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ENHANCING THE PRODUCTION AND SUPPLY OF GOOD QUALITY YAMS IN GHANA

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INTRODUCTION

Yam (Dioscorea species) is one of Ghana's major staples, being ranked second in importance (in tonnage terms) after cassava in staple food production. However, the relatively high unit price of yam makes it the most important food crop in terms ofvalue of production. The crop makes a valuable contribution to national and household food supplies; along with cassava it provides 31% of "national food security" and supplies in excess of 50% of the calorie needs of the average Ghanaian. Yam is grown mainly by smallholders. It provides a valuable income source for producers and distributors. In addition, yam exports generate valuable foreign exchange earnings.

Research funded by the DFID Crop Post-harvest Programme identified potential pre-harvest, harvest and post-harvest practices/activities essential to the production and supply of good quality yams.

PRE-HARVEST (PRODUCTION) ACTIVITIES

PRODUCTION AREAS AND SITE SELECTION

In Ghana yam is produced commercially only in some regions and districts (Table 1). Site selected for commercial yam production should always be in the main yam producing areas. The soils should be deep, well drained, loose sandy loams and rich in humus. A gentle slope has an advantage. In the yam growing areas land used for cultivation is either virgin or that which has been left to fallow for at least 5 years.

SPECIES/VARIETIES

Six species of yam are grown in Ghana. These are white yam (D. rotundata); water yams (D. alata); yellow yam (D. cayenesis); Chinese yam (D. esculenta); aerial yam (D. bulbifera) and trifoliate yam (D. dumentorum) . White yams which are more popular account for about 80% of the total yam production. There are many varieties of white yam in Ghana, but the most important ones include Puna, Lariboko, Denteh (Punjo), Asana and Araba. Others are Serwaa and Tilla.

Table 1: Main yam producing regions and districts in Ghana Region District

Northern	Salaga, Yendi, Nanumba, Gambaga, Zabzugu/Tatale, Saboba/Chereponi, Tamale, Savelugu/Nanton, Gambaga, Bole, Tolon Kunbungu, Damongo.
Brong Ahafo	Atebubu, Sene, Kintampo, Techiman, Nkoranza, Wenchi
Ashanti	Ejura-Sekyedumase, Sekyere East, Sekyere West
Eastern	Kwahu North
Volta	Kete-Krachi, Nkwanta.
Central	Efutu, Senya Awutu

Two of the popular varieties of water yam are Matches and Akaba. Some of these varieties have other names specific to localities.

Care must always be exercised when varieties are selected for cultivation. The best varieties that can fetch premium prices and can do well under a particular climatic and soil condition should be selected and planted.

Factors that influence the choice of varieties that farmers grow include:
In decreasing order of importance, consumer taste preference, early maturity, storability, yield, adaptability and availability of planting materials.

LAND PREPARATION

Land preparation begins with clearing of the vegetation. Trees and shrubs that can be used for staking the vines are left standing. Mounds are prepared after clearing. These operations are completed before the onset of the major rains. Mounding is normally done from early December to about mid March. Observation of the rainfall pattern in a particular area should be made before mounding is done. Time for land preparation can be easily known by the activities of local farmer.

In the preparation of mounds some farmers dig the ground while others do not. It is however, recommended that the ground should be dug to a depth of about 60 - 75cm before the mounds are raised on the pits made. Where practicable, manure should be applied. Sizes of mounds and distances between them differ from farm to farm. Farmers do not plant in line and this makes the assessment of plant population very difficult.

Mounds should be about 90-100cm high with a base diameter of about 90cm. It is recommended that the distance between the apex of one mound and the next be about 120cm. Mounds should be made in lines to facilitate other agronomic practices on the farm.

PLANTING MATERIAL

Farmers normally plant whole yams or cut pieces of yam. These are referred to as **seed yams.** They are either specially produced after harvesting of **milk yam** or obtained from harvested **ware yams**. To produce the special seed yams, vines from which milk yams are harvested are replanted in the mounds. Tubers that are produced from the replanted vines are smaller in size and are used as seed yams. Such seed yams are the most reliable source of planting material for Puna and Laribiko varieties of white yam. Planting materials for the other varieties are normally obtained from the harvested ware yams.

The ware yams are cut into pieces and used for planting. The most reliable pieces are those obtained from the head or top portions of the tuber followed by those from the middle section. It has been observed by farmers that the bigger the seed yam, the bigger the tuber that is harvested from it. The cut pieces used as seed yams should have at least 2-3 'eyes' (buds) to ensure good sprouting. Cut surfaces of the pieces should be allowed to dry before they are planted. It is also recommended that seed yams be treated with appropriate fungicides before planting.

Production of seed yams from minisetts

A "mother" seed yam is a seed yam used to prepare minisetts. Select clean, healthy yam tubers (500 – 1000 g) of the right physiological age (i.e. these are tubers harvested when the leaves turn yellow to brown and wilt). Select tubers immediately after dormancy is broken (i.e. tubers that are beginning to sprout), 2 - 3 months after harvesting. Usually, the development of sprouts at the head-ends of tubers indicates the end of the dormancy period.

