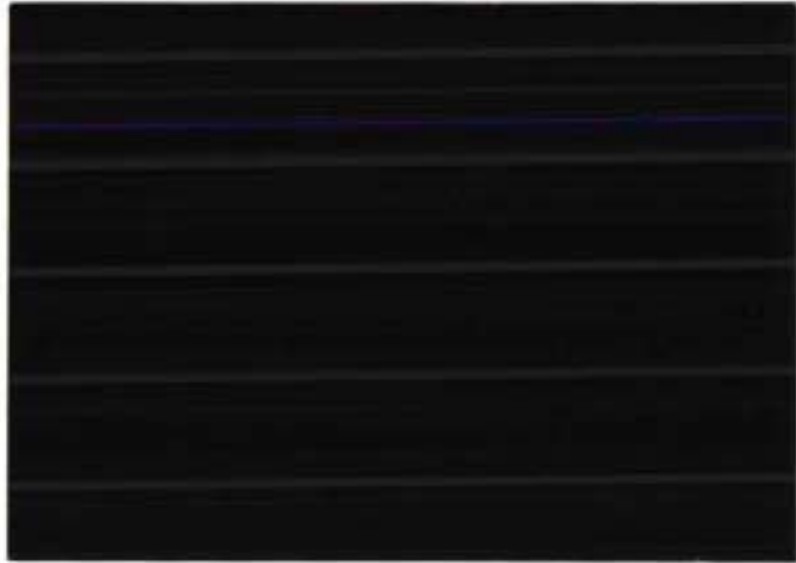


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REPORT ON A VISIT TO GHANA
from 17 - 28 February 1995

**Integrated Food Crop Systems Project in
Brong Ahafo**

**Preliminary Study to Investigate Possibilities
for a Vegetable Seed Industry**

Project No. F0065

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SUMMARY

1. The primary objective of the present study was to assess the vegetable seed production technology, the present supply system and to investigate possibilities to produce improved vegetable seed in Ghana.
2. Vegetables are commonly grown in Brong Ahafo Region even though their range is limited and most are consumed in stews or soups rather than as a salad. The majority of Ghanaian farmers are used to saving their own vegetable seeds for economic reasons but also because they find it very difficult to find good quality seeds to buy.
3. The disadvantages of producing seeds for many seasons without proper control are clearly seen in many farms. Varieties have degenerated to the extent that the fruit quality becomes less acceptable on markets and yields are getting lower. Seed-borne diseases are found throughout the area and necessitate the use of chemicals by farmers which requires foreign exchange to import them.
4. The average annual cost of seed imports during 1992-1994 has been \$ 77,500. This year farmers experienced a 3-month delay in their arrival, resulting in a shortage of especially tomatoes during the dry season and very high prices for the consumer.
5. There is a seed dealers association and a seed growers association in Ghana but so far the people involved restrict themselves to agricultural seeds. No facilities exist for organized and controlled vegetable seed production and yet, there is a great interest both from policy makers and from the farming community. There are several areas in Ghana which have a good potential for quality seed production. Those are particularly in dry regions in the north of the country where there are irrigation facilities.
6. The initial demand for vegetable seeds is rather low but there is a great potential for expansion. Once seeds become readily available, the horticultural industry could develop faster than is presently the case.
7. Discussions held with potential investors indicated a great interest and hopefully this interest will be followed by action through provision of funds. It is considered essential that vegetables seeds should be produced by the private sector rather than the public sector. It is however envisaged that the public sector will continue to support the industry through research and extension efforts as well as through monitoring by the Ghana Seed Inspection Unit.

TERMS OF REFERENCE: HORTICULTURE ADVISOR FOR IFCS PROJECT IN GHANA

8. During previous visits to Brong Ahafo region the main horticulture-related constraints were found to include credit, marketing, pest and disease problems, water, seeds, limited research facilities and crop diversification. A more detailed investigation of most of these constraints is needed. A basic input of a horticultural industry is seeds. More information is needed on the present availability and quality and on the feasibility of producing vegetable seeds within the country.

