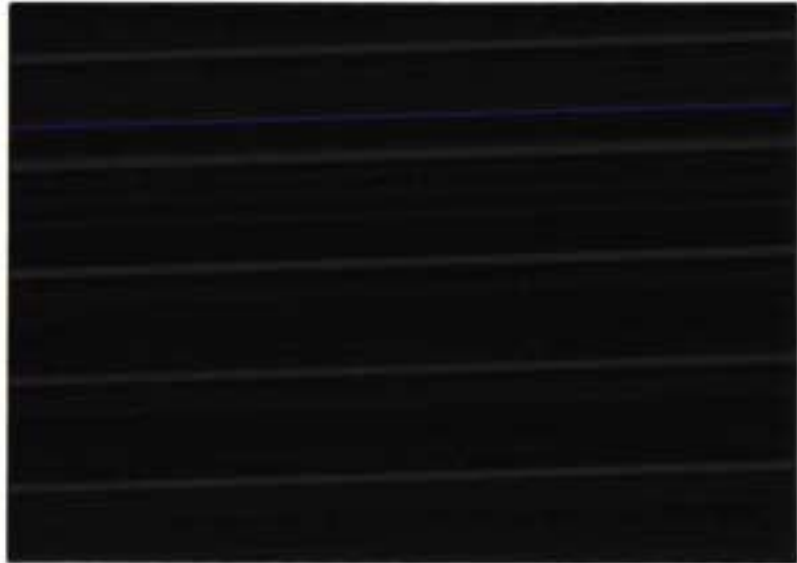


R6630-005



**INTEGRATED FOOD CROP SYSTEMS
PROJECT: ENHANCING SMALLHOLDER
LIVELIHOODS THROUGH ADDING VALUE
TO AGRICULTURAL PRODUCTION IN
BRONG AHAFO REGION, GHANA**

Phase I Report

April 1995

A Westby

ODA	Ms F Proctor	Ghana	Professor Norman Mr A A O Frimpong
NRI	Dr N Poulter Dr J Orchard Ms H Warburton Mr R Schippers Mr M Holland Dr S Gowan Dr A King Dr B Critchley		Mr V Suglo Mr K Gager Mr F Lyon
CABI	Dr D Moore		

Natural Resources Institute
Central Avenue
Chatham
Kent
ME4 4TB
United Kingdom

CONTENTS

PROJECT SUMMARY INFORMATION

BACKGROUND

PROJECT OBJECTIVES

PROJECT ORGANISATION AND IMPLEMENTATION

Counterpart organisation

Associate Professional Officer

Associated training through the British Council

BACKGROUND TO VEGETABLE PRODUCTION IN THE BRONG AHAFO REGION

PROJECT ACTIVITIES, ACHIEVEMENTS, OUTCOMES AND OUTPUTS BY OBJECTIVE

Objective 1: Investigation of the relative importance of horticultural crops to smallholder livelihoods and identification of major pre- and post-harvest constraints in horticultural-based systems.

Objective 2: Investigation of net income from smallholder horticulture and the options for alternative higher income crops.

Objective 3: Investigation of the range of vegetable varieties grown and characterise them in terms of the quality attributes important to smallholders and identification of appropriate new varieties with the required quality attributes

Objective 4: Analysis of soil and water management by smallholders and development of appropriate strategies based on the priorities and resources available to smallholders;

Objective 5: Analysis of weed, pest and disease problems and development of strategies based on the priorities and resources available to smallholders.

Objective 6: Investigation of horticultural commodity system and identification of potential areas and criteria for technical interventions

Objective 7: Development of strategies for improved harvesting, handling, distribution, marketing and processing systems based on outputs of objective (6).

FORMULATION OF PHASE II OF THE PROJECT

Appendix 1: Abbreviations

Appendix 2: Project Memorandum

Appendix 3: Summary of expenditure (Phase 1)

Appendix 4: Summary of Project Outputs

Project definition phase

Phase I activities

Appendix 5: Terms of reference for Associate Professional Officer

PROJECT SUMMARY INFORMATION

Title

Integrated Food Crop Systems Project: Enhancing Smallholder Livelihoods through adding Value to Agricultural Production in Brong Ahafo Region, Ghana

Project Leader

Dr R G Poulter

Project Managers

Dr N Poulter, Dr A Westby

Project memorandum

The project memorandum (Appendix 2) was prepared for a project in two phases to be run over a two year time frame. This report refers to Phase I, but some activities were designed to continue into Phase II.

Main collaborator

National Agricultural Research Project (Council for Scientific and Industrial Research), Ghana

Start and finish dates

9 August 1994 - 31 March 1995

Phase I budget

£95,000; Phase I expenditure is detailed in Appendix 3.

Funding

The first phase of the project was jointly funded by three programmes of the ODA's Natural Resources Research Department: Food Science and Crop Utilisation, Resource Assessment and Farming Systems and Integrated Pest Management.

BACKGROUND

1. This project was formulated as a result of a rapid rural appraisal undertaken in Brong Ahafo in May/June 1994 (Ashitey *et al.* 1994¹). The appraisal indicated possible areas worthy of integrated research in a number of topic areas. Following discussion with CSIR (NARP), it was decided to proceed with an integrated project on horticultural production systems and in particular issues of soil fertility, pest management and post-harvest handling and marketing.

2. In July 1994, a project formulation team visited Ghana to install the Project (Warburton *et al.* 1994). During this mission, the nature of the project was developed in detail, resulting in the production of a project memorandum which was agreed by the Government of Ghana. Project reports associated with the establishment of the project are listed in Appendix 4.

PROJECT OBJECTIVES

3. The projects objectives were jointly formulated and agreed by the NARP and NRI. The overall objective was to develop and validate sustainable strategies appropriate to smallholders in Brong Ahafo to increase income from horticultural based systems.

4. This will be achieved through the following scientific and technical objectives (Project Memorandum 1994):

(i) to investigate the relative importance of horticultural crops to smallholder livelihoods and to identify major pre- and post-harvest constraints in horticultural-based systems;

(ii) identification of net income from smallholder horticulture and the options for alternative higher income crops;

(iii) to investigate the range of vegetable varieties grown and characterise them in terms of the quality attributes important to smallholders and to identify appropriate new varieties with the required quality attributes;

(iv) to analyse soil and water management by smallholders and develop appropriate strategies based on the priorities and resources available to smallholders;

(v) to analyse weed, pest and disease problems and develop strategies based on the priorities and resources available to smallholders;

(vi) to investigate the horticultural commodity system and identify potential areas and criteria for technical interventions;

¹All references cited in the text are listed in Appendix 4

(vii) to develop strategies for improved harvesting, handling, distribution, marketing and processing systems based in (vi).

5. This report is organised around these seven guiding objectives.

PROJECT ORGANISATION AND IMPLEMENTATION

6. The project valued at £95,000 in its first phase started on 9 August 1994 and was completed in its current form on 31 March 1995.

Counterpart organisation

7. The project counterpart organisation in Ghana is the Council for Scientific and Agricultural Research (National Agricultural research Project) CSIR (NARP). The project is based in Sunyani in the Regional Ministry of Agriculture and is co-ordinated by Mr E K J Suglo. The CSIR administer the project accounts and provide logistical support when needed. The project has a Land Rover and motorbike. The latter is for use by a project assistant locally employed from the Regional Ministry, who is familiar with the area and can also act as interpreter.

Associate Professional Officer

8. An ODA Associate Professional Officer (APO), Mr Fergus Lyon, has been appointed to the project. He took up his appointment in March 1995 and is based in Sunyani. A copy of his terms of reference are attached at Appendix 5. He will be supervised by Dr N Poulter (Dr A Westby), Ms H Warburton and Mr E K J Suglo.

Associated training through the British Council

9. One British Council training award was associated with the project. Mr L. Abbey has commenced the MSc course in Tropical and Sub-tropical Horticulture at Wye College which started in October 1994.

BACKGROUND TO VEGETABLE PRODUCTION IN THE BRONG AHAFO REGION

10. Brong Ahafo Region is an important vegetable producing area for tomato, garden egg, pepper, okra and cocoyam. Onion and shallots are widely grown on a small scale. Large production areas are in the middle transitional zone and have developed particularly along the main roads from Kumasi to Sunyani, Wenchi and Kintampo. The other main production area is around Atebubu in the eastern part of the Region and outside the immediate project area. Exotic vegetables are grown on a small scale.