When mother seed yams of the sizes described above are unobtainable, use ware yams (over 1000 g); the tuber must have ended dormancy. Minisetts prepared from ware yams sprout late and unevenly.

Cut the mother seed yam into cylindrical pieces, each about 5 cm long. Depending on the circumference of the pieces, cut each piece longitudinally into 2, 3, 4 or more pieces. Each piece or minisett (should contain part of the periderm of the tuber) weighs about 25 g. One mother seed yam of 500 – 1000 g gives 20 – 40 minisetts. Treat freshly cut minisetts with a recommended fungicide (This treatment is necessary to protect minisetts against rotting agents like fungi and bacteria) and spread them in light shade for 1-2 hours or more to dry the cut surfaces. Do not expose minisetts to direct sunlight.

Pre-sprouting is done in wooden boxes or polyethylene bags filled with moist sawdust or moist sandy loam soil. It can also be done in nursery soil which has been sterilised. Keep wooden boxes or polyethylene bags in shade or cover nursery beds with dry grass mulch to conserve soil moisture and reduce bed temperature. High bed temperature encourages rotting of the minisetts. Water

the sawdust or soil to keep it moist. Depending on the variety, minisetts sprout in 3 - 4 weeks and are ready for transplanting onto the field. Ideally, prepare the minisetts 3 – 4 weeks before the rains are steady.

Minisetts grow best if transplanted between the "just sprouting" stage and the stage when they have short vines without any leaves, or short vines with unopened leaves. Overgrown minisetts with long vines and fully opened leaves do not usually establish well after transplanting in the field. Just sprouted minisetts are transplanted onto mounds which are mulched with straw or leaves. All agronomic practices (weed control, pest control and staking) should be strictly carried out on schedule.

The minisett technique only works well with certain varieties of yams (i.e. water yam species). Though promoted widely in Nigeria and to a lesser extent in Ghana, few farmers have taken it up as it is perceived as complex and unreliable, and the cost-benefits have not been demonstrated. Interaction with farmers indicate that the minisett technology is not used at all.

Seed Yam Production and Storage

Seed yams are the most expensive inputs in the yam production business. Farmers normally produce most of their seed yam requirements and purchase the rest from other farmers. Interactions with farmers show that every farmer prefers to use his/her own seed yam. Considering the fact that seed yams are obtained from the farmers' own farms, the following suggestions are given to enable the farmer obtain and use good seed yam for planting:

i. Observation should be made of all the plants while they are growing and those growing robustly (free of disease and pest attack) selected for harvesting for seed yams,

ii. Harvesting for milk yam should be done during the period that the replanted vines will have enough moisture to grow. This will ensure that good seed yams are produced later,

iii. Harvested seed yams should be handled and stored well:- in shady and reasonably aerated areas inaccessible to rodents.

PLANTING

A hole is made about a third to half way down the mound and the seed yam placed in it after which the hole is covered. Cut pieces are planted with the cut surface up. The mound is mulched by putting some dry straw on top of it and keeping the straw in place with a clod of earth. This prevents evaporation of the soil moisture and also protects the seed yam from the sun's heat and subsequent dehydration.

STAKING AND TRAINING OF VINES

Staking in yam production is very important as it has a very positive effect on yield. This has been recognised by farmers and so during initial clearing, trees and shrubs that can serve as stakes are not cut down. They are later pruned of leaves to serve as stakes. Stakes should be provided where there are no such trees. Stakes should be about 250 – 350 cm high and should be placed firmly in the ground to withstand strong winds.

After sprouting and vine formation the vines should be trained (clockwise) on to the stakes. This will facilitate the climbing of the vines on the stake and expose the leaves for efficient utilisation of the sun's energy during photosynthesis.

RESHAPING OF MOUNDS

Mounds are sometimes destroyed after heavy rains. When this happens there will be the need to scoop up the earth around the mounds and reshape them. Failure to do this may expose forming and already formed tubers to harsh environmental and other conditions which eventually will result in lower yield.

WEEDING

Yam fields should be kept free of weeds at all times since yam is sensitive to weed competition. Weeding can be done manually with cutlasses and hoes or chemically through the use of appropriate/recommended weedicides. It has been suggested that it may be profitable to control weeds chemically on very

large farms. In all cases however, the advantages and disadvantages associated with the two options should be weighed before selecting the better one.

PEST AND DISEASE CONTROL

The main pests attacking the growing tuber are termites and the tuber beetle. Diseases that are predominant on yam are caused by fungi. Measures should be put in place to control and prevent pest and disease attacks. Such measures include:

i. use of clean and healthy seed yams,

ii. treatment of seed yams with fungicide before planting,

iii. practising crop rotation with legumes and cereals,

iv. keeping farm clean of weeds.

HARVESTING

Yams can be classified into two groups according to the maturity period. Varieties like Puna and Lariboko are classified as early maturing and they are ready for harvesting in 7 – 9 months. The late maturing varieties are harvested after 9 – 12 months.

In Ghana yams are harvested twice. The first is harvesting of milk yam while the second one is harvesting of ware yam.