9. An input is required by an all-round horticulturist with experience in seed production and seed quality during February 1995, for a period of two weeks to liaise with Mr V Suglo, Project Field Coordinator, and Mr L Delimini, Head Ghana Seed Inspection Unit, to undertake the following work:

(a) to make an estimate of the annual demand for purchased vegetable seed in Ghana based on discussions with seed merchants and other traders, farmers organisations, officials from the Ministry of Food and Agriculture, the Ghana Seed Inspection Unit and other relevant institutions or people concerned; enquire about cross-border vegetable seed trade including imports by air; collect information on seed prices, when possible for different qualities;

(b) to consider the extent of seed production by farmers themselves or by small companies and by seed extractors working in fresh produce markets;

(c) to consult farmers organisations, government officials and traders on the need to produce seeds within the country and establish their possible interest in participating in a seed production programme;

(d) to discuss technical issues with staff from the Dept. of Horticulture of the University of Science and Technology in Kumasi and with staff from the Ghana Seed Unit;

(e) to visit potential seed production areas in the Northern or Upper Eastern Region of Ghana or any other suitable isolated area identified; to estimate quality and yield potential;

(f) to advise on crop selection criteria, adapted production methods and seed extraction technology for the various crops; seed drying, screening and packing;

(g) to indicate the feasibility of setting up a local vegetable seed industry and if considered at least technically feasible, consider the steps to be taken,

(h) to assist in drafting a manual on post-harvest management of horticultural crops;

(i) to prepare a draft report by 8 March 1995.

INTRODUCTION

10. This report concerns a preliminary study on vegetable seeds undertaken in Brong Ahafo Region, Upper West Region, Upper East Region and Northern Region of Ghana during February 1995. This study follows on from the rural appraisal of farming systems carried out in May/June 1994, a survey of vegetable production carried out in September 1994 and an investigation into post-harvest constraints in October 1994. These studies were undertaken as part of the "Integrated Food Crop Systems Project: Enhancing Smallholder Livelihoods through Adding Value to Agricultural Production in Brong Ahafo Region".

11. In the survey of vegetable production and during the investigation into post-harvest constraints, a number of major problems were identified and later prioritised as follows:

- (a) lack of capital or credit facilities
- (b) marketing
- (c) pest and disease problems
- (d) land and water-related problems
- (e) seeds - quality and availability
- (f) limited horticultural research
- (g) crop diversification.

12. The topics of marketing, pest and disease problems and land and water related problems have been addressed by subject matter specialists, leaving seeds, applied research and crop diversification issues to be dealt with.

13. Seeds stand at the basis of the food production chain and is thus an essential input for most farmers. Yet, the supply of seeds was found to be unreliable or erratic unless farmers could produce their own. This year, farmers at Tono Dam near Navrono in the Upper East Region (UER) who usually get their seed supply through imports, were faced with a major dilemma when their tomato seeds arrived in October instead of July. As a result the markets throughout Ghana experienced a shortage of tomatoes with consequent high prices for the consumer.

14. Seeds produced by farmers themselves can be of good quality, but are more often than not affected by genetic deterioration or a low germination capacity due to poor storage conditions, poor viability, presence of seed-borne pathogens or a combination of these factors. If these seed-borne diseases are not immediately destructive, killing the embryonic seeds or seedlings at an early stage, their longer term damage can be much greater when their symptoms become apparent at a later stage of the plant life. This will then mean that the farmer can be faced with disease problems for which he will need to use expensive chemicals.

15. Proper storage or packing is a further problem which the farmer needs to solve when there is dependance on farm-produced seed. For okra, farmers are aware that seeds are best stored in their pods until just before sowing. The germination capacity of tomatoes, peppers and garden egg is basically influenced by the way in which the seeds are extracted and the subsequent drying and storage process. Onion seeds are the most sensitive and it is essential to store them in a dry place or even better in an area with a low relative humidity.

THE PRESENT SITUATION

Production of vegetables

16. Despite efforts made to promote industry in Ghana, the country still has a predominantly rural character in which agriculture plays a major role. Most farmers have at least a small plot with vegetables for their own use and many farmers produce vegetables for sale at the markets. In addition, there are many households in urban areas where a few fruits or vegetables are produced in back gardens for home use.

17. Statistics on the area under vegetables are prepared and made available by the Policy, Planning, Monitoring and Evaluation Department (PPMED) of the Ministry of Food and Agriculture (MOFA) for which the last figures published refer to the year 1989. Since 1989, there has been a considerable increase in vegetable production according to staff from MOFA, for which only rough estimates can be made. For 1989 PPMED mentioned 20,400 ha tomatoes, 57,000 ha peppers, 28,000 ha okra and 2,100 ha of garden eggs for the whole of Ghana. These figures are in rather sharp contrast with the 1994 figures for Brong Ahafo Region alone where farmers cultivated 43,500 ha of tomatoes and 16,400 ha of garden eggs, amongst others. Unofficial estimates by the Plant Protection & Regulatory Services Department for 1993 indicate 55,000 ha of tomatoes, 120,000 ha of peppers and 95,000 ha of okra (most of these okra for home use). No estimate was made for garden egg but considering Brong Ahafo's dominant position for this crop the country-wide area under cultivation will probably not be much more than 20,000 ha.