11. Prior to the 1970s, vegetable production was usually small-scale and mainly for home consumption. Often vegetables would be intercropped with other vegetables, legumes and starchy staple crops (especially yam). The construction of markets, for example, the weekly market in Bofourkrom in the 1960s, meant that surplus vegetables

could be more easily sold. Both production and marketing of vegetables were the responsibility of women.

12. From the 1970s there has been a growth of more commercially-oriented production by both men and women, especially in the dry season in areas close to good water supply. In Abesim, dry season production was said to be started by women farmers, whereas in Techimantia, men were said to have been involved in commercial production from the start.

13. The widespread bush fires of 1983, which destroyed most of the cocoa trees, the main cash crop in the area, gave an impetus to increased vegetable production as farmers looked for alternative cash crops. The lack of other employment opportunities for young men also added to the number of farmers who went into vegetable production.

14. Commercial vegetable production has therefore developed from a primarily subsistence-oriented activity carried out by women to a cash crop produced by both men and women. However marketing of vegetables (wholesale and retail) still remains almost entirely in the hands of women. With the continued evolution of commercial vegetable production, it is possible that this aspect may also change in the future (Warburton and Lyon 1995).

PROJECT ACTIVITIES, ACHIEVEMENTS, OUTCOMES AND OUTPUTS BY OBJECTIVE

Objective 1: Investigation of the relative importance of horticultural crops to smallholder livelihoods and identification of major pre- and post-harvest constraints in horticultural-based systems.

Planned activities

15. The following activities were planned:
 - a. Review existing literature on horticulture in shifting and permanent production systems with declining fertility and literature on vegetable commodity systems in Ghana (Phase I);
 - b. Baseline survey of smallholders to determine the relative importance of horticultural crops to smallholders' livelihoods and to characterise the types of production and marketing system (Phase I);
 - c. Prioritisation of major pre- and post-harvest constraints on horticultural-based systems by smallholders (Phase I -> Phase II);
 - d. Identification of the nature and local of losses through case studies with producers and traders (Phase I -> Phase II).

Achievements

16. A baseline study of smallholder vegetable producers was undertaken (Sherington and Suglo 1994) to achieve activity b.
17. The prioritisation of major pre- and post-harvest constraints (activity c) was initiated during phase I (Schippers *et al.* 1994, Holland, 1995, Gowan 1994, Bolfrey-Arku 1994, Hemeng 1994, Suglo 1994, Twumasi, 1994). These included reviews of the literature (activity a) where appropriate.
18. Case studies to identify the nature and local of losses (activity d) will be undertaken in Phase II. Case study sites were identified (Schippers *et al.* 1994).

Detail

19. The baseline survey (activity b) of vegetable producers in Brong Ahafo was undertaken in September 1994 (Sherington and Suglo 1994). Three hundred vegetable growers in 16 villages and their neighbouring "settlements" in five districts in the region were surveyed.
20. Vegetable growing is an important source of income for farmers in the region, equalled only by the production of staple foods such as maize for respondents in the survey. About 60% of people (men and women) grow vegetables commercially and most other women grow vegetables for domestic consumption. Pepper, tomato,

garden egg, okra, shallot, and onion are the main species (ranked in order of importance)

21. Three main types of vegetable producers were identified: men (commercial), women (commercial) and women (domestic). This classification affected a number of aspects such as land ownership, amount grown, agronomic practices, labour sources and methods of disposal (marketing) of produce. Other factors such as accessibility and zone (forest or transition) had smaller effects within the limited survey area.

22. Use of hired labour (particularly for clearing land), use of fertiliser and chemical sprays are common. Farm gate sales of vegetables to traders were the major methods of disposal, and local markets were also important.

23. The main problems stated by the smallholders were, lack of funds to expand production, lack of chemical inputs and fluctuating prices/marketing problems. Farmers generally produce their own seed.

24. The prioritisation of major pre- and post-harvest problems is reported against the objectives below.

25. The distinction between commercial and home consumption/local sale farmers was further investigated by Warburton and Lyon (1995). The differences between these two groups not only related to differences in disposal of the crop, but also to agronomic practices, crops and varieties grown, and resources invested. Within the commercial urban market-oriented farmers, there is a wide variation in access to resources from farmers who undertake all farm operations themselves to those who hire labour for most tasks and own water pumps and spray equipment. The home consumption/local market-oriented farmers are not always recognised as 'vegetable producers' as they tend to grow vegetables as intercrops and often on food crop farms. It was recommended that further investigations of their constraints and priorities are undertaken to ensure they are properly represented in the study.

26. Case studies (activity d) will be undertaken as part of Phase II, however case study sites have been identified and formed part of the assessment of pre- and post-harvest needs assessments (Sherington and Suglo 1994; Schippers *et al.* 1994, Holland, 1995, Gowan 1994, Bolfrey-Arku 1994, Hemeng 1994, Suglo 1994, Twumasi, 1994). Determination of the representiveness of these case study sites of the overall client base will be one of the objectives of the APO (Lyon 1994). The characteristics of these villages plus one additional village added by Warburton and Lyon (1994), which is outside the main vegetable producing area, are shown in Table 1.

Suggested Phase II activities

27. In each of the areas (post-harvest, plant protection, and land and water) the major constraints have been identified and prioritised. Suggested future work programmes have been suggested and in the second phase of the project it will be important to further develop these concepts within the contrasting case study areas.

Table 1: Summary of village characteristics

	Abesim	Techimantia	Manso	Akrobi	Bofourkrom
District	Sunyani	Tano	Techiman	Wenchi	Sunyani
Vegetation type	Forest-transition	Forest- transition	Forest-transition-savanna	transition - savanna	forest-transition
Relative village size	Large	Small town	Medium	Small	Small
Facilities in village	shops, school, clinics, daily market	shops, banks, secondary school, daily market	school, clinic, roadside market	small market	weekly market
Main ethnic groups	Brong	Ahafo	Brong	Brong/ Banda	Brong/ Ashanti
Location & access to main roads	On trunk road, Kumasi-Sunyani	On secondary road, Bechem - Kumasi rd.	On trunk road, Kumasi-Techiman	On secondary road, 3km from Wenchi	On secondary road, Odumase - Badu
Area well known for	Garden egg	Tomato	Tomato	Okra	none
Main seasons for vegetables	Dry season	all year	all year	from early rains	rainy seasons

28. The integration of the different elements of the study will be a key element to the overall success of the project. This should be assisted by having one socio-economist taking an overview of the entire project, a project leader who has a broad approach and an Associate Professional Officer charged with approaching problems from the participatory research perspective rather than any specific technical discipline.

29. The identification of the nature and location of losses through case studies with producers and traders will be an important theme to develop in Phase II of the project. Such activities will have a firm footing based on the investigations carried out to date.

30. There is also a need to include home consumption/local sale farmers as a client group for the project and carry out a further investigation of their constraints and priorities.

Outputs

BOLFREY-ARKU, G.E-K (1994) Survey on weed management in vegetable production in the Brong Ahafo Region.

GOWAN, S.R. (1994) Report on root knot nematodes as pests of vegetables in the Brong Ahafo Region of Ghana and the possibility of their management. Visit to Ghana to the Integrated Food Crop Systems project in Brong Ahafo region to make a preliminary survey of the root crop nematode problems and identify locations for field work for their bio-control (6-16 November 1994).

HEMENG, B.M.S. (1994) Nematode: pests of four vegetable crops in the Brong Ahafo Region, Ghana.