HARVESTING OF MILK YAM

Milk yams are not physiologically matured and so have to be harvested with extra care. Farmers normally harvest milk yams for two main reasons:

i. to take advantage of high prices of the commodity, since at the time of harvest the supply of the commodity on the market is very low,

ii. to be able to produce seed yams. This is done by replanting the vines from which the milk tubers are harvested. Tubers that are obtained from the replanted vines are used as seed yam.

Maturity indices of milk yams

The main indices used in determining the 'maturity' of milk yams are the planting time and the rainfall pattern in the specific areas. Milk yams are harvested after about 3-5 months from the time of sprouting and always done at a time that will enable the replanted vines take advantage of the rains to continue growing to produce seed yams. The leaves on the vines are green and still growing.

Method of harvesting milk yams

During harvesting part of the mound is 'destroyed' to expose the tuber. The neck of the tuber is then carefully severed from the tip of the vine with a suitable tool. The vine is replanted in the mound and the latter reshaped. Care should always be exercised to ensure that the tuber is severed from the vine without damage to both tuber and vine.

HARVESTING OF WARE YAMS

Ware yams are physiologically matured tubers. They are therefore harvested after the tubers are fully matured.

Maturity indices of ware yams

There are certain indices that can be used as a guide to assess whether the yam crop is matured for harvesting. These include:

i. Planting/sprouting time:– the planting and sprouting time of the crop can be used to assess whether the crop is matured. Early maturing varieties take about 7 – 9 months after planting to mature while late maturing ones can be harvested after 9 – 12 months after planting.

ii. Condition of leaves and vines:- the leaves and vines of matured crops turn yellow/brown. In some cases the leaves begin to wither.

iii. Condition of mounds:- Mounds develop cracks and in some instances expose some parts of the tuber.

Due to the irregular nature of sprouting, some of the crops of the same variety planted at the same time mature earlier than others. Care should therefore be taken to select only those crops that are fully matured for harvesting at any particular time.

Method of harvesting ware yams

In harvesting ware yams the mounds are destroyed and the tubers removed by severing them from the vines. Harvesting should be carefully done with the appropriate implement (Cutlass, hoe, etc) to avoid any injury to the tuber.

HARVESTING OF SEED YAMS

Seed yams are harvested at about the same time that ware yams are harvested and are also harvested in the same way as ware yams.

Harvesting of milk, ware and seed yams should be done in the morning/late afternoon to protect the tubers from the heating effect of the sun that can

adversely affect the storage potential of the tubers. Planting in mounds normally makes harvesting easy.

YIELD

Depending on the variety, a well maintained yam plot can yield about 10 – 12 metric tonnes of tubers per hectare.

PRODUCTION COST

Table 2 depicts the yam production cost in the Ejura-Sekyodumasi District according to farmers. Planting material or seed yam, land preparation, mound construction and weeding are the most expensive inputs in the production system. Similar information could be collected in the other production areas/districts.

Table 2. Production cost per hectare of yam plantation in the Ejura-Sekyedumase district.

Input	Cost (US $)	Cost (Cedis ¢)
Land preparation (labour)	365.00	3,212,000.00
Mound construction (labour)	770.00	6,776,000.00
Planting material/seed yam	1,200.00	10,560,000.00
Planting	200.00	1,760,000.00
Staking material	150.00	1,320,000.00
Labour for staking	100.00	880,000.00
Weed control (labour)	500.00	4,400,000.00
First harvest (milk yams)	250.00	2,200,000.00
Second harvest (ware yams)	250.00	2,200,000.00
Total cost	**3,785.00**	**33,308,000.00**

POST-HARVEST ACTIVITIES

Post-harvest activities carried out on yam are categorised into five main operations. These include field operations, handling, storage, transportation and marketing including export of yams.

FIELD OPERATIONS

The first field operation after harvesting is gathering of tubers to a collection point. Tubers should be gathered immediately after harvesting to a purposely selected collection point on the farm. The collection point should be sited under a shade and should be reasonably ventilated. Farmers normally gather harvested tubers under big shady trees. Some of the trees however, do not provide the adequate shade required for the tubers. Where practicable, a temporary structure can be built to provide shading for the tubers. This is because initial cooling (pre cooling) of the tubers is very essential for subsequent good storage of the commodity. The collection point should be cleared of all protruding and piercing items such as sticks and stones that can cause damage to the tubers. The ground should be covered with dry soft straw or vines to serve as pad for the tubers.

Collection of the tubers from the harvesting to the gathering points should be done carefully with appropriate containers and receptacles. The containers should not cause any damage to the tubers. A container should be filled with a quantity of tubers that can be conveniently handled by the person carrying it.

Sorting and grading

Sorting and grading which are very important activities that are carried out on the farm after harvesting are normally done at the collection point. Sorting is carried out to ensure subsequent proper storage of the tubers. During sorting, damaged and diseased tubers are separated from good tubers as only good yams are suitable for storage.