18. For other vegetable crops virtually no information is available. Judging by the availability on markets in Techiman, Kumasi and Accra, the few other vegetables traded are mainly onions and cabbages plus small amounts of other crops including lettuce, carrots, cucumbers, pumpkins, beans etc. A (very) limited supply was also noted for local greens including Jute mallow (*Corchorus olitorius*) and Amaranth. In the northern parts of Ghana and especially in Upper East Region, onions (and to a more limited extent shallots) are quite important. No estimates on their area under cultivation could be found but judging by the quantities seen at the main markets and by their popularity with farmers in the northern parts of Ghana it could well cover about 3,000 ha.

Imports of vegetable seeds

19. Seed imports were not found to be significant, mainly due to their high costs when expressed in local Cedis. Cross border trade by road is considered to be negligible and most imports come by air through commercial seed merchants.

No accurate records could be found on imports of vegetable seeds. Staff from the Ghana Seed Inspection Unit interviewed the main dealers and were thus able to estimate the imports for 1992-1994 as follows:

Average imports of vegetable seeds from 1992 to 1994:

Crop	Av. weight in kg	Price /kg in S	Value in US \$
Tomato	395	75	29625
Carrots	245	75	18375
Cabbage	55	250	13750
Onion	120	40	4800
Beans	290	15	4350
Cucumber	150	30	4500
Sweet Pepper	20	60	1200
Egg Plant	15	30	450
Okra	45	10	450
Total			77500

These seed imports came mainly from Denmark, Holland and Italy and some very small quantities from Japan and the USA. In addition, there is a limited trade across borders, especially with Burkina Fasso for onion seed. In recent years, most onion seeds are produced by farmers in the Bawku area of Upper East Region.

20. When looking at these seed imports, one could observe that cabbage and carrot seeds are not likely to be produced in Ghana for climatic reasons whereas all the others (in so far that they are not of hybrid origin) may well be produced within the country, offering a potential saving in foreign exchange of about US \$ 45,000 annually.

Traditional vegetable seed production in Ghana

21. When a Ghanaian farmer needs seed to produce his next crop and did not save any from previous crops, he or she can either go to a professional seed merchant or to the vegetable market.

22. At the markets some ladies specialize in extracting seeds from commercial crops obtained towards the close of the market when commodities become cheap. Fruits used for this purpose are almost by definition left-overs, including fruits which are rotten and frequently including fruits which carry a seed-transmittable disease such as early blight or stem rot on tomatoes, pod spot on okra, Phomopsis fruit rot on garden egg etc.

23. Often, a farmer will get his seed supplies through a produce trader who would like to see the farmer grow a variety of his choice and therefore has to provide him or her with the right seed. Such a produce trader may involve the market ladies as described below or get his seeds from a reliable farmer who has selected certain plants for seed purposes only. Alternatively, a farmer may obtain his seeds free of charge from friends or from other farmers in his neighbourhood.

24. In most cases however, farmers do not want to buy seeds when they are satisfied with the seeds which they can produce themselves, for which they do not have to pay with cash. In that case, farmers will extract seeds from the crop produced during a time when the price is low or from a ripe crop for which he cannot find a ready market. This applies specifically to hot peppers and tomatoes.

25. For garden eggs and okra the situation is somewhat different since seeds of these crops are obtained from mature fruits which have no value as a commercial vegetable. When seeds are extracted from left-over garden eggs found at markets, it is likely that the seeds obtained are not fully mature yet and thus result in either a poor germination capacity or in weak seedlings.

26. In the case described above, little selection takes place although farmers will avoid extracting seeds from obviously diseased fruits or from fruits with a distinctly different shape. Few farmers make a special effort to pre-select plants, set aside for seed purposes only. In this case, the main selection criterium is the desired variety plus its yield capacity.

27. For okra, farmers have realised that seeds are best stored inside the pod so that farmers harvest fully ripe dry pods and do not break these open until sowing time to release the seeds inside. At the markets okra seeds sell at relatively high prices when compared with those of tomatoes or garden eggs.