- HOLLAND, M.D. (1995) Report on a soil and water input to the Integrated Food Crop Systems Project, Brong Ahafo, Ghana: 12 - 26 February 1995.
- LYON, F. (1994) Notes on the approaches for on-farm research on the integrated Food Crop System Project, Brong Ahafo, Ghana. File note: 2 December 1994.
- SCHIPPERS, R.R., SUGLO, E.K.J., BRUCE, P. and KUFFOUR, S.A. (1994) Report on a visit to Ghana to discuss the Integrated Food Crop Systems Project in Brong Ahafo (11-29 October 1994).
- SHERINGTON, J. and SUGLO, E.K.J. (1994) Baseline survey of vegetable producers in Brong Ahafo Region, Ghana.
- SUGLO, E.K.J. (1994) Report on survey of pests, their importance and control on four vegetables in the Brong Ahafo Region of Ghana.
- SUGLO, E.K.J. (1995a) Integrated Food Crop Systems Project: Enhancing Smallholder Livelihoods through adding value to agricultural production. First quarter report August - December 1994. 30 January 1995.
- SUGLO, E.K.J. (1995b) Integrated Food Crop Systems Project: Enhancing Smallholder Livelihoods through adding value to agricultural production. Second quarter report January - April 1995.
- TWUMASI, J.K. (1994) Survey report on the identities, importance, distribution, control/management options of diseases affecting vegetable production in the Brong Ahafo Region of Ghana.
- WARBURTON, H. and LYON, F. (1995) Report on preliminary socio-economic studies for the Integrated Food Crop Systems Project in Brong Ahafo Region, Ghana. NRJ Report.

Objective 2: Investigation of net income from smallholder horticulture and the options for alternative higher income crops.

Planned activities

31. The following activities were planned:

- a. Identification of alternative food crops/varieties based on information gathered in objective 1 (Phase I-> Phase II).
- b. Analysis of net income from vegetable production and identification of alternative crops through selected case studies and construction of farm budget where possible (Phase I -> Phase II).

Achievements

32. The identification of alternative food crops was partially achieved by Schippers *et al.* (1994). Further work needs to be done on alternative varieties, this is partially as a seed supply problem that was addressed as a feasibility study by Schippers and Delimini (1995). Warburton and Lyon (1995) initiated work on the determination of incomes from vegetable production and the construction of farm budgets (activity b).

Detail

33. Costs of production were collected from six farms in two villages (Warburton and Lyon 1995). Although they only provide rough initial estimates, they do indicate that a significant amount of cash costs is spent on agro-chemicals. The expenditure on agro-chemicals accounts for a major component of variable costs on all the farms: from 18% to 33% of variable costs on pesticides and from 10% to 52% on fertiliser. Amounts spent on other farm operations showed more variation, in particular the cost of transporting the produce to the road can be high, especially for tomatoes where porters have to be hired to headload the heavy crates.

34. The data collected on production costs were the result of a single visit. In order to gain more accurate information, data would have to be collected from farmers at regular intervals to avoid problems of recall as no records are kept. Also better estimates of time actually spent on the farm are required. What the figures did however indicate was that a significant amount of capital is required to enter vegetable farming. Given the difficulty many farmers have in obtaining credit, this does highlight the problem of the need for capital which was perceived as the main constraint by farmers in the baseline survey (Sherington and Suglo 1994).

35. In terms of widening the range of vegetable crops grown, Schippers *et al.* (1994) identified onion as a potential alternative crop along with a range of leafy vegetables including *Amaranth*, *Celosia*, *Basella*, *Kenaf*, *Corchorus*, *Talinum fruticosum* and other semi-indigenous vegetables seen growing around Accra.

36. The issue of seed supply is discussed against objectives 6 and 7.

Suggested Phase II activities

37. The data to enable the costs of production of various crops has been initiated. Additional work is required in this area to enable the analysis of net income from vegetable production and identification of alternative crops through selected case studies.

Outputs

SCHIPPERS, R.R., SUGLO, E.K.J., BRUCE, P. and KUFFOUR, S.A. (1994) Report on a visit to Ghana to discuss the Integrated Food Crop Systems Project in Brong Ahafo (11-29 October 1994).

SCHIPPERS, R.R. and DELIMINI, L. (1995) Report on a visit to Ghana for a preliminary study to investigate the possibilities for a vegetable seed industry.

WARBURTON, H. (1995) Visit to Ghana to carry out socio-economic studies for the integrated food crop systems project (26 March - 8 April 1995) [File 9294 937/097/025A].

WARBURTON, H. and LYON, F. (1995) Report on preliminary socio-economic studies for the Integrated Food Crop Systems Project in Brong Ahafo Region, Ghana. NRJ Report.

Objective 3: Investigation of the range of vegetable varieties grown and characterise them in terms of the quality attributes important to smallholders and identification of appropriate new varieties with the required quality attributes

Planned activities

38. The following activities were planned:
- a. Characterisation of local vegetable varieties by farmers, traders and consumers based on their own classification of quality attributes (Phase I).
 - b. Identification of potential new varieties is based on information from activity a (Phase I).

Achievements

39. Local vegetable varieties were characterised by Schippers *et al.* (1994). A further more detailed listing was developed by Warburton and Lyon (1995) to achieve activity a. Potential new and crops were identified by Schippers *et al.*, but more work is required in this area.

Detail

40. As defined in the baseline study of Sherington and Suglo (1994), the main vegetable crops grown in Brong Ahafo are garden egg, tomatoes, peppers and okra. The varieties were generally diverse which is a reflection of the use of locally prepared seed without strict selection criteria.

41. The main varieties of garden egg, tomato, okra and pepper have been described (Schippers *et al.* 1994, Warburton and Lyon 1995) including where appropriate the attributes important to farmers, traders and consumers. Box 1 details the information given in Warburton & Lyon (1995) which builds on that provided by Schippers *et al.* 1994.

Box 1: Vegetable varieties in Brong Ahafo Region

Garden Egg (*Nyaa doa*, *Solanum aethiopicum*)

Aworoworo: pale green to white, egg shaped, 4-6 cm with slight extrusion towards the pistil end, becomes smaller at the tail end of the season, preferred by traders and used in soups.

Obolo: ("quite big"): bigger and rounder than **aworoworo** but not so common (found in Techimentia), used in stews and preferred by the traders from Accra.

Ansrowia: ("does not fear the sun"): bitter, grows in clusters of up to 7, green fruit often striped, low yield but resistant to drought; preferred as they get a higher price and can be sold when there is a glut, although there are higher costs for picking; it is early maturing.

K19: grows in pairs, rounded base, traders like it, only seen in Abesim.

Nsusuaa: small (5-10 mm), bitter; medicinal uses for malaria and improving appetite.

Kwahu-nsusuaa (Kwahu are a tribe in the Eastern Region) wild, clusters, light green colour, bitter, used in soup

Antropo: local aubergine, white with dark stripes.

Kwafre: rare, only seen in Ofuman, pure white, 5 by 6 cm, flat pistil base and fruit is irregularly lobed.

Dwamena: rare and not popular, from Cote d'Ivoire, 2.3 by 6.5 cm with spine like appendages on the fruit skin.

Tomato (Ntoose)

Power reno (a cross with Laureno?): round, less ridges preferred by traders as they are hardier and can last up to 7 days, withstands the rain well.

Reno (Laureno?): even smoother and less flat than power reno, preferred by traders, grown on more fertile land.

(Power) Rasta: lots of ridging, bigger, not preferred as there is "not enough food (pulp) in it", it is watery and gets bruised easily.; it lasts only 4 days; if there is plenty of rain then fruit may crack. It has the advantage in that it is bigger and so "fills the crates quickly".

Roma or Atowa (found in Manso): long, oval shape, usually small. Grown in the north. It has few seeds and gets sun scold

Asowaa (found in Bofourkrom): many small fruits on each bush, very sweet, lasts into the dry season as it is drought resistant

Traditional variety (found in Manso): big furrows and grows on a creeping plant, sweeter taste but does not last long; grown for home consumption.

Other varieties from the North:

Auntie Adwoa (named after the trader who took the seed there)

Yokohama (named after a type of tyre with deep furrows)

Okro (nkruma, Abelmoschus sp.)

Asontem "early maturing": large variety of types, early maturing, needs less spraying, subdivided into those "from Burkina Faso" - fat, short and round and more mucous (Abelmoschus caillei?); the seeds were brought from Burkina Faso to the market by migrants from the north.

Also those "from Accra" - long and thinner (Abelmoschus esculentus?) and preferred by Ga people.

Europa ("the late one") or Atuagya "farmer leaves the land when the plants are not yet dead": large variety of ridged and smooth, long and short, long fruiting into the dry season.