Criteria used for selecting damaged tubers include presence of bruises, cuts, 'cooked' spots, splits and breakage. Others are signs of rodent attack and holes

made by termites, spear grass, beetles and millipedes. The major disease used as a criterion during sorting is rot. Careful examination of the tubers is very important in this exercise as some of these criteria factors may be hidden. Diseased and damaged tubers sorted out should be disposed of immediately. Diseased and damaged portions of tubers may be cut off and the good parts consumed. Damage caused by cuts and bruises may be divided into 'serious' and 'slight'. Whereas the slightly damaged tubers can be 'cured' and stored over a period of time, seriously damaged ones should be put to immediate use. Careful selection is a very important prerequisite for good storage and exploitation of the maximum shelf life potential of the tuber.

Grading is normally done on the basis of variety and size of the tuber. During grading tubers of the same variety are grouped together. Tubers are then grouped according to sizes normally using length and weight by estimation. Grading facilitates pricing as yams are normally priced according to sizes.

HANDLING OF TUBERS

Tubers should be handled with great care to avoid bruises and injuries. There are some handling practices that are recommended for enhancement of tuber storage. The most important one is curing. The term curing in root and tuber crops is used to describe their exposure to comparatively high temperatures (30-40 C) and relative humidities (80-95%) for short periods with intention of enhancing their subsequent storage life. Its effect is to encourage rapid wound healing through cell suberization and periderm formation which retards water loss and acts as a barrier to invasion by micro-organisms.

Farmers in Ghana do not consciously practise curing as the technology for doing it appears not to have been tried on a commercial scale and simplified for use. However, it has been suggested that curing can be done by spreading tubers carefully on straw or vines in a shade for 1 - 2 days. Whether milk yams can be cured is not very clear so the suggestion may do for ware yams. Curing, if it should be done, has to be carried out immediately after harvesting.

One other practice carried out on tubers is **cleaning of the tubers.** During cleaning, soil adhering to the tuber is cleared. This helps to protect the tuber from potential soil borne diseases. Most farmers however, do not normally purposely clean their tubers before putting them in storage. Some even seal holes on the tubers with soil. This practice should never be encouraged.

STORAGE OF TUBERS

Storage is normally done to ensure the availability of yams at all times and also for farmers and traders to take advantage of scarcity and release them for higher prices. Tubers should be stored well to ensure maximisation of their shelf life potential.

There are three main methods of storage used by farmers in Ghana. These are pit storage, storage in barn, and storage under trees. Pit storage is used for milk yams while ware yams are stored in barns and under shady trees.

Pit storage

Pit storage is normally used for milk yams. During this process pits large enough to contain the harvest are dug on the farm. Tubers are then arranged in the pit with the tail ends down. After the pits are filled with tubers they are covered and mounds made on them. The mounds help in directing rain and running water away from the stored yams.

Storage in pits takes a small percentage of the total tubers stored by farmers. This is because during the period of harvesting of milk yams, demand for freshly harvested tubers is so high that almost all yams harvested are sold immediately.

Pits should not be dug in water logged areas and should be away from ant hills. They should be dug under shady areas. Tubers packed in the pit should not be covered with straw before covering with soil as this practice attracts termites to the tubers.

Barn storage

Barns are normally used for the storage of ware yams. There are different types of barn in use depending on the locality. Barns are basically huts made of local materials like sticks, straws, vines and woven mats. They are normally constructed on the farm as farmers believe that storage on the farm is safer than in town/ village.

Arrangement in the barn differs among farmers. Whereas some arrange the tubers with the tail ends down, others arrange them on the sides. Tubers are packed/arranged according to grades. This facilitates fast transactions during farm gate selling of tubers.

Seed yams are also stored in barns as in most cases they are harvested at the same time that ware yams are harvested. They are, however, packed separately from the ware yams.

Storage under shady trees

Some farmers store ware yams under shady trees. The ground around the trunk of the tree is cleared of stone, sticks, twigs and any thing that can cause injury to the tubers. Tubers are then arranged around the trunk either with the tail ends down or on the side. Yam vines are then used to cover the tubers.

Storage in improved yam barn

The improved yam barn is a storage structure built on stands of about 1m high. The stands are fixed with rodent guards to provide adequate protection against rodent attack. It is also built to provide adequate ventilation for the stored tubers. Shelves may be built in the barn to aid in the arrangement/packing of the different grades of tubers. The improved yam barn can be built of sawn timber or local materials. The roof is always made of thatch to facilitate the creation of a cool 'atmosphere' in the barn. The barn should be built away from trees and other structures that can aid rodent to jump into it.

Preparation before storage

Some preparations have to be made before the yams are harvested and stored. This will ensure that tubers are stored on time and storage management carried out with less difficulty. The preparations include

- selection of good site for pit storage,
- digging of pit large enough to accommodate all tubers meant for storage,
- selection of good site for the construction of barn,
- construction of appropriate barn with strong local materials. Barns should be constructed to facilitate easy entry and exit as well as easy filling and removal of tubers,
- selection of a reasonably shady place ('tree under'),
- clearing and cleaning of storage places. Anything that can cause damage or injury to the tubers should be removed.