28. Farmers extract tomato seeds through a fermentation process whereby fruits are placed in a container with water and are then squeezed or broken to a rough pulp. After a day, the heavy seeds fall to the bottom and the remainder floats to the top, thus facilitating their separation. After collecting and washing the seeds, they are left to dry in thin layers. Another method is occasionally used whereby fruits are cut in two pieces and its seeds are removed by hand or by using a spoon, often together with parts of the core. Some water is added to these, allowing the mixture to ferment for one day. After washing and removal of debris, seeds are dried in the shade for about three days during which time they are turned and rubbed to avoid lumping of the seeds.

29. For garden eggs, the process is somewhat similar. Ripe, orange fruits are collected and left for about three days to soften during which time seeds start to become loose. The fruits will then be smashed and put in water for one night thereby allowing the seeds to become separated from the surrounding flesh. Part of the seeds will have dropped to the bottom but others will have to be removed manually. Seeds are then collected, washed and dried.

30. There are two systems for peppers. The best quality seed is obtained from selected plants where farmers cut ripe fruits lengthwise and place these in water for less than a day. Often people use a piece of wood to remove the seeds since direct contact of hot peppers with the skin or with a small wound can be highly irritating. Seeds are then dried. This system produces better quality than seeds extracted as a by-product of processing peppers. In the latter case peppers are fully dried in the sun but are not first dipped in scalding water to avoid bacterial or fungal breakdowns. These dry fruits are then placed in a bag and beaten after which seeds can be sieved out and the remainder will be ground up for the spice trade. Such seeds are dark brown or greyish in colour and could produce some abnormal seedlings due to internal damage, whereas seeds extracted using the earlier described method, are golden yellow in colour and have a better germination capacity.

Possibilities for improved traditional seed production by farmers

31. In Brong Ahafo and other regions there are farmers who realise that quality seeds can only be obtained from the best plants and these farmers have a very selective approach and will certainly not extract seeds from rotten fruits. These farmers have a crop which is quite uniform and less infested with seed-transmittable diseases than the average farmer. Such farmers could be trained further in proper extraction technology and storage and become an example to other farmers. Seeds produced by these farmers can then be distributed or sold to vegetable growers in surrounding villages. A limitation to such a solution is that there is not much choice in the current range of varieties. A wider varietal choice is very much looked for by both farmers and marketeers. A second limitation is that less efficient or less careful farmers may end up multiplying problems (e.g. diseases) rather than quality seeds.

Seed Prices

32. Farmers are not used to paying a high price for seed. Most farmers produce their own seeds, which does not cost them much or alternatively seeds are obtained from neighbours or friends and given free of charge. This low price is also seen at the markets where seeds are a by-product of a crop which would otherwise have been thrown away.

33. Seed prices at local markets are for quantities which are not weighed, making comparisons relatively difficult. Most are sold in small tin cans which normally hold 50 grams or 100 grams of a liquid or solid product but the same container probably does not hold more than 20 or 40 grams of seeds. A very rough estimate had to be made (since there were no accurate scales to be found on a large market such as the one in Kumasi) for a container with about 150 grams of seed as follows: tomato, ₵ 1500; garden egg, ₵ 4000, okra, ₵ 2500 and pepper, ₵ 3000. Translated in dollar terms per kg, for tomatoes this will amount to \$ 10; garden egg, \$ 26; okra, \$ 16 and pepper, \$ 20 per kg.

34. Imported vegetable seeds are considerably more expensive, such as \$ 95 for a kg of tomato seeds of the variety Laurano 70, lettuce seed for \$ 90 and onion seed (Texas Grano) for \$ 55. Yet, even these prices are very cheap by international standards, reflecting the high probability that a seed choice has been made at the bottom end of the market where one can no longer demand a high quality. This is however understandable, given the hard currency limitations, and Ghana is by no means the only customer for such seeds. Seeds of this quality are often by-products or they are seeds which have been produced as a commodity without paying too much attention to trueness to type, varietal purity, presence of seed borne diseases etc. That does not mean that these seeds are bad but it does mean that there appears to be ample scope for improvement when similar seeds could be produced under proper control in Ghana.

Estimated annual vegetable seed requirements in Ghana

35. For the most important vegetable crops: peppers, okra, tomato, garden egg and onion, farmers can produce their own seed or could obtain those from local sources. Experience from other African countries (e.g. Kenya and Tanzania) shows that traditional farmers change their seed source or their variety once every 3 or 4 years on average and buy new seeds from markets or seed merchants once in every 7 years when there are new

varieties available. Farmers who are used to high quality or hybrid seeds in order to produce export quality for instance, normally buy seed for every crop they grow.

