people think the solution is early shelling, treatment and storage in bags. People want credit but find it very difficult to obtain (though whether they would use it responsibly is a matter that would need testing). Also, people think that villagers would benefit from a long list of types of processing equipment.

OTHER INFORMATION OBTAINED

Land leasing

According to the village chief in Abora they have too much land for them to manage. They have neither the labour nor the money to cultivate it more fully. They would like to attract enterprises with capital to cultivate the land so that the village gains from the rental and from labour.

The chief in Sampa made a similar request, to find entrepreneurs to lease land from the community. There is a river here that does not dry and good quality land around it. It would be suitable for irrigated vegetables, and the local people could work on the land.

The manager of the Rural Bank confirmed that a few entrepreneurs are coming into the area, perhaps to grow cashew, black peppers and sweet potato (he knows of such enterprises). But there are land tenure difficulties including a local system whereby the owner takes one-third of the crop (the ebusa system) but this puts off entrepreneurs - they prefer to lease land with an annual rent for a specified number of years.

Mr Nicol was surprised to hear that some village leaders were saying that they wanted organisations to lease land and farm. He said that in practice the problems of leasing are great because land ownership is very divided and unclear and claimants can effectively block any development for years.

Villages

The village of Abora is small, and is clearly poor. There are few concrete houses, mainly mud brick, often badly eroded. The house roofs are made from rusting corrugated iron, and many are in a state of collapse. The houses in Adabra are small, all of about the same size and made of mud brick. In part this may be due to lack of money but it is also in part due to the fact that the people here are Ewe who build houses of this simple style. In both Lome and Sampa, which are much larger settlements, there are many substantial houses, some made of concrete blocks, giving the appearance of greater wealth.

Roads

The track from Ankamoh to Abora rolls with the undulating topography. It is narrow, some parts drivable at 30-40mph, but some gradients are badly gullied, and one to two places on low land are deeply rutted and impassable for periods of time in the wet season. The group of village elders said that in April and May heavy rains can be a real problem because they stop trucks arriving when the maize price is at its highest. Women said that all the grain is taken by headloading to Ankamoh for milling and that if the road is wet they may slip and lose the load, especially the boys and girls. The total minimum time to take maize to the mill, wait for it to be milled and then return, is 1.5 hours, but sometimes if the mills are busy they have to leave the grain in the morning and collect it in the evening.

But the road to Adabra is now in good condition, well graded and wide, and causes no problems for marketing. In fact, when asked about the road the mill operator simply said that on market days he must grate the cassava or grind the maize early in order not to miss the vehicles that will take it to market. He did not mention special problems of using the road in the wet season. Nevertheless, very few cars still ply the route.

In Lome a woman trader complained that because of the poor state of the road, a driver hired to cart goods might only take 30 bags in his vehicle instead of 40 which therefore incurs extra costs and loss of her time.

The road to Sampa though long is graded and mainly wide and of good quality. Nevertheless, the traders said that because they live a long way up a track, few cars come, and when they do come they charge more than normal. For a mini bag of corn the charge by the driver is 3000 cedi plus 1000 for the person each way. Therefore a total of 5000 for a single mini bag. Thus 10 mini bags would cost 32000. Farmers sell in small quantities and

therefore the men, women and children take the grain to the junction. This also causes children to lose time at school on market days.

In Aworabo people stated that marketing is a problem in part because they do not have access to transport, and because the market is a long way from the village. When traders come here, they are therefore able to force low prices. When the road is bad very few traders come to the village at all, and many people do not yet know that the road was well graded, in November and December last year. Nevertheless, many cars are now coming from Foso. The local farmers and traders are reluctant to take their crops direct to Foso themselves unless they have a definite customer. If there is no definite customer, the traders know that the people do not want to take their crops back home so again they are able to force low prices. It is also notable that people in Odumase to a significant extent regard Akim-Oda as being their main town. For example, the millers buy their diesel from Oda because the road is good and because the cost of a seat in a car is 1300 instead of the 1200 to Foso. Also, people look to Oda for the purchase of spare parts, access to rice threshing machines, and even purchase of machinery.

Although the road from Assin Foso is now in good condition, the road from Odumase to Aworabo is the worst of all the roads I travelled on. It is narrow, badly gullied where the gradients are steepest and also has deep potholes in low-lying places, which are both slippery and wet. It took our taxi 35 minutes to make the journey. The informants in Aworabo said that no cars come there from Foso.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

What are suitable future roles for farmers, village traders and processors, and how should they be organised? Risopoulos *et al.* (1998) define market access in terms of the opportunity for farmers to participate in a market to their advantage. But this begs the question of the point at which the farmers enter the market. That point may, in the off-road communities in this study, be at the point of sale to village traders. The latter give the impression of being more entrepreneurial and generally much better informed about demand and prices in the District and Regional markets. It may be appropriate, therefore, to encourage farmers to become better producers and to create the conditions under which village traders can become even more effective in their marketing operations. Risopoulos *et al.* also, in their conclusions, suggest institutional innovations including groupings of farmers and traders and the improvement of trust relations between them. However, it might be more effective to identify and seek to reduce or eliminate specific bottlenecks in the local production, storage, processing and marketing systems than to spend time and effort on creating institutions which might seem, to the farmers and traders, to be artificial and difficult to comprehend.

Indeed, Hall and Andrews (1996), in their study of entrepreneurial skills and the adoption of food processing technology in Ghana concluded that group approaches to the adoption of food processing technology are weak. Not only are entrepreneurial skills often absent from groups specifically formed for technology transfer, because the groups fail to engender them, but worse, such groups may stifle entrepreneurial skills. Individuals who have demonstrated entrepreneurial flair, their conclusions also state, are the most receptive target of food processing technology though by definition they tend to be rare.

The present research found no evidence of groups effectively working together to improve storage, trading or processing. Yet evidence of entrepreneurial knowledge, awareness,

ingenuity, risk-taking and flexibility was found in individuals, notably amongst the women village traders. This was also evident, perhaps to a lesser extent, amongst millers, and least evident amongst the farmers. If these comments about groups are correct and if the off-road villages are to benefit from the Village Infrastructure Project, the Project will have to modify its determination that credit should only go to people who have organised themselves into groups. Or alternatively, a massive effort will be required to identify people who have the capacity, confidence, trust and will to work together and to give them a full understanding of the mechanisms by which they may achieve and sustain benefit from such group work.

Bottlenecks to progress (to making the system more productive, efficient and remunerative) include: (a) unpredictable climate, (b) shortage of skilled labour, (c) shortage of credit, (d) shortage of equipment and (e) lack of information, amongst the more identifiable factors. Information is probably not a major constraint, but perhaps 'will' and determination to succeed are, though these are difficult to perceive and quantify in a short period of fieldwork.

Hall and Andrews (1996) recommend that 'technology needs to be tested in an interactive approach because this is likely to be more appropriate for applied research / technology transfer types of activities'.

There is a need for an additional step in the research in these off-road villages. Using the Hall and Andrews phrase, this may be defined as an 'interactive approach', or applied research, to trial-and-demonstrate the most appropriate technologies which are considered likely to have beneficial impact, and to trial-and-demonstrate the most appropriate ways of introducing them into the off-road villages.