Care during storage

During storage some practices have to be observed and carried out to ensure the maximisation of the full potential shelf life of the tuber. These practices include the following:

- Maintenance of hygienic surroundings in/around storage area. The surroundings should always be kept clean. Rotten pieces of tubers and other refuse materials should be kept away from the storage site.
- Careful packing/arranging of tubers in storage structure. This will ensure that no injury/damage is caused to the tubers.
- Provision of adequate ventilation and shade for the tubers. These should be seriously taken into consideration during construction of the storage structure.
- Periodic inspection of tubers to remove any tuber that shows signs of deterioration. During inspection all sprouts on tubers (except seed yams) should be carefully cut/broken off.

Advantages and disadvantages of the main storage structures used by farmers

The various storage structures used by farmers have advantages as well as disadvantages. They should be taken into consideration when the structures are selected for use. The main advantages and disadvantages are shown in table 3. It is recommended that barns should be sited in the village and not on the farm for the following reasons:

- losses caused by bushfire and roaming cattle as well as theft will be reduced.
- Frequent inspection of tubers can be carried out.
- Tubers will be closer to roadside and markets. This will facilitate marketing transactions.

Table 3: Advantages and disadvantages of storage structures

Storage structure	Advantages	Disadvantage
Pit	• good protection against high temperature • very low tuber weight loss • Prevent rodents, bush fires and animal damage	• inadequate aeration for tubers • nematode infection may be high
Under shady tree	• Aeration is increased, thus reducing the problem of rot due to heat and wounds • Very little cost involved • Sprouting can be monitored	• Prone to rodents, stealing, bush fire and other pests (termites, ants etc) • difficult to inspect tubers easily.
Local barn	• adequate protection against solar radiation • use of local materials which cheap • easy inspection of tubers	• inadequate protection against rodents and other pests • intensive labour required are during storing
Improved barn	• good aeration for tubers • adequate protection against rodents • adequate protection against solar radiation • easy inspection of tubers	• construction is expensive • stacking may cause bruises • labour required for stacking is high

Storage and dormancy

A major feature of yams is a natural period of dormancy between harvest and the sprouting of new vines. The storability of yam tubers depends to a great extent on their dormancy, which begins after the tuber has reached the physiologically matured stage. During the period of dormancy all metabolic processes are greatly reduced thus making the tuber 'dormant'. Dormancy has been recognised to help the tuber withstand unfavourable climatic conditions. For this

reason the dormancy period of yam varieties that originated from areas with long dry seasons are longer than those of tubers that are natives to areas with short dry periods. Different varieties therefore have different dormancy periods and this, to a great extent determines their natural storability.

Dormancy period is also influenced by factors such as temperature and relative humidity. Whereas high temperatures and high relative humidities will reduce dormancy period, low temperatures and low relative humidity will prolong it. Therefore for exploitation of the maximum potential shelf life of yam tubers during storage, conditions that ensure low temperatures and low relative humidity rather than high ones should be provided. In Ghana these are provided by good shading and aeration of the storage area.

At the termination of dormancy, the tempo of respiration and metabolic activity within the tubers increases and tissues become more prone to physiological deterioration and decay as the resistance of their tissues to microbial attack diminishes. At the end of the dormancy period or where dormancy is broken, the tuber begins to sprout. Sprouts should be broken whenever they appear in storage as they affect the quality of the tuber. Weight loss as a result of water and dry matter loss is accelerated when sprouting sets in.

Farmers in Ghana do not consider sprouting as a major problem as sprouts can easily be broken off. Even though giberellic acid has been shown to be effective as a sprout suppressant, very little has been done on its commercial use in Ghana.

TRANSPORTATION OF TUBERS

Yam tubers may be carted and/or transported from the farm to other locations including markets where they are sold. Transportation may be from the farm to village/local market, from the farm to urban market or from the local market to urban market. Within the market, yams may be carted from one point to the other.

The choice of means of transport depends mainly on the distance to be covered, the available means of transport and the cost involved.

Transportation from farm to village/local market

This is normally done by head-loading, bicycle, push trucks and tractor with trailer. Head-loading and bicycles are used where the distances to be covered are not long and where tractors are not available. In head-loading, tubers are normally carried in big bowls or baskets. Where bicycles are used, the tubers are arranged and tied at the back with a rope. The tubers may also be packed in a sack and tied at the back of the bicycle. Push trucks are used to convey relatively larger volumes of tubers over not-too-long distances and are normally used where there are farm tracks. Tractors are mostly used to convey very large volumes of tubers from the farm to the village and local markets.

Care should be taken during packing and carting of tubers. Tubers should be arranged in such a way that bruises are avoided or reduced to a minimum. The volumes carried by porters and bicycles should be such that they can be conveniently carted. In loading tractor trailers and push trucks straw or vines should be spread in them before the first layer of tubers is packed. Similar materials should be spread in between layers to cushion them and minimise bruises that may be caused through rubbing of tubers against each other. The top layer should also be covered with materials that will provide ample shade and protect the tubers from solar radiation. Tractors used for carting should be in good shape to avoid break downs while working. In some areas canoes and boats, some fitted with outboard motors are used in transporting tubers. Loading of the canoes should be done in such a way that bruises are avoided.