36. Using this information and working with the average seed rates used by those farmers, the seed requirements per annum can be calculated as follows.

Crop	Est. Cultivation in Ghana in hectares	Average Seed Rate used in grams/ha	Total requirement in kgs
Pepper	120,000	400	48,000
Okra	40,000*	4000	160,000
Tomato	55,000	500	27,500
Garden egg	20,000	250	5,000
Onion	3,000	2000	6,000

* For okra the figure of 40,000 hectares of commercial crops has been used in these calculations. When new detailed estimates become available these data will need to be adjusted.

37. Realising that not all farmers can afford or are prepared to buy improved seeds at probably a higher price than they are used to, an assumption is made that only about 25-30 % of the farmers will buy improved seeds. This assumption combined with a purchase once in every 7 years means that only about 4 % of the annual requirement can be expected for purchases of the more expensive quality seeds. In this case, one can estimate that a company which aims to produce quality seed only, can find an annual market for about 1100 kg tomato seeds and 250 kg of onion seeds. Similar calculations can be made for the other major crops once new or improved varieties have become available. To these figures we could add a certain quantity used by growers producing for high value markets, including export markets, where farmers will need quality seeds at every planting season. A better estimate may be obtained through a survey on the farmer's perception on what price they would be prepared to pay for improved seeds, and how many farmers wish to procure seeds from improved varieties.

38. A factor in the supply of commercially available vegetable seeds will be the application of seed laws and conditions imposed on registered seed merchants. If these laws will be strictly adhered to then it is obvious that the assumed 25-30% will be raised considerably.

GHANA SEED INDUSTRY - PAST AND PRESENT

39. The state-owned Ghana Seed Company, which was the major source of seed for Ghanaian farmers, was identified for re-structuring and was privatised in 1990, following various studies conducted between 1984 and 1989. From 1990 onwards, a number of small and medium sized enterprises have engaged themselves in seed production, processing and marketing, aided by public sector institutions through research and production of breeders' seed plus quality control and seed certification schemes.

40. Since the inception of this privatisation, support has mainly been provided by the NGO Sasakawa Global 2000 but also by agencies such as USAID, DANIDA, GTZ, IFAD and the World Bank. This support has been in various forms, e.g. through building and strengthening the institutional base of the public sector, which would support the private sector. This included supplies of processing and seed testing equipment. Staff from the Ghana Seed Inspection Unit and others received extensive training both in-country and overseas.

41. The seed programme in Ghana started with maize through the Ghana Grains and Legume Development Board. This has been followed by other crops including sorghum, cowpeas, soyabeans and groundnut. Certified seed for all these crops is now available to farmers. Rice seed is also available as commercial seed but is not certified due to a lack of breeders seed. Seeds are being tested and quality control does take place. Agricultural seeds are offered to farmers in units of 1 kg, 2 kg, 5 kg and 9 kg.

42. The approximately 100 seed dealers have formed a seed dealers association with about 25 active members. The largest of these, Aglow Agricultural Products distributes about 150 tons of cereals and legume seeds annually, representing around 20 % of the country's production. Aglow's market share of imported vegetable seeds is said to be approximately 60 %. Also the seed growers have organised themselves into a seed growers association with sectors in the North (Tamale), the Brong Ahafo and Ashanti area (Techiman) and the southern sector based in Winneba. Membership of this association now stands at 120.

43. The Ghana Seed Inspection Unit registers both seed growers and seed dealers. It monitors seed production and processing and carries out a seed certification programme. Activities are undertaken at the National Seed Testing Station and at five zonal areas in Ho, Winneba, Kumasi, Tamale and Bolgatanga. The seed testing station at Pokoase carries out referee testing of samples drawn from all five zonal areas with the view to establish a uniformity in seed testing.

44. So far, vegetable seeds have not been given the same attention as cereal and legume seeds. There is however a clear interest both from government circles and from the farming community to take action at an early date. What will be needed is technical support and guidance to establish the industry on a sound footing.

45. There is concern that the agricultural seed industry has lately been given a lot of support and one wonders what will happen when this support will be withdrawn. Even though the government is likely to continue with assistance in research and monitoring, there is a question whether the industry can continue to ask low prices for the seeds which it produces. Most farmers have a low purchasing power and unless the industry can continue to come up with new improvements, farmers are likely to resort to saving their own seeds again, especially in the case of legumes with their high level of self-pollination (and thus a lower rate of degeneration).