Pepper

Mnako (Cayenne types of Indian origin): medium length 8-10 cm, 0.8 cm in diameter, heterogeneous. Mostly dried and then often ground

Makohuam (from Marie Janette group of French origin) rounder, large wrinkles, relatively thin cell wall, 2-3 cm in diameter. Usually sold fresh but occasionally dries; the plants can last into the next season and they get a good price in November and December.

Meswa: very small 1 cm, grows wild and believed to be transported by birds; very hot.

Ohema nsateaa "queen mother's finger": long, thin and hot.

Shallots and Onions (Oyene)

These are described as those from the north (onions) and local, southern types (shallots).

Leafy vegetables

nkontomire: - cocoyam leaves (*Xanthosoma* sp.)

nyanya: (Kenaf or Roselle) - used in groundnut soup

alefu: (*Amaranthus* sp.)

ayoyo: (*Chorchorus* sp.)

osupura: (found in Manso) - a creeping plant
many volunteer plants on the bush fallow farms

okra leaves: mixed with other vegetables

cowpea leaves: popular with northern migrants

42. In terms of widening the range of vegetable crops grown, onion was identified as a potential alternative crop along with a range of leafy vegetables including *Amaranth*, *Celosia*, *Basella*, *Kenaf*, *Corchorus*, *Talinum fruticosum* and other semi-indigenous vegetables seen growing around Accra (Schippers *et al.* 1994).

Suggested Phase II activities

43. The identification of new varieties based on the needs of the farmers, traders and consumers is a key issue for Phase II. This can only be fully addressed with a sound knowledge of the current varieties and their qualities.

Outputs

SCHIPPERS, R.R., SUGLO, E.K.J., BRUCE, P. and KUFFOUR, S.A. (1994)
Report on a visit to Ghana to discuss the Integrated Food Crop Systems Project in Brong Ahafo (11-29 October 1994).

WARBURTON, H. and LYON, F. (1995) Report on preliminary socio-economic studies for the Integrated Food Crop Systems Project in Brong Ahafo Region, Ghana. NRI Report.

Objective 4: Analysis of soil and water management by smallholders and development of appropriate strategies based on the priorities and resources available to smallholders;

Planned activities

44. The following activities were planned:
- a. Analysis of soil and water characteristics from case study sites (Phase I)
 - b. Characterisation of local soil and water management systems using rural appraisal methods (Phase I)

Achievements

45. All the planned activities (a and b) have been achieved during a field visit by an NRI soil and water specialist and subsequent follow-up by his counterpart at the Soil Research Institute.

Detail

46. The soil and water management activities were undertaken in February 1995 during the dry season (Holland 1995). It focused on the case study areas identified in other parts of the project (Schippers *et al.* 1994).

47. Dry season vegetable production was confirmed to be commercial and undertaken by more men than women. Dry season and wet season production are undertaken on completely separate farms with that in the dry season on valley bottom land that is seasonally waterlogged or flooded.

48. Soils in the area are ancient, highly weathered/leached, many with ironstone concretions or pans, with low inherent nutrient status and cation exchange capacity. Soil fertility and water holding capacity is dependent on its organic matter content. Organic matter content was traditionally managed by bush fallow system. Now that fallow periods are shortening active organic matter management will be required in association with continued inorganic fertiliser inputs. Fire is a common (and useful) agricultural practice in Brong Ahafo, but its control will be essential for any organic matter strategies.

49. Potential soil and water interventions were discussed by Holland (1995), these were aimed at enhancing or sustaining fertility, increasing soil water holding capacity and reducing soil loss by erosion. On-farms trials on:

- contour cultivation and ridging in sloping land with live barriers to reduce run off and erosion;
- use of animal manure where they are available;

- use of elephant grass mulch. The techniques would have to be adapted to suit the farming practices. The objective of these trials would be to identify and overcome the farmer constraints to the adoption of mulching and organic matter management than to quantify the benefits.

Suggested Phase II activities

50. Holland (1995) recommended that the study be undertaken again in the wet season by the Ghanaian counterparts to ensure that the differences between the seasons are clearly understood.

51. Other potential areas of farmer participatory on-farm research are noted above and could be taken forward and integrated with other on-farm research in the second phase of the project.

Outputs

BOADI, S. (1995) Land and water management for vegetable production in Brong Ahafo Region of Ghana. [Appended to HOLLAND, M.D. (1995) Report on a soil and water input to the Integrated Food Crop Systems Project, Brong Ahafo, Ghana: 12 - 26 February 1995].

HOLLAND, M.D. (1995) Report on a soil and water input to the Integrated Food Crop Systems Project, Brong Ahafo, Ghana: 12 - 26 February 1995.

Objective 5: Analysis of weed, pest and disease problems and development of strategies based on the priorities and resources available to smallholders.

Planned activities

52. The following activities were planned:

- a. Study of farmers' perceptions and control activities for weeds, pests and diseases (Phase I);
- b. Identification and prioritisation of weeds pests and disease problems of vegetables based on (a) (Phase I -> Phase II);
- c. Development of crop protection strategies based on information from comparable systems, current practices and resources available to smallholders. Initially this would start with the control of root-knot nematodes (Phase I -> Phase II);
- d. Participatory validation of best practices with farmers (Phase II);
- e. Outline manual on integrated pest management based on a,b,c and d above (Phase I).

Achievements

53. Farmer surveys by four Ghanaian consultants have examined the major plant protection problems (weeds, nematodes, insect pests and diseases) affecting vegetables (activities a and b). This included some broad determinations of farmer perceptions which have been summarised and enlarged upon by Warburton and Lyon (1995). A work programme on the control of root-knot nematodes has been developed (activity c). A draft plant protection manual has been developed (activity e).

Detail

Identification of pest and disease problems

54. Activities (a) and (b) were carried out by means of a field surveys of case study vegetable farmers (Bolfrey-Arku 1994, Hemeng 1994, Suglo 1994, Twumasi, 1994). Each of the studies aimed to determine the farmers' own perceptions of the pest and disease problems and determine current management practices.

55. Twumasi (1994) visited 5 villages/towns interviewing informally and then 5-10 farmers concentrating on the diseases of pepper, okra, tomato and garden egg. Forty farms were surveyed in total over a two week period. The major diseases were reported and a number of important fungal species from field samples were identified in the laboratory. On okra, the major diseases in order of importance were leaf spot, flower and bud rot. On tomato the most important were *Septoria* leaf spot caused by *Septoria lycopersici* and *Sclerotium* wilt. Details of the other diseases recorded are detailed in Twumasi (1994).

56. With the exception of pepper, diseases were more common in forest areas than in the transition zone. Farmers did not in general recognise disease problems and when asked about diseases pointed out insect damage. Farmers do, however, use fungicides on their vegetables, often as a cocktail. The reasons for using fungicides were not necessarily in response to a disease, but because they produced luxuriant vegetative growth or healthy looking flowers. Farmers knowledge on the correct use of fungicides, in terms of the correct method of preparation and application and in terms of which fungicide to use, was considered poor and in need of improvement.

57. Twumasi (1994) also mentions the importance of weed management since these can serve as alternative hosts for several pathogens.

58. Suglo (1994) determined the importance insect pests of garden egg, tomato, okra and pepper. This was done as a survey of 53 case study vegetable farmers. A database of local literature on pests and diseases was also compiled. Traditional methods of controlling insect pests are only used by a limited number of farmers. Cultural methods, such as removing infested fruits and crop rotation, are practised by a few farmers. Chemical pest control is widely practised.

59. Bolfrey-Arku (1994) interviewed 35 farmers in 5 villages about issues concerned with weed management. Hand weeding with a hoe was the major weed management method used by farmers. Weed frequency was high because vegetable crops do not develop a canopy that effectively shades the ground. Most farmers do not mulch. However, mounding and ridging were used as a form of weed control. The most difficult to control were *Imperata cylindrica*, and *Cyperus* spp.

60. Various research opportunities for weed control were suggested including the use of mucuna or other legume cover crops; studies on planting distances and varieties; weeding frequency and timing studies; chemical weed control; fertiliser studies to give crops a head start; and, methods of integrated weed control.

61. Hemeng (1994) reviewed the nematode problems. This included a review of the literature. Fifty farms were visited as part of the survey. Samples of infected plants and soil were collected and subsequently analysed. Detailed breakdown of the results are given in the report, but it was concluded that each of the four vegetable species considered (tomato, okra, pepper and garden egg) were severely infested with nematodes especially the root-knot nematodes, *Meloidogyne* spp.. The population densities of the plant parasitic nematodes were all above the tolerant levels for each crop.