Transportation from farm to urban market

Depending on the distance this is done by tractors or cargo trucks. Where the distance is short tractors are used. Transportation over long distances is done by either tractor and cargo trucks or by cargo trucks alone. Where there are no good access roads to the farm, tractors and other means such as head loading and bicycles are used to convey the tubers to a collection point, from where they are loaded into a cargo truck and sent to urban markets. Trucks used for transporting tubers should be suitable for the purpose. They should provide adequate aeration and shade for the tubers while moving. Loading of the truck

should be the same as loading into tractors. Straw/vines should be spread in the truck before the first layer is loaded. Thereafter similar materials should be spread in between layers. Cargo trucks that are well maintained should be used in carting tubers.

Transportation from local to urban market

Transportation of tubers from local to urban markets is mostly done by cargo trucks. However, in some cases especially in the Volta region transportation through the use of ferries is not uncommon.

Problems associated with transportation of yam

Yam transportation from the farm gate to the marketing centres faces some problems which need to be addressed. The problems include:

- Lack of access roads and farm tracks to most of the farms.
- Poor nature of the feeder road network in the yam growing areas.
- Unsuitable nature of some of the trucks used for carting tubers.
- Frequent break down of trucks.
- High transportation charges of tubers.
- Transporting of tubers and other commodities together in the same truck

The lack of access tracks to the farms and poor nature of the feeder road network in most of the yam growing areas do not encourage many transporters to go and cart tubers. Few vehicles therefore go into the areas to transport yams and as a result charge exorbitantly.

To encourage more vehicles to go to the yam growing areas to cart yams and to ensure competition among transporters that will bring down charges, the feeder road network has to be improved. This is a major investment that has to be made by the Department of Feeder Roads and the District Assemblies.

There are situations where vehicles like buses and others without adequate ventilation facilities are used for carting yams. Such vehicles are not suitable as conditions in them can contribute to deterioration of the tubers. Such vehicles should never be used in transporting yams.

Frequent breakdown of trucks transporting tubers can be checked through good maintenance of the vehicles. Only strong and well maintained suitable vehicles should be used to transport tubers to ensure their safe and timely arrival at designated destinations. At the destinations tubers should be off loaded with care and gathered under shady and well-aerated area.

Transporting of yam tubers and other commodities including livestock should be discouraged. This is because in all cases when transported with other things, commodities like bagged maize, groundnuts and cassava are packed on the tubers. This causes damage/bruises to tubers and also prevent adequate ventilation of the tubers.

MARKETING

Locally, yams are marketed/sold at different places and markets. In all cases they should be sold at appropriate places and in appropriate structures/facilities. The following recommendations should be carefully observed when yams are marketed/sold:

- Yams should always be displayed under shade and in a well-aerated area. The practice where tubers are displayed in the open/sun should be dis couraged as this speeds up deterioration of the commodity.
- They should always be displayed on straw or on any suitable soft material. This will cushion them and help prevent them from coming into contact with the bare ground that may have pebbles and sticks on it. The ground on which the straw is spread should always be dry.
- Tubers should not be covered directly with tarpaulin or plastic sheet as these materials absorb heat and transmit it to the tubers.

The above calls for a conscious effort to build appropriate structures and facilities at the various markets for yam traders.

Storage at market

Yams are not normally stored over long periods at market places when they are being sold. However, for the short periods that they are stored they should be kept well.

They should be kept under shade in well-ventilated areas which are not accessible to rodents. Where structures that can provide shade are not available, yams can be covered with vines, straw or zana mats. These materials do not absorb heat that may be transmitted to the tubers. Never should the tubers be stored in the open covered with a tarpaulin or plastic sheet.

Preparation of tubers for the market

The purpose of marketing/selling is to make maximum income. For this reason yams that are meant for the market/sale should be 'prepared' to attract consumers, facilitate speedy transactions and to make good sales out of them.

The following suggestions are recommended for farmers and traders who want to sell their consignments of yam:

- Yams should be cleaned of all dirt. The practice where holes on the tubers are sealed with soil should be stopped. Such practice, if seen may discourage potential buyers from purchasing from the seller.
- Consignments should be inspected and all unwholesome tubers (with signs of disease and pest attack, deep cuts/injuries) sorted out. These may be sold separately.
- Tubers should be graded and sold according to grades (sizes). This facilitates quick transactions.

Market hygiene

Hygiene is very import in any environment where yams are marketed/sold. Good hygiene should be maintained at all times at places where tubers are sold and it should be observed whether tubers are on display for sale or not. The following recommendations are given for observation:

- Yams should always be displayed on clean materials that will not cause any damage or injury to them.
- The market should be sited at a reasonable distance away from toilet facilities and refuse dumps.
- All cut pieces of rotten and pest-infested tubers should be gathered and thrown into refuse gathering point.
- Domestic animals and rodents should always be kept away from the market.

EXPORT OF YAMS

Yam is one of the commodities that are exported to earn foreign exchange for the country. To command competitive price the exported tuber should be of a very high quality. Exported tubers therefore need more careful 'treatment' throughout the production, handling and marketing chain until they get to the export destination.