Recommendations

According to Stephanie Gallatt of NRI (based in the TechnoServe office in Accra), although NRI has technically tested some cassava chippers there is a real need for a more comprehensive and thorough approach to technical testing of all the equipment that is now available in Ghana for post-harvest work. The machines may have been tested in the workshop, but not in the field; not even Sosakawa tests or monitors the equipment in the field. Even more important, she says, no economic study has been undertaken to measure the impact of the use of the machinery. NRI wants to create a project to undertake some of this work.

Part of a technical and economic study of post-harvest technologies could be undertaken in the off-road villages of Abora, Adabra, Lome, Sampa, Odumase and Aworabo which are the focus of the present research project (Access to market opportunities in Ghana's off-road communities: phase 1). The value of such a study would be improved by being undertaken in the context of a wider research objective that considered all the factors which have a bearing on the net output of the post-harvest system in the off-road villages, including their impact on production. From the comments made at the district workshops (Porter, 1999b) people would appreciate equipment, techniques and facilities which would allow the early shelling, drying, treatment and bag storage of maize. They would also appreciate more small-scale equipment of almost all types but would need, and want, easier access to credit to make it possible.

A suitable approach to this research might be as follows:

1. Identify the various points in the current post-harvest system at which potentially beneficial interventions could be made; these might include combinations of small-scale mechanisation, credit, and intermediate transport systems to facilitate movements between farm and village and between village and market;

2. Determine the most appropriate ways in which to make these interventions;
3. Make selected interventions;
4. Monitor and evaluate the impact of the interventions;
5. Recommend, on the basis of this experience, 'sets' of interventions (and means of making the interventions) which are likely to be sustainable because they improve livelihoods of local people and are perceived by them to be beneficial.

As far as potential storage and processing interventions are concerned for maize and cassava, the following suggest themselves on the basis of the present study:

Intervention point	Type of intervention, and possible direct impact
At maize harvest	Provision of a community maize thresher (sheller): ITTU in Cape Coast make a multi-crop thresher (cost, 1.8mn) said to be suitable for maize (as well as rice). ENTESEL also make a much simpler sheller, turned by hand. The thresher would need to be 'owned' by the community to justify the cost. A possible direct impact will be that the maize can be harvested dry, obviating the need to build cribs, can be treated with actellic and stored in bags in the village.
Post-harvest, maize	Credit to the traders: some traders say that their purchases of shelled maize are restricted by lack of credit. A possible direct impact will be that maize is stored for a shorter time in the crib, thereby avoiding losses to weevils and grain borers.
Post harvest, maize (at time of maize shelling)	Supply of actellic: ensure that actellic (and super actellic) are available (together with appropriate information about usage) when the maize is shelled and is drying. A possible direct impact will be that the maize grain, when stored in the bags, is fully protected, thereby preventing losses.
Post harvest, maize (post shelling)	Local storage: ensure that storage space is not a key factor limiting maize shelling, by providing credit to construct storage space. A possible direct impact will be that more maize is sheller sooner after harvest, thereby limiting storage losses.
Post harvest, maize	Access to silo at Mprumem: the requirement is for inventory credit, perhaps feasible for villages near the silo and where crib storage losses are otherwise up to one-third or higher. A possible direct impact will be that losses are minimised.
Processing, cassava	Testing the ITTU, ENTESEL and Larkai equipment: to include: cassava chipper / slicer, rack, press, grater of ENTESEL, and the Laakai Cassava Processing Machine (for gari) and the Laakai Cassava Slicing Machine of Larkai, and perhaps the cassava grater, bagging stand, double screw press, cassava chipping machine, Gari sifter and Fermenting rack of ITTU. A possible direct impact is greater production and reduced losses.

If it seems that some of the above interventions are reducing time and other constraints on production, and encouraging people to think about increasing the area under cultivation, the

monitoring and evaluation might be extended to include credit for land clearance and fertiliser.

More discussion will be needed with members of the village communities and with senior local officials including the District Chief Executives, key members of the local branches of MOFA, Managers of the relevant branches of the Rural Banks, Mr Nicol of MOFA and others about the most appropriate ways of making the interventions. It will be necessary to ensure that the credit is properly used and that positive progress made during the project will thereafter be sustainable because the local permanent institutions are actively involved.

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ANNEXES

Annex 1. Case studies of maize traders

- Esi Kwagyiriwa (trader and taxi owner). Woman trader in Abora: she sells fuel wood from Abora and also collects fuelwood from other villages, loads into her car and takes the fuelwood to Accra. And she sometimes takes maize from Abora. She buys at 2,700 per rubber now, at the current price, and sells at 3000 per rubber. There are two traders in Abora and some others at the new village site, which is about three-quarters of a mile nearer the main road. Two years ago there was a good harvest. She bought 60 mini bags of maize. Last year the harvest was poor and she bought 15 mini bags. She stores them in Abora and takes them to Apam in April and May when the price is high. Last year she bought at 1500/rubber and will sell in April and May when she hopes to get 5-6,000 per rubber. She stores in mini bags; the agricultural extension officer adds actellic. Currently in store are 15 bags for which she paid 12,000 for treatment. She used to sell cassava but has now stopped because it incurs losses. There is no specialist trader here for cassava.

- The maize marketing method in Adabra is that there are some 6 women in the village buy from other people and take to Kasoa market. They are taken to the market by a driver who comes early on market day. They sell in the market using a smaller olonka and a difference of price per olonka. The mark up is about 50-100 cedi (price depending on quality and on the day). The mark up is the price to the driver. The smaller olonka gives the women their profit. Highest market price: reached 1200 last year but can go to 2000. Road, now well graded and wide, is not a problem for marketing.

- We spoke with a woman trader in Lome. She buys maize at 2000/rubber at the low price. She then stores and sells eventually at 4000. She preserves using actellic bought from Swedru (one teaspoonful diluted in a little can of water will suffice for a mini bag). She spreads the maize on the floor or polythene bag and sprinkles the mixture on it and then lets it dry. Then she packs the maize into bags, and sews the tops. She stores the maize in a large room - 50-100 mini bags each year. She says that there are 40 traders in Lome. Of the 40 people, one trades maybe 150 bags. Our woman is an average buyer. She farms as well. For selling she organises two mini busloads in a day (she travels with first and sends the bus back for the second) and markets in Mankessim, Bawjiase and Kasoa. She takes cash, but some credit too which she collects the next week. Because of the poor road the driver may take only 30 bags instead of 40 - therefore she specifically suffers from the poor road. She has her own capital and does not borrow, but because of school fees she has less capital than she would otherwise use. She is thinking of going to the bank to try and borrow some capital for buying. However, no one she knows borrows. She stores some maize up to April and May, and never incurs losses. She treats her maize with actellic once. Actellic costs 45,000 a litre but she will sell some if she does not use it all.

- We also spoke with a man trader in Lome. We also spoke to a man trader, in his shop. He treats his maize in the same way as the woman trader. Sankubi (sp?) is an alternative to actellic (but in this case they are instructed not to use the grain within three months of applying the insecticide). He buys maize in August and September and sells in April and May. Last year he bought 23 bags and this year he bought 33 bags at 2,000. The selling price can rise to 5-6000, if there is a national shortage. Maize here is higher quality than in Ashanti, he says.