SEED LAWS AND REGULATIONS AFFECTING VEGETABLE SEEDS

46. Currently seed laws and a number of seed regulations are being prepared to be tabled in parliament. No copy was obtained to comment on. It is however understood that little attention has been given to vegetable seeds since the present seed industry is mainly involved in cereals and grain-legumes. Seed rules will eventually need to be drafted to accommodate issues like cropping history, seed progeny, isolation time and distances, standards for moisture content, germination capacity, inert material and presence of seed-borne diseases, weed seeds etc.

47. Since vegetable breeding work is currently not undertaken in Ghana, there is little need to certify the origin of seeds through a programme using basic seed and certified seed generations. Instead, it is recommended to adopt a standard seed scheme, similar to the ones used in Europe for vegetable seeds. In this case responsibility for quality will mainly be vested with the seed company although seed standards will need to be set and controlled by an independent organisation e.g. the Ghana Seed Inspection Unit.

48. Once further work has been set in motion and when the organisational structure has been put in place there will be a need to draft seed rules for the major crops and seed regulations may need to be added to cater specifically for a vegetable seed industry.

CONSTRAINTS AND OPPORTUNITIES FOR THE VEGETABLE SEED INDUSTRY

49. The range of vegetables produced and consumed in Ghana is rather limited when compared with other countries in the tropics. Leafy vegetables are hardly known which may partly explain the high incidence of anaemia in the country, caused by a shortage of iron in people's diet. Most vegetables are either used in stews or in soups or used as a spice. Only few vegetables are used in salads and this is mainly the case in restaurants rather than at home. The first signs of change are there already through increasing popularity of cabbage and lettuce. In addition there is a renewed interest in exports of vegetables such as french beans for which seeds will be needed. The potential for change and expansion of the industry is therefore significant.

50. Due to limited foreign exchange, imported vegetable seeds (mainly tomatoes) were not always of the best quality and certainly did not represent the latest varieties. There is evidence that in the case of tomatoes, seeds supplied were by-products of the tomato processing industry. Varietal purity, trueness to type and freedom from seed transmittable diseases should be issues to be concerned about. Again, the potential to improve the varietal range through selection of locally available germ plasm and through new introductions and performance trials is undoubtedly great.

51. A wide range of diseases which could be carried either on the seed coat (e.g. many fungi and some viruses) or in the seeds themselves (especially bacteria but also some fungi and even nematodes in case of onions) are known to occur in Ghana. The habit of multiplying seeds at the farm without having the knowledge or the facilities to prevent seed-borne pathogens has led to the current widespread occurrence of such diseases. The result is not only a reduction in yield and quality but also the high cost (in foreign

exchange) for agro-chemicals. Seed production from selected and controlled parent material, carried out in isolated areas with dry climatic conditions will likely result in a considerable reduction of seed transmittable diseases. Unfortunately however, farmers are not likely to benefit from this until their production plots plus the surrounding areas are free from the vegetable crop in question and have been without this crop for such a time that there are no spores left of the particular pathogen species.

52. The best areas to produce seed are those where the Relative Humidity is low and areas where there is limited farming activity especially activity related to the crop from which seeds will be multiplied. For this reason vegetable seed production in Brong Ahafo region is not recommended. The driest areas in the country can be found in the north. However, in the dry north eastern parts of Ghana there is also an intense cultivation of vegetables, especially tomatoes and onions near most of the dams where production can take place. In the northwestern parts a number of dams are known where vegetable production is very limited or zero. These include the Sankana dam, approximately 30 km west of Wa where there appears to be a good potential, which will however need to be investigated further by means of small-scale trials.

53. Meteorological data were obtained in Wa, where the average maximum Relative Humidity (RH) measured between 1986 and 1994 were as follows:

Period / time	06.00 hrs	15.00 hrs
January-March	55 %	15 %
April-May	70 %	50 %
June-October	90 %	65 %
November-December	60 %	25 %

54. Judging by these figures, Wa looks like a very good place to dry, pack and store vegetable seeds for most of the year. The comparatively humid months of April to the end of October are the crop production months in most parts of the country during which seed stocks are likely to be low. Generally speaking, there are almost no problems to be expected for vegetable seeds stored at a RH of 60 % and below since insects which could be problematic in grains at a RH of 60 % and below, hardly affect the type of vegetable seeds contemplated.

55. The ideal storage formula which is often used, whereby RH plus temperature in degrees Celcius should not exceed 100 is applicable for Wa. Even the ideal combination whereby $RH + ^\circ C = 80$, which is used for packing seeds in sealed containers, can be found in Wa from mid-November until mid-March, the period when crops are likely to be harvested and new seeds become available.