Farmer perceptions of pests and diseases

62. Warbuton and Lyon (1995) summarised the information on farmer perceptions and practices collected during their rural appraisal, together with information from the individual pest surveys carried out (Suglo 1994, Twumasi, Hemeng 1994, Bolfrey-Arku 1994, Gowen 1994).

63. Vertebrate pests and weeds are known by the farmers and they appear to have considerable knowledge of individual plants. Bolfrey-Arku (1994) found that farmers could identify different weeds, they knew the effects of ridging and mulching on weeds (for example, ridges are commonly used in areas with *Imperata cylindrica*), and had noticed the effect of weeds on the incidence of insect pests. None of the farmers used herbicides.

64. Knowledge of insect pests is less clear. It is not known, for example, what proportion of farmers understand metamorphosis, and how carefully farmers differentiate between species. Certain categories such as caterpillars, ants, butterflies, weevils and beetles are commonly identified as pests, but it is not known whether farmers distinguish between harmful, harmless and useful insects. With the growth of commercialised vegetable production and use of chemicals, farmers have become more 'insect-conscious'; farmers appear to perceive new varieties and monocropping practices as being more susceptible to pest problems.

65. Misunderstanding of disease problems appears common. Twumasi (1994) found 90% of the 40 farmers interviewed confused insect damage with disease damage, and thought that diseased plants may have been affected by physical conditions such as lack of water.

66. Damage by root-knot nematodes (galls on roots) was noticed by farmers who thought it was some kind of disease. However, a common practice was to uproot and discard the plant, then replant in the same hole (Hemeng 1994). Farmers had tried a variety of fertiliser and chemical controls without success.

67. Commercial, urban market-oriented farmers appear to rely almost entirely on chemical controls. Farmers distinguish between two types of chemicals: 'poison' or 'DDT' which include all liquid insecticides, and 'powder' which includes all fungicides and foliar fertilisers.

68. "Poison" is used by farmers to kill insects; it is not used to cure diseases. It is unlikely that farmers distinguish between different insecticides for different pest problems. They do take advice from pesticide dealers and other farmers on what to buy, but farmers interviewed did not give specific reasons as to why or what they were spraying. Pyrethroids such as Karate (lambda-cyhalothrin) and Cymbush (cypermethrin) are recommended by extension agents, but subsidised cocoa insecticides such as Gammalin (lindane) and Uden (propoxur) are much cheaper and widely used. Both ULV and EC formulations are available, but farmers do not always know the difference and will use a ULV formulation mixed with water in a knapsack sprayer, for example.

69. "Powder" (fungicide and fertiliser) appear to be used almost interchangeably to keep the plants looking healthy rather than to treat specific fungal diseases. Sometimes this may amount to the same thing. For example, if flower fall is caused by a fungal disease, use of powder may promote a healthy plant with healthy flowers. However, in many cases, the chemical used may be inappropriate and the dosage incorrect so that effectiveness is negligible.

70. Chemicals are often mixed together in cocktails of varying dosages. It is not known how closely these dosages relate to recommended rates, but there may be a tendency to underdose as the chemicals are expensive, and some may already be adulterated before use. Application equipment can be lever-operated knapsack sprayers, motorised blowers (designed for cocoa trees) or palm fronds tied together and used to brush the cocktail over the plants. Safety precautions appear minimal.

71. By contrast, home consumption/ local market farmers make little use of chemical control, not only because they cannot afford it, but also because it is not thought to be so necessary. A higher proportion of traditional varieties are grown which are perceived as more pest resistant. Also traditional methods such as the use of woodash to control leaf-feeding insects are used when there is a pest problem.

72. The growing reliance of commercial farmers on chemicals is illustrated by their identification of the costs of chemicals as a major constraint (Sherington & Suglo 1994). However, misuse and misunderstanding of pesticides probably means that many are wasting their money and storing up long-term problems of pest resistance and resurgence for themselves. The introduction of any Integrated Pest Management (IPM) techniques will be insufficient if it is not fully understood by farmers, as they will then lack a rationale for introducing the techniques. Therefore any future research on IPM must take account of farmers' indigenous knowledge and build on from that.

Work to address nematode problems

73. Gowen (1994), in a short visit, investigated the status of nematodes in vegetable farming in the Brong Ahafo region. As a result of the field work and subsequent analysis of samples in the laboratory, it was concluded that root-knot nematodes are a major pest of vegetable crops grown in the Brong Ahafo region. Their importance was always apparent since other pests and diseases affect the crops and cause obvious symptoms on aerial parts of the plant. Root damage is, therefore, often overlooked.

74. Strategies for the management of key pests and diseases will have to be developed. For nematodes it was recommended that a project on biological control be initiated based on previous NRD-funded results and in addition, control methods involving varietal resistance and tolerance should be included. An outline of this programme has been developed (Gowen 1994). The parasite *Pasteuria penetrans* was found to be infecting root-knot nematodes at a least two locations and *Verticillium chlamydosporium* has been isolated from samples collected at eight locations.

Pest manual

75. A draft Integrated Pest Management Manual (activity d, Critchley 1995b) has been prepared. A preliminary draft of the manual was prepared in the UK by means of a literature survey concentrating on pest, disease and weed constraints affecting vegetables in Ghana and other neighbouring countries in West Africa. A visit was made to Ghana (Critchley 1995a) to gather information on pests, diseases or weeds

omitted in the literature search and to meet the project counterparts to agree the layout and contents of the manual.

76. As a result of the visit whiteflies, *Bemisia tabaci*, were identified as a common pest which had not been covered in the literature. This pest has now become important as a result of the misuse or overuse of pesticides. Fairly common, were diseased tomato plants suffering from one or more viral infections. These may have been seed-borne or transmitted by insects. Root-knot nematode infestations on garden egg and okra were also seen fairly frequently. A previously unrecorded wilt disease of garden egg, tentatively identified as *Corynebacterium michiganense*, was also observed.

77. The preliminary draft manual was discussed with counterparts in Ghana and was greeted very favourably. It was noted that most extension officers can only identify insect pests to the level of order. It was therefore suggested that the final manual should include photographs to show the key pests and their typical damage symptoms.

Suggested Phase II activities

78. It is suggested that the biocontrol and cultural options for root-knot nematodes are developed and tested on-farm by Ghanaian scientists with specialist inputs from NRI when necessary. The objective would be to promote naturally occurring parasitic fungi (*Pasteuria penetrans* and *Verticillium chlamydosporium*) as biological control agents and to integrate these with other promising control strategies such as crop rotation, the planting of resistant/tolerant crop varieties and the use of grass fallows of *Pennisetum purpureum*. The main elements of this work could be undertaken by a PhD student from the University of Science and Technology in Kumasi.

79. The draft Plant Protection Manual needs further elaboration to enable the easier recognition of the major pests by the intended users of the manual, namely, the extension services of the Ministry of Food and Agriculture, as well as a wider audience including students and progressive farmers. Incorporation of further information on farmers' indigenous knowledge of pests and diseases would also improve the value of the manual.

80. It is also suggested that a pest database, partly developed during the production of the draft manual, is further elaborated.

Outputs

BOLFREY-ARKU, G.E.K. (1994) Survey on weed management in vegetable production in the Brong Ahafo Region.

CRITCHLEY, B. (1995a) File note: Visit to Ghana to gather material on the IPM of horticultural crops in the Brong Ahafo Region: 15-24 February 1995. (File: 937/097/009A).

- CRITCHLEY, B. (1995b) Draft Manual for the IPM of vegetables in Brong Ahafo, Ghana.
- GOWEN, S.R. (1994) Visit to Ghana to the Integrated Food Crop Systems project in Brong Ahafo region to make a preliminary survey of the root crop nematode problems and identify locations for field work for their bio-control (6-16 November 1994)
- HEMENG, B.M.S. (1994) Nematode: Pests of four vegetable crops in the Brong Ahafo Region, Ghana.
- SUGLO, E.K.J. (1994) Report on survey of pests, their importance and control on four vegetables in the Brong Ahafo Region of Ghana.
- TWUMASI, J.K. (1994) Survey report on the identities, importance, distribution, control/management options of diseases affecting vegetable production in the Brong Ahafo Region of Ghana.