- We visited the market outside Sampa and spoke to two lady traders from Sampa about maize trading. In Sampa they said there are 7 maize traders. In September and October these two women are most busy, but they also throughout the year, though very little in May to July. They buy from Sampa and some from Akropong (village near Sampa). One may buy up to 20 bags at a go, store it in Sampa and then take it to market on Tuesday and Friday - she does not wait for the high price season because she has no working capital. In September to October she buys at c 2000, and in January to February at c 3400 (now) and in May at c5-6000. And she can add about 200 for the sale price. She buys all shelled maize. She brings her maize to market in a mini bus. She does not treat the maize. She also owns a farm on which she grows maize. On the farm she stores the maize in a crib without treatment; because the amount is not very great she does not bother with chemical treatment. She opens the crib when she needs money and she knows that if she keeps the maize in the crib a long time the losses will rise. In the market people prefer the local varieties of maize over the 'agric' varieties. Buyers of her maize are from Winneba, Dago, Emmuna, Grafa, Arkra, Mankessim and Cape Coast.
- Farmers themselves in Sampa used to sell maize direct to market at Kyiren-Nkwanta. But now there are a few specialised traders.
- We were told that there are 10 traders in Odumase Akropong, and others from other places come to buy.
- We spoke to a woman trader in Odumase. She is local and was in the market making and selling banku. She buys maize and makes it all into banku. In August and September she is very busy buying shelled maize which she dries on a broad polythene sheet in the sun and sprinkles with a chemical - but does not know its name. Then she stores the maize in sacks, which she sews closed and stores on boards on the floor in her house. She has no losses. She buys 300,000 cedi of maize (or 150 rubbers or 15 mini bags). She stores major season maize until March to May and then makes it into banku when the price is high. For the period before this, to keep her banku business going she buys small amounts from the market regularly. She makes banku every day, not just market days. She uses any of the three mills in town to grind her maize, and pays 400/rubber.
- In Odumase we spoke with what was described as perhaps the main trader (also a woman) in the village. It is also her main occupation. She buys maize from Odumase, Adiembra (1 mile) Akwasi-Adu Oboba (1 mile). She walks to find and buy the maize and after buying comes back to Odumase to hire a car to collect the maize. Sometimes she headloads. She buys throughout the year. Sometimes she stores the maize, not so much, for 2-3 months. In some years the harvest is high and then the price does not rise so much and so it is not worth storing. Also there are storage problems (weevils and rain) and she does not really have enough money to buy and store. She could get information about these things from the agricultural extension officer, she believes. She said that in some low-lying and wet parts of the local area the farmers can start sowing the maize in January and February and therefore harvest in March and April. But because they are not many farmers and there is little other maize around she buys at the high price of 4-5000. In June to August is the main harvest and she may buy at 2000. Much of the maize locally goes into cribs in September and October and therefore there is a shortage by Christmas and the price rises to 3000-3500 and then continues to rise afterwards back up to 4-5000 again. Currently the local price is 5000/r. She sells the maize in Winneba, which is a reliable market. She used to go to Accra, but was harassed by the security people there. She will take to Winneba 15-30 maxi bags at a time, or even more than 30. The bush weight of a maxi bag is about 100-110kg and the city weight is 120-150kg. She

showed us a maxi bag. It measures 52" long and 27"wide. The rubber here is bigger than in Assin Foso. She buys by the bigger rubber but sells by the Winneba bucket type of rubber (her example she showed is 9" diameter by 9" high. She said that 2 times the local rubber (bowl-shaped) equals 3.5 times the Winneba bucket. The bowl of maize currently costs 5000 but the bucket will sell for 3000 each or for 3400 for credit. In other words she buys at 10,000 and, at this time, would sell for 10,500 (and therefore because at this time the difference is not great she does not trade). In April to July the trade is good in Winneba. Then she buys a bowl at 2000 (lowest buying price) and sells the bucket at 2500-2600. This is equivalent to buying for 4000 and then selling at about 8,800 [but this seems to conflict with the local prices she gave earlier]. The transport to Winneba costs 8000 per maxi bag plus 1000 loading, therefore 9000 for a bag. It takes 25 bowls to fill a maxi bag. When she does not sell in Winneba she sells occasionally in Accra. Two years ago she went to Takoradi. where the measure is in the olonka. She does not sell locally or in Assin-Foso. She said again that she is the main trader in maize here.

Annex 2. Case studies of maize and cassava milling (grinding) and grating

- Adabra village: In the village is one grinding enterprise, housed in a cramped mill shed made from wooden posts to either side of which are tied laths leaving a space which is filled with a crude mud brick. All the grinding is done in the village. And some maize comes from the villages of Aduafo and Kuma-Akura if the grinders there are broken. Cassava processing uses the same engine but belted to a cassava grater. The engine is a Solac diesel engine, made in UK. The grinder is a Hunt grinder made in Earls Colne, Essex, UK. The cassava grater is, I think, made in Ghana. The owner bought the machines all second hand from someone in Krodua village, and brought them from there some 3 years ago. The cost of the engine and cassava grater together cost 250,000 while the grinder cost 270,000 from Accra also second hand. The operator bought the engine and cassava grater with his own money. For the grinder he used the local susu fund for which he had to pay interest at the rate of 50,000 per three months on a loan of 200,000. He did not think he could have borrowed money from the bank. Usage is almost every day; rarely not in use for as long as three days. Usually not on Sun. The engine may work for about a mean of 2.5 hours per day. If he works 2.5 hours he gets through 13 rubbers per day of maize and 10 mini bags of cassava. Before market days on Tuesday and Friday he may grind up to 20 mini bags of cassava. For grinding maize, based on the bucket-shaped rubber, which is equal to two olonka and a bit more, when the maize is dry (for making akpele) he charge 700 for a rubber; when the maize is soaked (for making banku) he charges 500 for a rubber. A family on average will come to him 4 times per week for grinding maize. The cost of milling cassava is 500 per large bowl, for gari; 800 per mini bag for Kasoa market (more costly because he must grate it twice. The running costs of the diesel engine include diesel fuel - under one gallon per 2.5 hours at a price of 3300 cedi per gallon. Some costs of spares include: nozzles in year he may use 6 @ 10,000; injectors last bought 3 years ago; his belts are 3 years and 2 years old; he buys a set of rings per year @ 7000; gaskets last 6 months or more @ 7000. The crankshaft lasts 6-12 months; maize plates last 2 months when well used but can last for up to a year; the cassava grater last 3-6 months. Maize plates cost 35,000 cedi (one pair per year). He services and maintains the engine and the grinder himself. However, for major repairs he may bring a specialist from the village of Bontrase for which he pays 15-20,000 per day- but he did not use him at all last year because he is learning his skills, and in the future he may use him just for crankshaft changing. He buys all the parts in Accra and says they

are easy to find. He buys from two suppliers: (a) Akwei shop and (b) Azagolo shop both near Goil Station at UTC.

- From Adabra we drove a short distance to George village, near Adabra. It has one mill. The owner was on the farm but his brother opened the mill for us. We saw a Lister diesel engine, bought from Ouom village 5 years ago where it had been for at least 27 years. Their father bought and gave to the elder brother who has been working with milling machinery since he was ten, and is now fifty. The mill shed, typical of what we subsequently saw, is made of strong planking nailed to sturdy posts and with a thatched roof. Mostly they work with maize and cassava. Sometimes they work a long day and sometimes only a short day. They charge 800 for a rubber of dry maize, and 400 for a rubber of wet maize. The charge for cassava is 1000 per mini bag, and 1500 for the larger bag (described as being a half of a maxi bag). The mill is for the use of his own house and the surrounding families'. The regular repairs and replacements include: plates, crankshaft, diesel pump, belts, and other engine parts. He buys the parts from Accra. The last semi-major repair work was when the stand for the cassava grater broke and was repaired by a man at Akoti junction. The brother does most of the maintenance himself. Sometimes he uses the maize grinder for coconut: chop and fry the coconut before grinding, using old hard nuts in which the flesh has browned. After grinding, then on to the fire to boil so that the oil rises to the surface. They can process 3-5 pans per day, but they are likely then to wait for 2-4 weeks before next load comes. The coconuts come from the villages of Amonana and Desum.