56. A potential problem, at least for the beginning of a new venture, is the relatively low demand for seed due to the expected low seed replacement rate and competition by low-priced, low quality seed sales by non-professional seed extractors at produce markets. If however, the quality offered and new varieties introduced are found to be distinctly better, then one could foresee a demand which might not be met by supplies during the first years of operation. Legislation could similarly be enforced whereby only registered seed merchants would be allowed to sell seeds, which will need to be approved by the Ghana Seed Inspection Unit. Such legislation has been introduced in Kenya where enforcement took place through seed import permits, which were tied to registration as a seed merchant.

The Ministry of Food and Agriculture encourages the use of improved seed and can be expected to promote vegetable seeds as well once they become available in adequate quantities.

57. Additional demand may well be found in neighbouring countries such as Burkino Faso, Togo, Niger, Benin, Liberia etc. These countries produce both indigenous and exotic vegetables but are not traditional producers of vegetable seeds. Seeds produced in Ghana could be exported to these countries especially when their quality/price ratio is favourable in comparison with competitive sources. In addition there is often a demand for "local" vegetables e.g. garden egg, which cannot normally be met by established international seed merchants.

58. Interest rates in Ghana are very high at the moment so that it is extremely difficult to get a long-term loan from a bank and to be able to repay the capital plus interest. For the seed venture envisaged, this means that most of the capital will need to come from money made available by the shareholders directly. Probably it also means that the venture will need to start on a modest scale, making use of readily available facilities including the equipment available at the Ghana Seed Unit (e.g. seed cleaning equipment) and including means of transport currently owned by individual seed dealers. Where possible equipment should be leased. In the case of sealing seed containers, a possible cooperation should be sought with a vegetable processing company where cans could be filled with seeds and sealed, using their machinery.

STEPS TOWARDS THE ESTABLISHMENT OF A LOCAL VEGETABLE SEED INDUSTRY

Call for investors

59. It has become clear that the public sector can only support a vegetable seed industry indirectly but it will not participate financially. This therefore offers a challenge to the private sector to invest in a new industry. Such investors are likely to be merchants who are presently dealing in cereal and legume seeds but they could also be a group of farmers wishing to specialise in vegetable seeds or even large-scale users of seeds such as farmers' associations or farm services organisations. One of the first actions to be taken therefore is to discuss the issue and to sensitize potentially interested parties.

60. Ideally, interested parties should sit together and form a company with shareholders. Management and staff could then be appointed to run the company on a day to day basis. If this approach is considered feasible, a lawyer will need to be consulted to arrange for the legal aspects.

61. Initially such a company can have a small capital base. What will be the minimum requirement is a manager plus an assistant. They will need transport and an office with a telephone. In the initial stages use could possibly be made of public sector services for the supply of basic seed and for seed quality control. Simple, laboratory sized seed cleaning equipment such as a clipper will need to be obtained. The same applies to packing material which could initially be simple polythene bags but that will soon have to be changed to

more professional packing material such as cans and coated aluminium foil. In addition some working capital is needed to pay the farmers for their produce (fruits or dried seeds).

Varietal screening and selection of basic seeds

62. Country-wide collections will need to be made of promising germplasm of both major and minor crops. These will include the most important five vegetables (tomato, pepper, okra, onion and garden egg) as well as shallot, lettuce, cucumber, watermelon, amaranth, corchorus, vegetable rape and others of local interest. Specific attention will need to be made to selecting from a range of varieties. Seeds or bulbs to be collected from plants which show a good yield potential, be of a good plant shape for the species concerned, early producing and disease free. It is important to make a note on the exact location of the collection in case further material might be needed.

63. Simultaneously a request should be made to international seed merchants or institutes (e.g. AVRDC and horticultural research institutes of African countries) to send samples of non-hybrid seeds of varieties which are likely to perform well under Ghana's climatic conditions. Such seeds to be limited to tomatoes, peppers (hot and sweet) and onions.

64. These collections will need to be catalogued, described and judged on their performance. Screening to be initially conducted in 3 areas (forest zone, intermediate zone and savannah area) and plants to be grown both during the rainy season and under irrigation in the dry season. Small plots to be established for each entry and randomly replicated at each study site. Where possible performance should be scored on plant habit, earliness (with flowering and fruiting dates), crop yield plus seed yield, quality attributes (size, shape, colour, firmness, keeping quality, taste etc.) and where possible tolerance to pests and diseases. An effort should be made to collect enough seeds from the observation plots to be able to repeat the trials at a later date.