Objective 6: Investigation of horticultural commodity system and identification of potential areas and criteria for technical interventions

and

Objective 7: Development of strategies for improved harvesting, handling, distribution, marketing and processing systems based on outputs of objective (vi).

81. These two objectives will be considered together since they only had one set of planned activities.

Planned activities

82. The following activities were planned:

- a. For selected horticultural crops, analysis of the commodity system, including marketing margins, integration and demand factors and identification of potential areas of intervention (Phase II)
- b. Development of post-harvest handling, processing and/or market information options based on information from a above (Phase II).
- c. Draft generic manual on post-harvest management of horticultural crops (Phase I).
- d. Development and validation of manual (Phase II).

Achievements

83. Items (b) and (d) were planned as Phase II activities. Activity (a) commenced with the visit of Mr Schippers in October 1994 (Schippers *et al.* 1994) and further work on marketing chains was undertaken by Warburton and Lyon (1995). A draft post-harvest manual has been prepared (item b).

Detail

84. Activity (a) was started in 1994/95 with the visit of a NRI horticulturist to the project in October 1994. For most farmers, lack of capital or credit was considered the major constraint. This was required to expand their farm, purchase fertilisers, pesticides or seeds. Other constraints were marketing, pest and disease problems, land and water related problems, seeds (quality and availability) and crop diversification.

85. Pest and disease problems and land and water issues are considered under Objectives 5 and 4 respectively. Of the remaining issues, marketing was considered the main constraint. Peaks in supply were a major problem resulting in a limited market for the crop at certain times of year. Other factors affecting efficient marketing include insufficient awareness of quality and a varietal choice that is not demand led.

A detailed analysis of the problems of the marketing system are given in Schippers *et al* (1994). These include:

- i) seasonal gluts made worse by erratic rainfall patterns;
- ii) some farmers negotiate prices individually which makes it harder for traders to locate the product they want;
- iii) limited access to markets; and
- iv) lack of security and storage facilities at markets.

The service centre approach to improving marketing was suggested by Schippers *et al* (1994) with the objectives of ensuring quality, adequate quantities for the market, a range of products and consistent supply.

86. The suggestion of the service centre concept is one that has to be further assessed and developed with farmers and traders, and compared against other concepts for improving marketing. Schippers *et al.* (1994) suggest that a full feasibility study is required to determine the production costs for farmers and possible margins that could be made. The economic aspects and costings of the envisaged sales structure including additional facilities would need to be considered in more detail in comparison with other means of overcoming the identified problems in vegetable marketing.

87. To assist in the analysis of the marketing systems and development of strategies to improve the situation, current marketing systems were further characterised by Warbuton and Lyon (1995). The structure of the marketing system was found to be characterised by a high proportion of produce from commercial farmers in areas well-known for vegetable production being sold through farm gate sales and transported direct to the large urban centres by urban-based or rural-based itinerant traders. Relay markets such as Techiman, therefore may play a relatively smaller role in vegetable marketing than for other staple crops. Kumasi appears to act as a centre point for vegetable marketing, not only as a relay market and large urban market, but also as an information centre, where traders can gather information on conditions in the production areas.

88. Local market sales are more important for villages away from the well-known vegetable production areas, for villages in the off-seasons when itinerant traders no longer visit, and for the home consumption/local sale producers.

89. Prices can fluctuate enormously from week to week, especially for the most perishable crops tomatoes and garden eggs. Vegetables that store for longer or can be processed (pepper, okra, onion) were reported to have less variable prices. Demand for garden eggs can also be affected by supplies of substitutable crops on the market, whereas demand for tomatoes, pepper and onion is less likely to be affected, as there are fewer substitutes.

90. Seed supply was another major problem identified by Schippers *et al.* (1994) and a follow-up visit was made to further assess the current vegetable seed production

technology, the supply system and to investigate the possibilities for improved vegetable seed production (Schippers and Delimini 1995).

91. Vegetable seed is mainly produced by farmers themselves, partly for economic reasons and partly because it is not possible to purchase good quality seeds at affordable prices. The disadvantages of producing seeds for many seasons without control could be seen on many farms. Varieties have degenerated such that fruit quality is reduced and become less acceptable to the market. In addition yields are reducing. Seed-borne diseases are common and necessitate the use of chemicals to control them. These chemical are imported.

92. A number of possible strategies for the improvement of vegetable seed have been proposed by Schippers and Delimini (1995). Improved traditional seed production was identified as one option, but was considered to have some limitations with respect to a limited selection of varieties and the potential for less efficient or less careful farmers to multiply problems (e.g. disease problems). The steps towards the development of a commercial seed industry were also detailed. The steps involved include a call for investors, varietal screening and selection of basic seeds. production of the seed and processing of the seed. Preliminary discussions with potential investors indicate great interest in the concept. Such a seed industry would have to be in the private sector, however, public sector support will be necessary through research and extension and well as through monitoring by the Ghana Seed Inspection Unit.

93. Clearly aspects of this latter strategy are not research and will have to funded from the private sector or through a technical assistance project. But, there are research elements that have to be developed such as the establishment of farmer preferences for varieties which would affect selection of germplasm.

94. The need to preserve the vegetable germplasm of the Brong Ahafo region was another issue raised by Schippers *et al.* (1994) to prevent genetic erosion. A project on this issue was subsequently prepared for submission under the Department of the Environment's Darwin Initiative.

95. It was also noted that there was a need for adaptive horticultural research in Ghana.

96. A visit was made to Ghana by an NRI Post-harvest technologist (part-funded by a visit to another project) to observe the post-harvest systems for the major horticultural commodities (Burdon 1995a). Although there were some seasonal limitations to the observations made, key information was gathered on the post-harvest systems to enable the preparation of an appropriate post-harvest manual. As a result of the visit it was decided that any manual should target growers, extension agents and specifically traders since they play a central role in the post-harvest handling system.

97. On the basis of the visit and NRI's previous expertise in the area a draft manual suited to the needs identified was prepared. It was decided that the most appropriate format should be pictorial with limited amounts of text. For extension workers, a more detailed explanation of the principles behind the recommendations

was included at the back of the manual. It should also be translated into Twi, the major language of Brong Ahafo Region.

Suggested Phase II activities

98. Improvements to the marketing of horticultural crops was the major post-harvest constraint identified. There is the need to undertake a study to evaluate potential options for doing this and test them on a case study basis. More detailed studies on marketing, looking particularly at information flows, credit chains, price variations and effects of farmers' and traders' associations, are required to enable this to be achieved. Possible strategies to be tested include the serve centre concept and improved market information systems.

99. Problems deriving from a variable and poor quality seed source are another post-harvest concern. The extent to which productivity and quality have been eroded because of the seed source have to be investigated.

100. The systems which supply seed to farmers should be carefully considered in Phase II as an adjunct to the above problem. A feasibility study has been carried and the research issues arising from this need to be isolated from those issues which are more a developmental nature that should be supported from other sources.

101. The potential role of adding value to the crops through processing needs to be evaluated where appropriate after further analysis of the commodity system, particularly in relationship to seasonal gluts.

102. Validation of the post-harvest management manual will be a key activity in Phase II. To assist in improving the quality and value of vegetable crops. Wider dissemination of the manual and training of extension workers and farmer associations will require additional non-research funds.

Outputs

BURDON, J. (1995a) File note: Visit to Ghana to gather information for a post-harvest management manual dealing with vegetables 22 February - 1 March 1995). [File FS 9294 937/248/060A].

BURDON, J. (1995b) Draft Manual for the post-harvest management of vegetables in Brong Ahafo Region of Ghana.

SCHIPPERS, R.R., SUGLO, E.K.J., BRUCE, P. and KUFFOUR, S.A. (1994) Report on a visit to Ghana to discuss the Integrated Food Crop Systems Project in Brong Ahafo (11-29 October 1994).

SCHIPPERS, R.R. and DELIMINI, L. (1995) Report on a visit to Ghana for a preliminary study to investigate the possibilities for a vegetable seed industry.

WARBURTON, H. and LYON, F. (1995) Report on preliminary socio-economic studies for the Integrated Food Crop Systems Project in Brong Ahafo Region, Ghana. NRI Report.