- In the very nearby small village of Kuma-Akura is another mill. We did not visit it, but spoke with the owner. He has owned it for one year, bought from Brata village for 1.5mn cedi (for engine, grinder and grater). He used a loan from relatives, partly now repaid - no interest. He is not a technical man, and relies on specialists for repairs. Sometimes uses the man from George and sometimes a man from Sogakpe in Volta region because he comes from there and trusts him. He gave a little information about running costs – he uses 3 gallons of diesel fuel a weeks if there is a lot of work, at 3200 per gallon; one gallon if little work. He buys plates, nozzles and crankshafts. The maize grinder is from R Hunt and Co, Earls Colne, Essex and the diesel engine is a Raja from India.

- At Akoti (junction) we walked from the main road in the opposite direction of Adabra 100m or so. In a dip on left was a typical grinding shed made of planking, with a thatched roof. It is one of two, both owned by men, in Akoti. This one belongs to Kofi Obri known as Kofi Campsi. The shed was well made and new. The mill owner and his young children were there making a repair - replacing the grinding plates, which they had bought the day before in Accra. In the next town of Awutu-Breku he also has a corn mill and a wheat-flour mill. When asked how he started milling, he said he was a farm manager at Campsi Farm at Awutu-Breku working for a Swiss with a Ghanaian wife. The Swiss died and the wife decided to sell the 1000-acre farm. A company bought and then resold unwanted machinery including an Italian Lombardini diesel engine and a mill. He bought them for a very special price of 40,000 cedi, and they formed the basis for his operation here. But the machinery currently in use here is an electric motor and new grinding machine (a Bentall Super Mill, UK)., which cost him 1mn cedi new 4 years ago, bought in instalments – again, it was a special price, this time through his brother in law in Swedru. Thus he has here a broken diesel engine, which he says he is repairing (at a cost of 300-500,000), and an electric motor and a grinder of which he is replacing the plates today. He says new today at full price the motor and mill would cost 2.1mn cedi. He has been operating here for one year. He did not obtain a formal loan, but wife helped with the purchase, saying milling is in the family because her father was a miller. He

tried to obtain money by selling his portion of his mother's inheritance of 10 cows; he wanted to sell two but his brothers and sisters stopped the idea. The main operating months are September to December, then during the minor season he works at half rate up to March. From March to August is slow. People bring maize to grind from Akraman, Akoti, and sometimes from Ojobi because of the good quality of the grinding here. But maize is not brought from a great distance along the main road, because each settlement has its mills. No Cassava is grated, and would be grated at a loss. But if he can find the money he has ideas for a cassava mill in Adabra because Adabra is a cassava area. Here there is little cassava. We asked about charges. He replied that he is starting to talk with other local mill owners (himself and the other man in Akoti Junction and the owners of the three mills in Ojobi) about standardising the price they charge (price fixing!). He thinks a good price would be 350 cedi per rubber for soaked maize and 1200 cedi per rubber for the dry maize. The shed cost him 385,000 cedi (wood from Swedru). His other corn mill needs repair, but his flourmill is working well. He buys parts from Accra. He used to buy from Aquip near Circle and GMTC motors near Farisco but they do not operate now. He now buys from the open market, exercising great care for reasons of getting good quality parts. During the main season, September to December, his operator here works early morning and evenings milling. He lives in the Ojobi. He is about to discuss salary with his operator. This area is gradually shifting from growing maize to growing more vegetables. He cannot give useful information about his customers because they are too varied. But one regular woman customer brings a bowl of maize twice a week and then makes kenkey for sale in Accra. Another good woman customer prods him into maintaining his mill or else she has to good some distance for another one.

- At Apam Junction along the graded track through the village houses in the direction of Abora there is a mill on the right of the road whose owner is Mr Isaac Aunsah. The mill is in a shed made of planking with a thatched roof. There is no diesel, only an electric motor (Chinese, Wonder Electric Co 7.5kw and 380v 3 phase motor). The electric motor is 1.5 years old (previously had a diesel). They changed because diesel fuel is expensive and parts are also expensive and liable to be of poor quality. The corn grinder is a Rex No2A Grinding Machine. The other machine, which can be belted to the motor, is for 'polishing' maize. This removes the hard husk from the maize and leaves white 'kernel'. The husk comes off as a finish powder and is used for feeding poultry. The owner reported that sometimes there is lots of work, sometimes not. October to December is busiest season; 2-3 hours in early morning and 3 hours in evening (before people go to the farm and after they return). In this time he may grind 3 mini bags and polish an additional 3 mini bags of maize. They charge 300 per rubber for soaked maize (10 rubbers per mini bag). Polishing is slower, and the resultant grain is cooked like rice or for porridge. It is also possible to use the polisher to obtain the 'kernels', which are then soaked overnight, then ground to make the dough for kenkey. But grinding is more common. The electric motor cost 900,000 and the grinder costs 600,000 4 years ago; the polisher cost 200,000 4 years ago. He used his own money - no loan – and he started milling 4 years ago. From January to September he finds some work, but fewer hours. Charge for rubber polishing is 150 and takes more time but grinding uses more current. He makes the repairs himself but the cost of spare parts he estimates every four months at 100,000. Electricity costs for last October and November were 160,000 and 103,000 respectively. There is a new charge rate since last August so previous charges were irrelevant. People come to the mill from Apam Junction and from Abora.
- There are reportedly 8 mills in Apam Junction, though one is for mixing wheat flour and making dough, which is then baked into bread by some women in their houses. There is

enough milling work for all. They do not attempt to take and install mills in the villages because the villages have no electricity. All the mills are about the same size with the same functions, but one is smaller (a smaller grinder) and one does not have the polishing machine. Two are diesel, the rest electric. No cassava at all is processed and there is no palm nutcracker. They use the maize machine for grinding the palm nuts.

- At Apam we were taken to one mill, in a corrugated iron shed belonging to Kwaku Akorful.. The owner was at church, but his son showed us inside. We saw an old diesel engine, with no belt attached. Also, an oldish electric motor attached to a corn grinder. Also in the shed is a small machine, powered by electricity, for blending tomatoes with other vegetables. The owner arrived and was happy to answer questions. He keeps the diesel engine as a reserve for use if he has a lot of work and there is a power cut, but he normally uses the electric motor. He bought the diesel more than 20 years ago, and the electric motor in October 1988. He changed to electric power because the price of diesel was then very high, and the electric motor works faster and maintenance and spares costs are less; he has not had to buy any spare parts for two years. The main cost is electricity; his highest bill, last November, was for 75,000 cedi, but this also covers the freezer in which he stores fish and he cannot separate them. His busy months are July to September as the maize is being harvested, but in other periods there is not so much work. In fact there is not a great deal of work at all because there are some 22 mills in Apam and so to some extent the owners try to divide the work between themselves. He charges 500 cedi a rubber and will increase this to 550-600 cedi. Costs for the grinder are: 50,000 for a pair of plates, which have to be sharpened every 2 weeks for 4000 cedi. Oil for the grinder for one month costs 3000 cedi. His income he estimates at 200,000 per month for July to September and perhaps 75,000 per month for October to June.