FACTORS TO CONSIDER TO ENSURE GOOD YAM EXPORT BUSINESS

Selection of variety

The popular exportable white yam varieties are: Puna, Punjo (Denteh), Asana and Araba.

Selection of seed yam

Production of the selected variety for export should begin with the planting of very good seed yams. Care is therefore needed in selecting the planting materials. Seed yams should be free of diseases and pest attacks and should be treated with the recommended fungicide before planting.

Agronomic practices and post-harvest operation

All agronomic practices including harvesting and post harvest activities including transportation are the same as those described earlier in this paper.

Yam export activities

Yam export activities in Ghana start from the time that the tubers are purchased to the time that they are put on the ship/cargo aeroplane and freighted. In between these there are other activities carried out by the exporter. The activities as presented in figure 1 are described as follows:

Sources of supply

Most of the Ghanaian yam exporters obtain most of their yam supply from markets in Accra. Few however, get their consignments from farm gates and other markets outside Accra for export. Consignments are mostly purchased through 'suppliers' who select good exportable tubers for the exporter to buy. From the purchasing centres the consignments are sent to exporters' ware-houses for further 'treatment'.

Sorting
Even though suppliers select exportable tubers for sale to exporters, sorting is again done at the warehouse and in some cases it is done twice. Sorting is done to remove all tubers that have defects on them. Some of the defects are rots, holes and cuts. Tubers that are deformed (branched, curved) or very big are also sorted out. In the warehouse consignments are also sorted according to varieties.

Cleaning
Cleaning is done to remove soil particles as well as root hairs and sprouts from the tubers. Soil particles are removed with brushes with the appropriate bristles while root hairs are trimmed with knives/pair of scissors. During cleaning further sorting is done to remove tubers with any defects.

Wrapping of tubers
Cleaned tubers are wrapped individually with newsprint. The newsprint is cut to cover every part of the tuber. This is done to prevent contact between adjacent tubers during packaging. Contact between the tubers can lead to injuries caused by rubbing against each other. It has however, been observed that this treatment is not done properly in some cases as some parts of the tubers are left uncovered. This is not a good practice and should be discouraged.

Packaging and weighing
The wrapped tubers are packaged in boxes/cartons. There are two types of cartons used by exporters. These are the normal and telescopic cartons, all of which are suitable for yam export even though telescopic cartons are stronger and can better withstand the rigorous handling processes during shipment. Both types of boxes have adequate vents for reasonable aeration of tubers that are packed in them. After packaging weighing is done to ensure that the correct export net weight of 25kg is obtained. Most of the exporters increase the weight by about 1-1.5kg to compensate for loss in weight during shipment.

Strapping
Cartons that are filled to the correct weight are strapped reasonably firmly to keep the tubers in place in the boxes. Strapping is done with strapping machines which all warehouses have. All strapped boxes are arranged on pallets and made ready for transportation to the port. Transportation to the ports is normally done by cargo trucks.

Port warehouse activities
Two ports - Tema and Takoradi harbours – are the main points of loading and export for the international market. Here the consignments are kept in warehouses until loaded into the ship. Depending on the mode of shipment, the packaged boxes are either palletised or not. Consignments are palletised if they are to be loaded into the hold of the ship.

In the ware house inspection of the consignment is carried out by the Plant Protection and Regulatory Services Directorate (PPRSD) of the Ministry of Food and Agriculture (MOFA) to ensure that consignments exported conform to export regulatory standards. Observations however, indicate that such inspections are either not carried out at all or casually done. The warehouses at the ports are also not suitable for storage of yams and indeed all perishable commodities as temperatures in these warehouses are very high. Improvement in the structural design of the warehouses at the ports is therefore a very urgent requirement for good yam export business.

On arrival of ships the consignments of yam are carted and loaded into the ship either in pallets or in refrigerated containers.