FORMULATION OF PHASE II OF THE PROJECT

103. This report has summarised the activities of Phase I of the project. Suggestions have been made for items to be included in the second phase of the project.

104. In order to bring together the different stands of the project and to develop a longer term work programme, it is recommended that a review meeting is held in Ghana as soon as feasible to review the Phase I findings (as presented in this report) and develop a new project memorandum and work programme. The meeting should involve project staff and key members of the collaborating institution to ensure a programme that meets the needs of the beneficiaries and the national strategy for these commodities.

Appendix I: Abbreviations

APO	Associate Professional Officer
CSIR	Council for Scientific and Industrial Research
EC	Emulisifiable concentrate
NRI	Natural Resources Institute
NRD	Natural Resources Division
NARP	National Agricultural Research Project
ULV	Ultra low volume

Appendix 2: Project Memorandum

PROJECT MEMORANDUM

1. Project Title

Integrated Food Crop Systems Project: Enhancing smallholder Livelihoods through adding value to agricultural production in Brong Ahafo Region, Ghana

2. Programme

Agronomy and Cropping Systems

3. Project Leader

Dr R G Poulter
Development Services Group, NRI

4. (a) Project Location

Sunyani, Brong Ahafo Region, Ghana

(b) Names and addresses of collaborators

Professor K A Haizel
NARP Coordinator and Deputy Director General (Agriculture)
Council for Scientific and Industrial Research
PO Box M32
Accra, Ghana
Tel: 233-21-777651 ext 228, 250 (office)
Fax: 233-21-777655

Mr E K J Suglo
Project Counterpart
c/o NARP
Council for Scientific and Industrial Research
PO Box M32
Accra, Ghana

(c) Overseas government approval

Exchange of letters between NRI and Professor Haizel

5. Start and finish dates

Phase 1: 9 August 94 to 31 March 95

6. Financial inputs:

(a) Total finance requested from R&D funds

£95,000

(b) Summary of finance

Inputs	Time	1994/95
NRI Staff costs		
AED	40d CB2	16200
FSCU	32d CB2	12960
RAFS	15d CB2	6075
SSG	21d CB2, 12d CB3	12585
CSD	1d CB3, 1d CB4	610
Total staff time costs		48425
Ghanaian staff costs		7830
Capital costs		20120
Consumables		2250
Overseas T&S		16370
Total		95000

See attached budget for details

(c) Support from other organisations

None

(d) Has the proposal been submitted for funding elsewhere?

No

7. (a) What development problems or needs is the project aimed at?

In spite of some progress made within the agricultural sector since the introduction of the Economic Recovery Programme in 1983, Ghana's agricultural sector (including the post harvest sector) continues to operate at very low levels of productivity. Research into the applications of new technologies has had limited effect with most producers, traders and processors continuing to use minimal inputs apart from labour.

Horticultural crops form an important part of the farming system, and are grown by almost all farming households in Brong Ahafo Region. Vegetables such as tomatoes, onion, garden egg (*Solanum integrifolium*), okra and pepper are staple ingredients in the diets of all Ghanaians. However, vegetable production is characterised by low productivity,

and the commodity system as a whole by wide fluctuations in availability of produce, accompanied by large fluctuations in prices and reports of high losses during the peak season. Vegetables are usually used fresh, and there is very little processing undertaken.

There has been some research work on horticultural production in Ghana (Plan Consult 1993), but results have not always reached the farmers, especially the majority of small-scale producers who are often women farmers growing vegetables within a mixed cropping system. There has been some development in large-scale vegetable production including some non-traditional crops, but this is limited to a minority of producers. Pesticides have been widely adopted amongst these producers and misunderstanding and misuse of these chemicals appears common. There has been limited research on the non-farm areas of food and agriculture industry and the potential for reducing losses and adding value. This has been acknowledged by the MoFA as an area where more work should be undertaken (Dapaar and Oteng 1993).

During the rural appraisal undertaken by NRI and MoFA staff in the Brong Ahafo Region in June 1994, the areas of pest management on vegetables, declining soil fertility and marketing, distribution and processing of tomatoes and garden eggs emerged as important issues both for smallholders and in discussions with researchers in Ghana.

(b) Contribution of project to resolving needs

The project will adopt an integrated approach in order to consider both pre- and post-harvest problems in horticultural-based systems. The goal of the project is to enhance the livelihoods of smallholders, rather than increase horticultural production per se, so the role of smallholders as producers, traders, processors and consumers will be taken into account. The outputs of the project will be the development of strategies in the areas of soil and water management, IPM, harvesting, marketing and processing appropriate to smallholders in Brong Ahafo which will enable them to reduce their costs or add value to horticultural production in order to increase their incomes.

The project outline was discussed with Professor Haizel and he confirmed that it would be in line with the overall objectives of the National Agricultural Research Project (NARP).

(c) Who will be the beneficiaries

Smallholders in Brong Ahafo Region

8. Scientific and Technical objectives of the project

(i) to investigate the relative importance of horticultural crops to smallholder livelihoods and to identify major pre- and post-harvest constraints in horticultural-based systems;

(ii) to investigate the net income from smallholder horticulture and the options for alternative local crops with potentially greater returns;

(iii) to investigate the range of vegetable varieties grown and characterise them in terms of quality attributes important to smallholders and to identify appropriate new varieties with the required quality attributes;

(iv) to analyse soil and water management by smallholders and develop appropriate strategies based on the priorities and resources available to the smallholders;

(v) to analyse weed, pest and disease problems and develop strategies based on the priorities and resources available to the smallholders;

(vi) to investigate the horticultural commodity systems and identify potential areas and criteria for technical interventions;

(vii) to develop strategies for improved harvesting, handling, distribution, marketing and processing systems based on (vi).

9. Plan of work

The project will develop and undertake a baseline survey to determine the relative importance of horticultural crops to smallholders in the project area, and to characterise the types of production and marketing systems. Then, using participatory methods, major pre- and post-harvest constraints will be identified in horticultural-based systems and smallholders identified who would participate in the project throughout its duration.

This will be followed by inputs from a multidisciplinary team working with the smallholders to identify and develop improved strategies for horticultural-based systems. Draft generic level manuals will be developed for use by the technical and extension departments of the MoFA for integrated pest management and post-harvest management of horticultural crops.

Running in parallel would be an analysis of the marketing system and identification of potential opportunities for

technical interventions. Development of improved strategies for post harvest systems will be based on this analysis.

The project is designed to continue into a second phase of two years after March 1995, in order to be able to gather data over all the seasons and to be able to develop and validate improved strategies with smallholders. It is proposed that phase 2 is included in the RTG bids. The main activities and phases in which they occur are shown below:

Activities

1.1 Review existing literature on horticulture in shifting and permanent production systems with declining fertility and literature on vegetable commodity systems in Ghana.

(Phase 1)

1.2 Baseline survey of smallholders to determine the relative importance of horticultural crops to smallholders' livelihoods and to characterise the types of production and marketing systems. (Phase 1)

1.3 Prioritisation of major pre- and post-harvest constraints in horticultural-based systems by smallholders. (Phase 1 -> Phase 2)

1.4 Identification of the nature and location of losses within the horticultural commodity systems through case studies with producers and traders. (Phase 1 -> Phase 2)

2.1 Identify potential alternative food crops/varieties based on information gathered in (1). (Phase 1 -> Phase 2)

2.2 Analysis of net income from vegetable production and identification of alternative crops through selected case studies and construction of farm budgets where possible. (Phase 1 -> Phase 2)

3.1 Characterisation of local vegetable varieties by farmers, traders, consumers based on their own classification of quality attributes. (Phase 1)

3.2 Identification of potential new varieties based on information from 3.1 (Phase 1)

4.1 Analysis of soil and water characteristics from case study sites. (Phase 1)

4.2 Characterisation of local soil and water management systems using rural appraisal methods. (Phase 1)

5.1 Study of farmers' perceptions and control activities for weeds, pests and diseases. (Phase 1)

5.2 Identification and prioritisation of weeds, pests and disease problems of vegetables based on (1) and 5.1. (Phase 1 -> phase 2)

5.3 Development of crop protection strategies based on information from comparable systems, current practices and resources available to smallholders identified in (1) and 2.2. Initially this would start with control of root knot nematodes. (Phase 1 -> Phase 2)