- In Abora we were told by the group of elders that it costs 300 per rubber for grinding soaked maize and 200 per rubber for polishing - both in Ankamoh. They do not take any maize to Apam because it is too far and there is no need. Any increase in price is mainly due to fuel price increases. Although it is cheap to mill in Ankamoh, in the off-road villages milling is more expensive - 500 per rubber for grinding soaked maize and 400 for polishing. We were told that the use of diesel engines is reason for high prices in the off-road villages. From Abora people take maize to grind twice per week, ie relatively infrequently, because of the longer distance, for consumption. However, they would go 4 times per week if preparing kenkey for sale. All the maize is taken to Ankamoh by head loading - and if the road is wet they may slip and lose the load, especially the boys and girls. If it is raining, or women not well, then the husbands will take the maize on their heads. The total minimum time for headloading both ways and milling is 1.5 hours but at other extreme if the mill is busy one may have to leave the load at the mill and collect the ground maize in the evening.

- In Lome there are two mills but no machine for polishing the maize. Like the other off-road villages there is no electricity so the grinding is undertaken using diesel engines. We visited one mill that had a Rex engine from Madras and a Rex grinder. The second mill had a Tirose International Rex engine, Madras, and a Rex No2A corn grinder and a local cassava grater. The miller said that the most popular demand is for grinding soaked maize at 400/rubber then fried maize at 600/rubber (mill twice), then, least popular, is dry maize (may grind four times) at 1200/rubber. The owner has owned the machines for 10 years. The engine and grinder set cost 600,000 from Accra second hand, and 450,000 for the cassava grater 2 years ago. He used his own money, no loan. Running costs depend on the work: 1 gallon of diesel/day at 3300 cedi when busy, 1gallon per 3 days if little work. Minor repairs he undertakes himself; for major repairs he uses a man from Swedru.

Engine oil - 1gallon lasts 3 weeks, at 16,000; grease 2000 each week; plates 70,000 per pair (second quality; best is 90,000, poor is 40,000); nozzle 3yrs ago 15,000; gasket last year at 15,000, duration depends. Purchase of plates depends on usage and care, they can last 6-12 months; sharpening costs 8000 every three weeks. A crankshaft lasts up to 5 years and he paid for one for 95,000 last year. Gaskets last 1 to 5 years. The mill is busy from August to October, 15-20,000 cedi per day; fot the rest of year maybe 3000 cedi per day. There is not much demand for processing of cassava in the village - he charges 5000 for a big pan.

- In Sampa there are two mills for maize, but no grater for cassava. The village chief also said that one of the mills is not reliable. And the other mill is owned by someone who lives outside Sampa To buy and install a good new mill they would have to mobilise the resources of the whole population. The chief explained that for making gari all they have is a hand grater for the cassava, and he got someone to demonstrate this for us. And it would not be possible to borrow money for a gari plant as people are unable to save because of the low level of incomes. They do not even have a susu scheme because no one has sufficient money to pay into it, he said. We visited one mill, which has an Adico diesel engine and grinder from Rajkot, India plus a costly looking rice polisher. The mill is working poorly - needs new plates – but the owner was not available and the operator has no money. In the second mill there is a Lister engine plus a Hunt grinder, together with a cheap cassava grater. The mill has been here for 8 years and came second hand from Cape Coast. He does not know the price. This mill had, waiting to be ground, a large bowl of soaked maize and a bowl of fried palm nuts. We found the operator, a boy, who is the son of the owner who lives in Abreku village. He charges for soaked maize 500/rubber (the main work); dry is 800; fried is 700 and palm kernels are 700. They are very busy in August and January (festivals in these months) then busy in September and October. The rest of the year is less busy. In August and January they may get 6000/day (7 days a week) but 2000/day rest of year average. (up to 50,000 a week absolute maximum). The running costs include: 2gallons/day diesel fuel when busy; 1gallon lasts 4 days when not; plates cost 50,000 a pair and last 8 months; he sharpens them in Winneba at 8000 every 2 weeks. Other costs include a crankshaft every 1-2 years at 120,000; grease 10,000 every two weeks; 1gallon of oil lasts one month and costs 21,000; bearings last 1-2 months at 12,000; a nozzle lasts 6-9 months and gaskets last 8 months. People come to the mill from all from Sampa.
- In Mprumem there are two mills.
- One of the mills in Odumase has a diesel engine made by Indo Agro International of Delhi, India, with a No2a Venus grinding mill. The mill is in a large new plank shed of typically sound construction with a thatched roof. He bought the mill new only 2 months ago, and has been operating for one month. He has taken to milling because farming is difficult and he wanted a second source of income for added money and security. The engine and grinder cost 1.6mn cedi. The owner said that the organisation that sold him the engine, usually deal only in spares but occasionally have a complete engine for sale. To buy the engine he had borrowed part of the money, from the Social Security Bank. They also have a rice polisher bought for 800th cedi, of Ghanaian manufacture, bought it in a shop in Oda and made in Oda. He charges: soaked maize 400/rubber; dried 1000/rubber; fried 1000/rubber; palm kernel 500/rubber. Soaked maize is commonest and fried maize is rare. During the one month of work so far they have perhaps averaged 6 rubbers per day, but many people do not yet know about the mill and it is also the off season. He has bought a press from Takoradi for 36,000, to remove water from ground cassava in making gari, and he uses it for his own gari, not for commerce. His operating

costs include: diesel from Oda 1gall at 3200, when plenty of work lasts a day or 4 days when little work. He buys diesel from Oda because the road is good and because transport to Oda is 1300 per seat whereas to Foso it is 2000. Other costs include: engine oil 12,000 lasts 2 months; grease 1-2000 lasts three days; the building cost 700th; the water cooling drums and pipework cost 250th; sharpening costs 8000 is done in Oda and if there is a lot of work lasts one month. People bring crops for grinding from Odumase and nearby villages.

- The second mill we saw in Odumase is housed in a type of lath and plaster building (with mud packed between laths that are tied either side of the uprights). It has a thatched roof. The engine and corn grinder are from Agro Industries of Delhi, India. He has been milling for two years. He bought his engine etc from a soldier who had been undertaking UN peacekeeping operations and brought the engine and mill from the Middle East. The solider lives in Akim-Achiase but the machine itself was in Accra. The cost of engine and mill was 1.6mn but by the time he had completed the installation he had paid 2.5mn cedi. He bought the rice polisher at Akim-Oda, where it was made. While we were there several sacks of rice were brought to the mill by different people for polishing. They produce quite a lot of rice here, and he traders come from the cities to buy polished rice. For rice polishing he charge 1000/rubber (7 rubbers in a mini bag of 50kg). For maize he measures with the other, bucket-shaped, rubber. His charges are: soaked maize 400/r; dry is 1000/r; fried 700/r and palm nuts 400/r. The major demand is for soaked maize, then dry is next most common. He estimates that rice polishing is about half of the value of the business. The busy times are June to August when he might do 60 rubbers per day. Then October is busy at 40r/day. In the lean time he might do 10rubers/day of rice (or perhaps none for a week) and the lowest for maize is 4rubbers/day. His repairs are done by the specialist in Oda. Plates cost 65-45-36-30,000 depending on quality, bought in Accra or Oda and may last one year. He has to sharpen them in Oda every two weeks at 8000. He uses up to 4gall/day diesel and down to 1gall/day in the lean times; engine oil 1gall at 15,000 lasts 500hrs; grease, 1000 for one week. Spare parts: bearings 10,000 per 6 months; gaskets 7,500 per 3 months; oil sealing 3000 per year; rings 6000 per 6 months.
- Aworabo is very difficult of access, some 35 minutes from Odumase along a poor track. The miller lives in Afator (where there is no mill) and operates the mill in Aworabo only on Friday, Tuesday and Sunday. He has been milling here for nine years or more. He also polishes limited quantities of rice, but has no cassava grater. There is no rice thresher here and therefore they have to bring a large thresher from Oda. They then bag the grain and have to take most of it to Oda for polishing, and then they sell it in Oda. In Odumase there is manual threshing. For what they in the village eat, they put the rice in sacks and beat it with sticks to thresh it. Their cassava is sold raw to traders from Ashiama, near Accra. They do not even have a grater in the village and therefore they grate by hand. If the local mill breaks down they go to another local village, either Kano or Kakuasa. The local maize grinding costs are: soaked 600/r; dry 1200/r fried 600/r. To polish rice costs 1000/rubber of the bucket type.