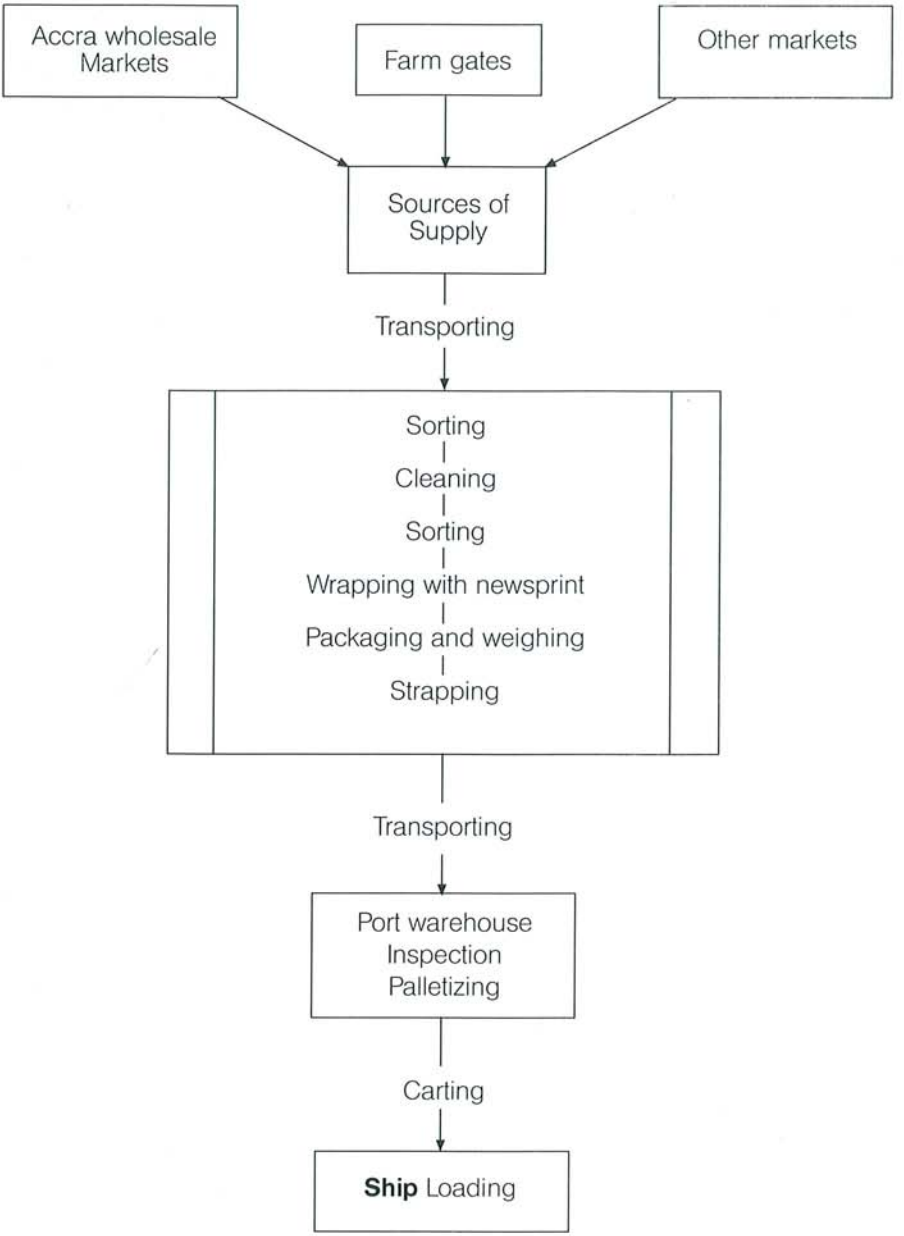
Recommendations for successful yam export business

The following are some recommendations that can be carried out to ensure a successful yam export business:

- Source of supply of tubers for export should be known. This will enable the exporter to trace back to rectify any problem that originates from the source. Purchase of tubers from the open market should be minimised and, if possible avoided. This is because the conditions under which such tubers are handled and brought to the market may not be good enough for the tubers to endure the journey to the export destination.
- Consignments of tubers purchased should be resorted at the point of purchase to remove all non-exportable tubers. Only exportable tubers should be transported to exporter's ware/pack house. Sorting may have to be done again before subsequent operations are carried out.
- All ware house operations (cleaning/trimming, wrapping, packaging, strapping and weighing) should be done well.
- Preferably, telescopic cartons should be used as they are stronger than the normal boxes.
- Boxes that have been filled with tubers should be arranged on pallets in the warehouse until they are transported to the port.
- Ware houses should be well ventilated, inaccessible to rodents and always kept clean.
- Strict inspection of tubers meant for export should be carried out by the authorised agency at the port before consignments are shipped.
- The right type of ship/cargo plane should be used for freight to export destinations.
- Export should be done when prices on the international markets are good. This requires getting access to yam export market information at all times.

Figure 1:

GENERAL FLOW CHART OF YAM EXPORT PROCESS



APPENDIX 1

SUGGESTED STANDARDS FOR YAM EXPORTS

The following are extracts taken from 'Standard Specification for Yam' prepared for yam exporters. The standard specification however, has not been gazatted and therefore not binding on the exporters.

- Yam shall weigh between 0.5 – 4.5kg and shall be of length between 300 – 450mm.
- Yam shall be free from cut surfaces, bruises, skin burns, 'sleeper' and other signs of deterioration
- Yam shall be free from external moisture.
- Yam shall be free from sprouting and hair/root
- Yam shall be free from insect infestations, nematode gall and microbial infection.
- Yam shall be free from outgrowths and visible buds.
- Yam shall be free from soil.
- The skin of yam shall have uniform colouration.
- The content of each package shall be uniform and contain only yams of the same cultivar.
- Every tuber shall be wrapped with paper which should not be grazed.
- Cartons used for packaging yams shall be telescopic corrugated board box, half slotted style and the load capacity shall not be less than 25kg.
- Ventilation holes shall be provided on the packaging. The number, size, shape and position of these holes must be such as will ensure that the box retains sufficient strength while the required ventilation is provided and resist the entry of rodents.
- Each package of yam shall bear the following particulars and indelibly marked:- a) name of produce and variety; b) origin of produce; c) packer or despatcher's address; d) net weight in kg; e) 'handle with care'; f) storage instructions, temperature 25º – 29º C, relative humidity 71 – 75%.