65. Once screening has resulted in a limited number of selections and their seeds have been extracted, a larger plot should be sown with the selected varieties to be used for further selections to obtain basic seeds. This screening may be of particular interest for onions where individual bulbs could be multiplied using family pollination, which will result in a much more uniform crop than the current mixtures.

Seed production

66. When a seed company has been formed and organised and basic seeds have been identified, the next step is to look for an ideal production site. As explained above, the best sites are those which are isolated from other vegetable farming activities for reasons of avoiding diseases but also to prevent potential customers from multiplying their own seeds. Copying other farmers' activities is quite normal but in this case this is not recommended because non-registered seed growers will not get access to basic seeds and will not be monitored and could in theory be multiplying problems rather than quality seeds.

67. As soon as farmers have been found who would like to grow seeds on contract, they will need to be trained in the production technology. This training can be given on the spot and will continue throughout the crop production phase and will mainly be geared

towards prevention of diseases, varietal purity and seed yield (extra Phosphorous rather than extra Nitrogen). It will also deal with seed extraction and drying techniques.

Seed processing

68. Once seeds have been dried by the farmers and their quality checked, delivery can be made. Seeds may then be dried even further but not below a critical minimum when seeds become brittle and can easily damage to produce abnormal seedlings. A very low moisture content may result in a complete loss of viability. Once seeds have dried to a moisture equilibrium with a RH % of about 35, it is advisable to store them for up to one week in an open container. This is necessary to slow down the respiration of the seeds themselves. If this precaution is not taken then it is quite possible that the seeds will consume all available oxygen from within an airtight container (seed packet or can), resulting in an alcoholic fermentation process and complete loss of germination capacity.

69. During the drying process cleaning could start. The first stage of a cleaning process will remove the obvious elements like non-seed plant residue (fruit skins in tomatoes, stalks in onions etc.) plus small stones or dust. In the second part screens will be used to separate seeds into various sizes whereby often the smaller sizes will be discarded because such seeds are not likely to produce strong plants. A laboratory-sized clipper can combine both functions and is therefore recommended for the start of a small company. Further details on seed cleaning could be dealt with during a follow-up.

70. Packing of seeds into material with a low air permeability is essential especially when such seeds will be used in more humid areas. Polythene material is certainly better than paper packets but if used, preference should be given to a rather heavy quality. Once the seed company has gone through the preliminary stages it is recommended to change from polythene seed packets into the use of laminated aluminium foil with a polythene coating. Further details on this topic including the use of lacquered cans could be given during a follow-up.

71. Seed bulk storage can be either in jute bags or in large plastic containers. Care must be taken that the storage room will not contain any shelves made of plywood. The glues used in plywood often contain formaldehyde, which is usually lethal to seeds.

Extension information dissemination

72. Many farmers lack technical guidance in their crop production efforts. A lot of information on basic agronomy is available at universities and elsewhere but this knowledge is hardly or not presented to the farming community. A good marketing ploy would be to sell seeds and provide the farmer with a hand-out as to what he should do to get maximum results.

Plant breeding

73. Landraces can in theory have built up a tolerance against local stress conditions including certain diseases or pests. This will however have to be established first whereas for common crops like tomatoes it is probably much easier to find genetically built-in tolerance or resistance in commercially available varieties. In Ghana, the major pest and

disease-related constraints for tomatoes include nematodes and *Fusarium*. Most modern varieties now have these resistances built-in. Therefore, rather than conducting an expensive search for tolerances in local landraces of tomatoes, faster results could be expected from varietal introductions to be screened on performance under local conditions.

74. Relatively little research has been carried out on garden eggs or African eggplant as they are also called. Even though Dr Seck carried out extensive studies in Senegal and Dr Pannekoek from Ghent University did the same, to my knowledge only limited breeding work with incorporation of disease resistance in garden egg has been undertaken. One could start with a germ plasm collection locally and by requesting for small seed samples of garden egg from gene banks such as the one at Birmingham University and to build on work already undertaken elsewhere such as in Senegal (but also South East Asia).

75. At the Horticultural Development Centre in Camberene, Dakar, Senegal, African eggplants have been found with genes resistant to spider mites. Also a high level of resistance has been noticed against nematodes, *Stemphylium* rot and against *Pseudomonas solanacearum*. In the Brong Ahafo region however, many other plants have been found with symptoms of these diseases. This indicates scope for further selection and breeding from the local landraces which could lead to a marked improvement over their current performance.

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