Annex 3. Processing maize and cassava into foodstuffs

Maize dough: A core activity is to prepare maize dough by soaking the maize for 2-3 days, then draining off the water. The soaked maize is then ground in one of the local mills. Water is added to the 'flour' to make dough, which is left standing for 2-3 days in order to ferment. From this material a number of dishes are prepared:

Banku (first method): dissolve the dough in water, on the fire, stir with a stick for 30-60 minutes so that it reaches a semi-solid, like mashed potato. It is eaten with a vegetable stew or with a strong soup or sauce, perhaps made with groundnuts or based on palm nut oil.

Banku (second method): First, boil water, then put the dough into the water, stir to a semi-solid state and eat with soup or stew.

Variations on the above banku dishes include adding some cassava dough to the mixture or cutting cassava chips and adding them to the corn before grinding.

There are various different forms of another important dish, kenkey:

1. Ga kenkey: divide the corn dough into 2 portions, semi-cook half like banku (cook half the time), place off the fire to mix with the other half of the dough rolled into a ball and wrapped in maize husk, back to water and boil and eat with soup or stew. Keep only a short time - it may be sold quickly while still hot.
2. fanta kenkey: like ga but when preparing the first half, do not boil so much. After mixing, then wrap tightly in dried plantain leaves, and then boil. Takes up to 3 hours, or overnight, to boil because a lot of plantain leaves are used. The kenkey will keeps 1-2 weeks (the plantain leaves protect it - if mould starts to grow on the outside of leaves, it is still good inside. Remove leaves, eat with soup or stew. Can also mash it in water and add milk and sugar and can even bottle it for chilling in a fridge - sold as iced kenkey.
3. Etew (nsiho dokono, polished kenkey): use only a little salt, (the dishes above require more salt). Take dry maize to the mill and polish. Then pour water on it and leave 2-3 days. Take to the mill to grind again, to dough. Add water to the dough, leave 2-3 days to ferment. Of all the dough take half to make banku and then mix this with other half. Either (a) cover with plantain leaves or maize husks and then boil in water – the different coverings give different tastes. Eat with soup or stew, or mash with sugar and milk.
4. Asikyire dokono (sugar kenkey) - more in the middle belt.
5. Adibi nkokoa: soak maize in water for 1-2 days, then drain the water, add pepper, onion, spices, and take to the mill to grind. Take half to make banku, then mix both parts, then add red palm oil. Then maize husks are tied round a lump of the dough, which is boiled, and the food is eaten hot by itself, - not with a stew.

A number of dishes are made with cassava (and can also add cassava dough to corn dough to prepare banku):

Gari: when the dried gari powder has been prepared (peel the cassava, grate, squeeze out the water and starch, sieve and fry) one can add milk and sugar and eat it like a cereal. Alternatively, one can add a little water, and the powder swells and becomes firm. It can be taken with stew or soup.

Kokonte: peel the cassava, cut to big chips, dry in the sun for 10-14 days, pound the dry kokonte in a mortar and pestle for a long time and sieve; or pound for a short time and grind in the mill, then sieve. Cook in hot water (not too much) - pour in the powder, stir with a stick to a semi solid state (somewhat sticky), and eat with soup.

Bankye-akrakro: dehusk the cassava and grate in the mill. Add ground pepper and onion and salt. Roll into tiny balls. Put a small ball in oil and fry. Perhaps eat with coconut.

Yaka-yaka: a northern dish.

Ampesi: peel cassava, cut to pieces, wash, boil in water for 20-30 minutes. Drain the water and eat with soup or stew (mostly stew).

Fufu: as above, but when take off fire, dry a bit and pound with pestle and mortar into a sticky mass, eat with soup.

Roast cassava: roast for 30-60 minutes, peel or scrape, eat as is or take with meat, stew or soup.

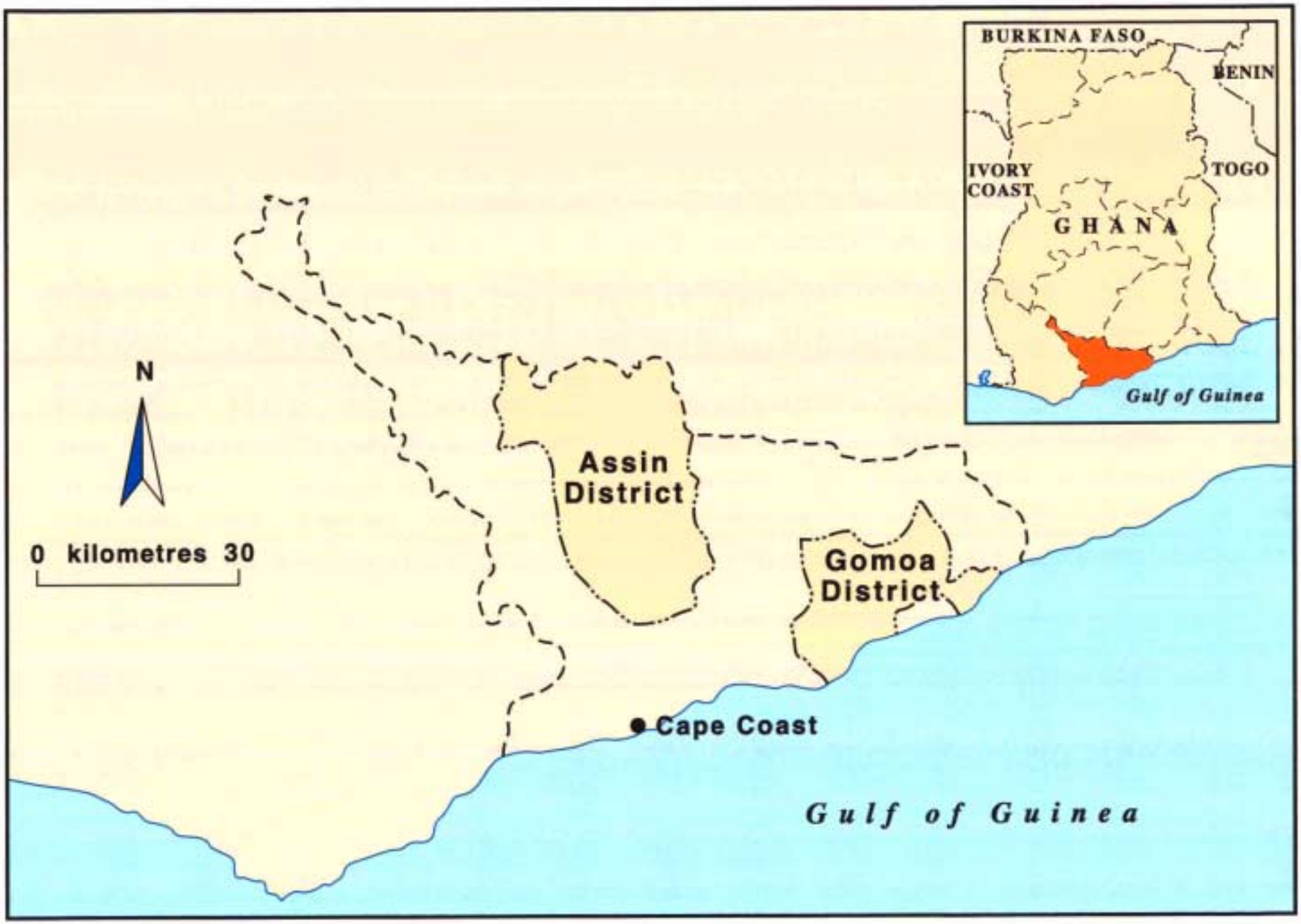
Corn porridge: take a little corn dough (fist size per person) and dissolve in plenty of water on the ground and boil 20-30 minutes. Add sugar and milk and take as porridge with bread.

Aprapransa: fry dried maize, grind it in the mill, prepare with red oil or palm soup; then either:

(a) eat with palm soup (made thus: boil palm nuts for 60 minutes, drain, put nuts into mortar and pound with pestle, then pour the whole contents into water (and remove any shell fragments), and onto colander or sieve. The liquid will pass through leaving palm kernels and chaff behind. Put the liquid on the fire and place meat in it and add onion and vegetables. Boil for 30-60 minutes and you have palm soup). Into the palm soup, pour the fried, powdered maize and stir for 20 minutes.

(b) eat with red palm oil: boil water, pour fried powdered maize into it, boil for 10 minutes, have a second fire on which place a bowl containing the red oil. Into the red oil slice onions and tomatoes and fry for 5-10 minutes. Add powdered pepper and slices of meat or fish. Take off fire and pour contents onto the fried maize powder in water, stir for 5 minutes and eat.

Local Tom Brown: fried maize powder (add fried groundnuts and fried beans) and grind with the fried maize. Dissolve the fried maize powder in a little water, then pour into boiling water, cook for 10 minutes while stirring, add sugar and milk. Eat with bread etc.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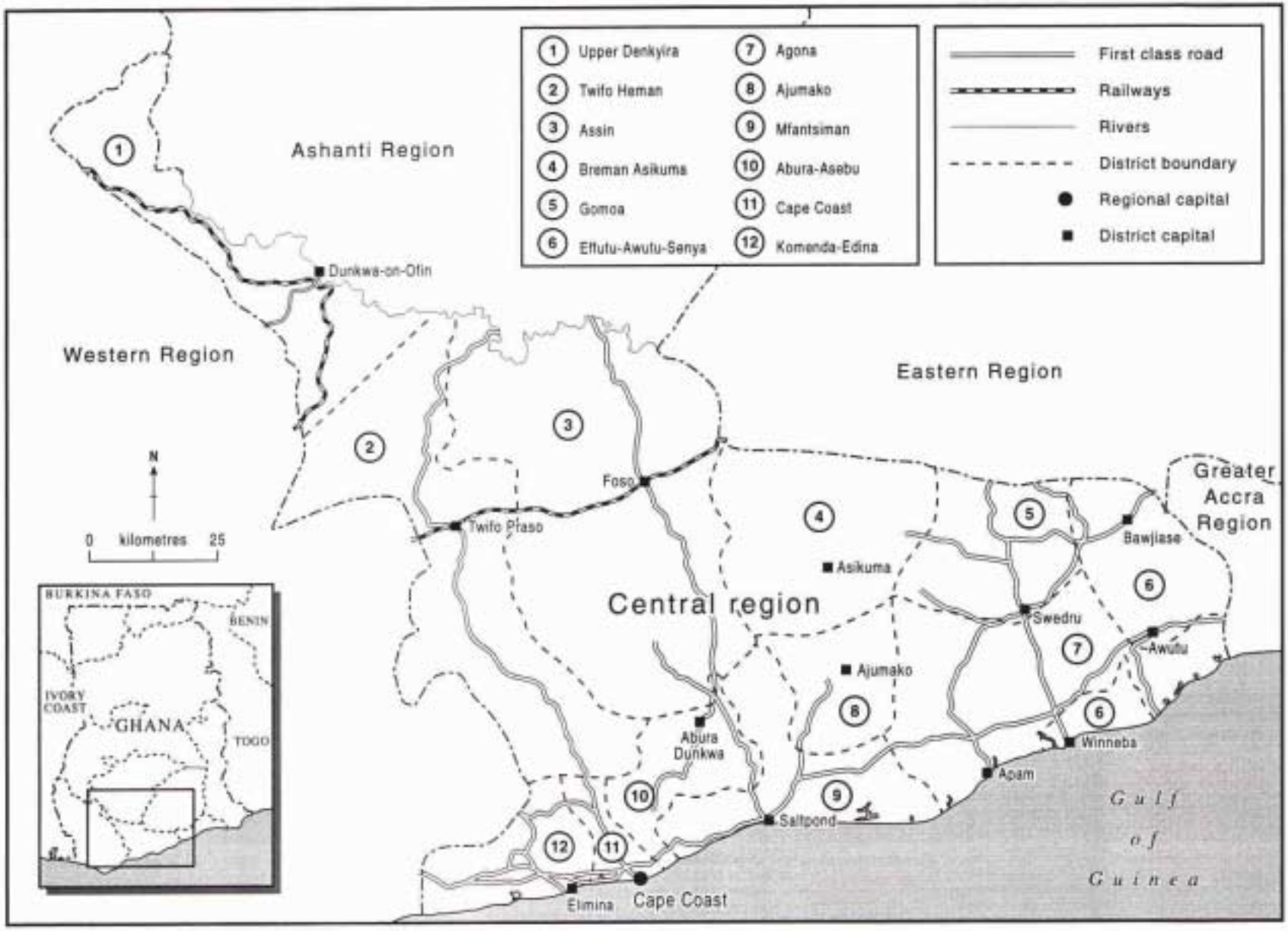
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10 Abura-Asebu
11 Cape Coast
12 Komenda-Edina
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Eastern Region
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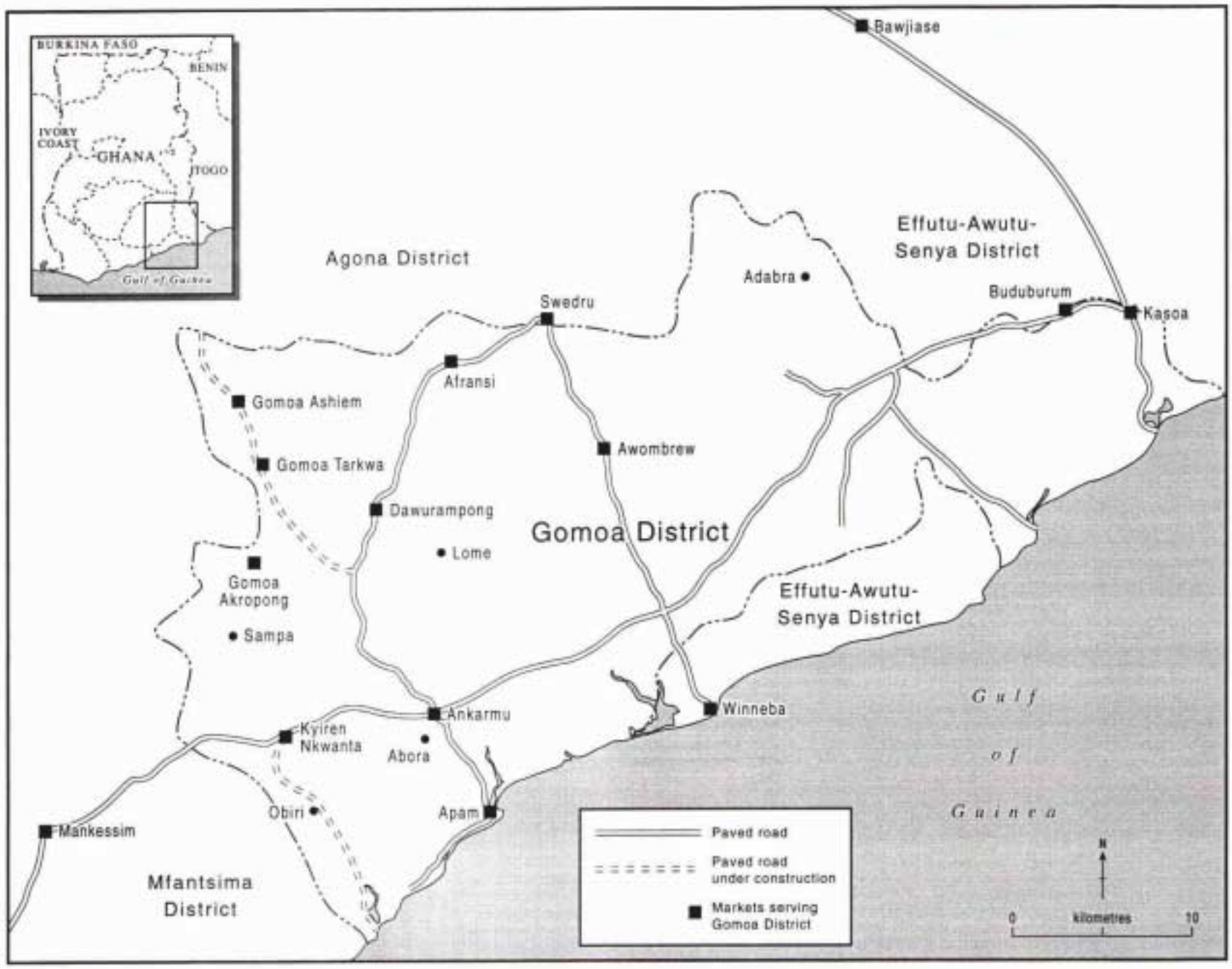
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Sampa
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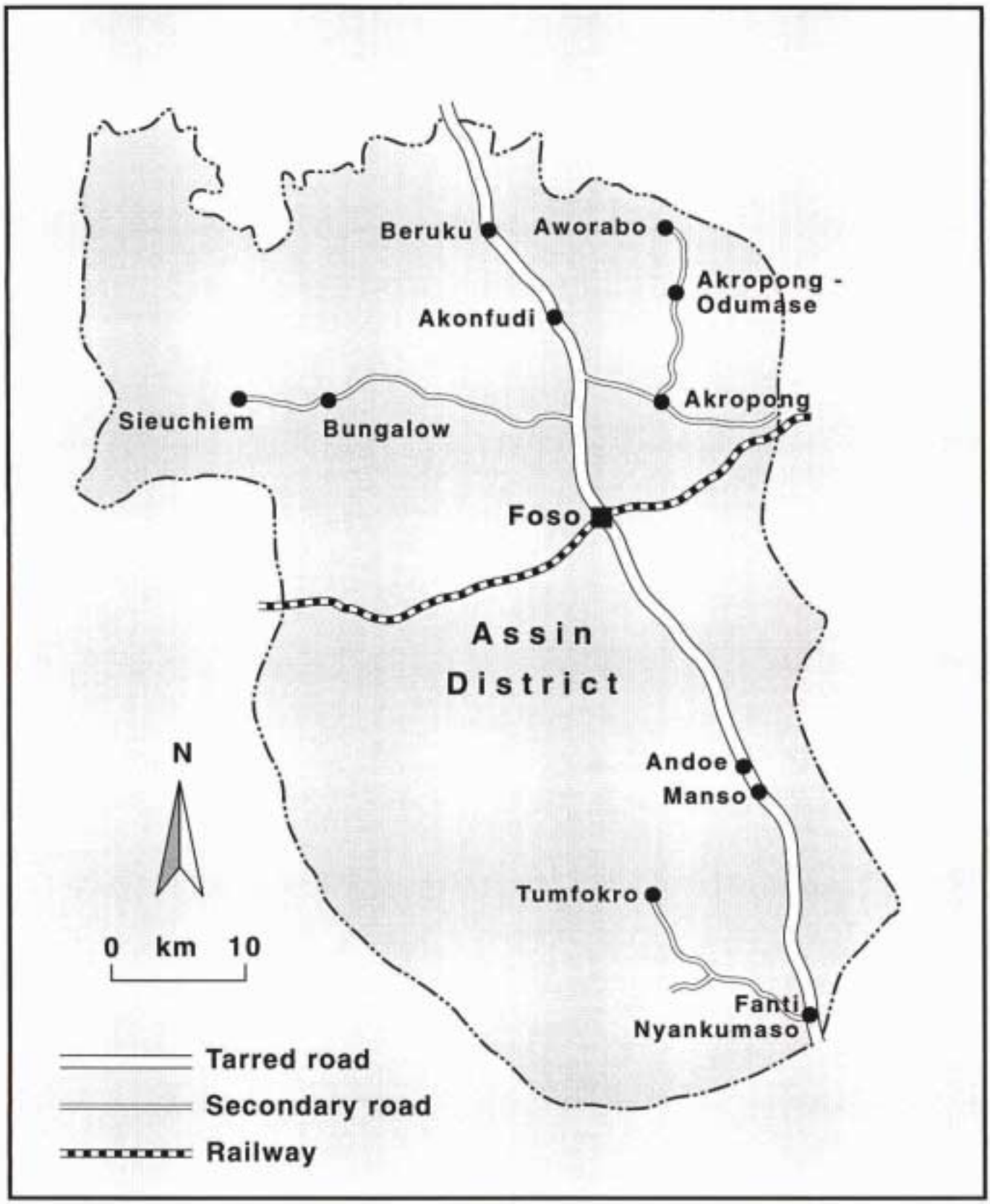
kilometres
10


Beruku
Aworabo
Akropong -
Odumase
Akonfudi
Akropong
Sieuchiem
Bungalow
Foso
Assin
District
N
Andoe
Manso
Tumfokro
0 km 10
Fanti
Nyankumaso
Tarred road
Secondary road
Railway