5.4 Participatory validation of best practices identified in 4.1, 4.2 and 5.3 with farmers. (Phase 2)

5.5 Outline manual on integrated pest management based on 5.1-5.4. (Phase 1)

5.6 Development and validation of manual. (Phase 2)

6.1 For selected horticultural crops identified in (1), analysis of the commodity system, including marketing margins, integration and demand factors and identification of potential areas of intervention. (Phase 2)

6.2 Development of post harvest handling and processing and/or market information options based on information from 6.1. (Phase 2)

6.3 Draft generic manual on post harvest management of horticultural crops. (Phase 1)

6.4 Development and validation of manual. (Phase 2)

10. (a) Outputs of Project

(i) Major pre-and post-harvest constraints in horticultural-based systems identified and prioritised for shifting and permanent cultivation in low fertility areas

(ii) Net income from smallholder horticulture and options for alternative local crops which potentially greater returns identified

(iii) Local varieties characterised and appropriate new varieties identified

(iv) Soil and water management strategies developed for low-input mixed cropping systems

(v) Strategies for integrated pest management developed for low-input mixed cropping systems

(vi) Strategies for improved harvesting, handling, distribution, marketing and processing developed

(b) Who will use the outputs of the project?

The outputs will be used initially by smallholders in the project area of Brong Ahafo. The draft manuals will be used by the technical and extension departments of the MoFA and by other organisations involved in horticultural systems.

(c) How will outputs be disseminated to reach their users?

Through direct contact and participation of smallholders on the project, then through local organisations such as growers and traders associations;

Through manuals designed for the technical and extension departments of the MoFA and participation of MoFA staff on the project;

Through direct contacts with other national organisations, international organisations (such as FAO) and regular meetings with staff from CSIR institutions.

11. What criteria will be used to measure the output of the research?

In the short term the outputs can be measured by the quality of the project reports and the draft manuals. In the longer term by the adoption and/or modification of the strategies developed by the project by smallholders in Brong Ahafo.

12. What factors could prevent the attainment of:

(a) Planned inputs?

NARP unable to recruit staff within agreed consultancy fees and time scale;

Project does not continue into phase 2.

(b) Scientific and technical objectives?

The attainment of these objectives relies on the close participation of smallholders with the project, good collaboration between the different subject specialists and coordination by the local project coordinator and assistant.

If the project is not extended into phase 2, then the objectives will be curtailed as it is not possible to collect case study data nor to fully validate strategies through the different seasons during the first phase only.

(c) Intended outputs

If the constraints identified are not amenable to cost-effective reduction

(d) The contribution of project to wider developmental needs identified in Section 7?

If the strategies developed by the project are not disseminated.

13. What work has previously been done, or is currently being pursued, on the objectives of the project?

A summary of research work on horticultural production in Ghana has been made by the NARP project (NARP 1993). The work has been concentrated on tomatoes, garden eggs, pepper, okra and onion with no identified research on minor vegetable crops. The research work includes studies on cultivars, agronomy, pests and diseases (chemical control and neem extract), which have been carried out mainly at the University of Ghana, University of Science and Technology and the Crops Research Institute. Some studies on processing and preservation have been previously undertaken at the Food Research Institute and University of Ghana (e.g. Dei-Tutu 1986). Little has been identified on marketing of vegetables in Ghana (2 BSc dissertations, one journal article), although there may be some studies held outside Ghana.

Apart from the CSIR institutes, other organisations currently involved in horticultural production include FAO (post harvest and IPM initiatives) and GRATIS (tomato processing). However, no existing research which combines both pre- and post-harvest issues has been identified.

14. What are the expected environmental impacts, positive and negative of:

(a) the project itself?

Neutral

(b) implementation of outputs?

The implementation of the project is expected to contribute to the development of a more sustainable agricultural system, particularly by developing strategies to combat declining soil fertility, and developing integrated pest management options as alternative to the current misuse of pesticides.

References

- Dapaah S K and S Oteng (1993) Formulation of National Agricultural Research Policy in Support of a National Agricultural Research Plan, National Agricultural Research Project, Accra
- Plan Consult (1993) Horticultural Crops, Appendix VI, Volume 3, A Report by the Commodity Committee of National Agricultural Research Project, Accra
- NARP (1993) List of Research Reports, National Agricultural Research Project, Accra
- Dei-Tutu J (1986) Preservation of Garden Egg (*Solanum integrifolium*) in Salt, CSIR, Food Research Institute, Accra

INTEGRATED FOOD CROP SYSTEMS PROJECT

Common Budget		
Staff Costs		
GHANA/IAN		
Full-time counterpart	7.8m	5200
Project assistant	7m	300
Local interpreters	21d	30
Consultants		
Plant pathologist	2w	450
Nematologist	2w	450
Soil scientist	2w	450
Post harvest/marketing	2w	450
WIAD	3w per diem	0
other contracts		500
NR/		
Socioeconomist	21d CB2 12d CB3	12585
per diems	4d Accra	340
	38d elsewhere	950
Support Services	1d CB3, 1d CB4	610
Air fares	2 @ 1750	3500
Capital costs		
Landrover		17200
motorbike		1300
air conditioner		0
office furniture		750
fax machine	UK purchase	0
microscope	UK purchase	0
PC	UK purchase	0
printer	UK purchase	0
1 fridge		370
house furniture		500
Running costs		
office rental	7m	250
CSIR office costs		0
vehicle running costs		1500
consumables, freight, insurance		500
Other costs		
publications		0
Total common budget		48185
AED		20880
FSCU		17520
RAFS		8415
Total project		95000

INTEGRATED FOOD CROP SYSTEMS PROJECT

AED, RAFS and FSCU budget		
AED		
Weed Scientist	15d CB2	6075
per diems	4d Accra	340
	10d elsewhere	250
Nematologist	15d CB2	6075
per diems	4d Accra	340
	10d elsewhere	250
Entomologist/Pathologist	10d	4050
Air fares	2 @ 1750	3500
Total AED		20880
RAFS		
Soil Scientist	15d CB2	6075
per diems	4d Accra	340
	10d elsewhere	250
Air fare	1 @ 1750	1750
Total		8415
FSCU		
Post harvest	32d CB2	12960
per diem	6d Accra	510
	22d elsewhere	550
Air fare	2 @ 1750	3500
Total		17520

Step 2: Project Logical Framework GHANA

Narr. & Summary (NS)	Measurable Indicators (OVI)	Means of Verification (MOV)	Important Assumptions
<p>Goal:</p> <p>1 To enhance smallholder livelihoods through reducing costs and adding value to agricultural production.</p>	<p>1.1 Net income from smallholder food crop production increases by 5% in project area by 2010.</p>	<p>1.1 National statistics Project reports</p>	<p>(Goal to Supergoal)</p> <p>1.1 -Enabling environment (policies, institutions, markets) for the adoption of new technologies exists.</p>
<p>Purpose:</p> <p>1 Develop and validate sustainable strategies appropriate for smallholders in Brong Ahafo to increase income from horticultural-based systems.</p>	<p>1.1 By 2005, strategies developed are validated by smallholders in the project area in Brong Ahafo, Ghana.</p>	<p>1.1 project reports, monitoring against baseline data</p>	<p>(Purpose to Goal)</p> <p>1.1 Project continues into 2nd phase; collaboration between WRI and KAAP and Ministry of Food and Agriculture, Ghana; cooperation of smallholders in Brong Ahafo; dissemination of outputs continued.</p>
<p>Outputs:</p> <p>1 Identify and prioritise major pre- and post-harvest constraints in horticultural-based systems for shifting and permanent cultivation in low fertility areas</p> <p>2 Identify net income from smallholder-horticulture and options for alternative local crops with potentially greater net income.</p> <p>3 Characterize local vegetable varieties and identify appropriate new varieties</p> <p>4 Develop soil and water management strategies for low-input mixed cropping systems</p> <p>5 Develop strategies for integrated pest-management for low-input mixed cropping systems</p>	<p>1.1 By March 1995 baseline survey on production and marketing systems carried out and case study determining nature and location of losses in vegetables conducted</p> <p>2.1 Preliminary analysis of potential alternative crops identified by March 1995; Follow-up analysis carried out during phase 2</p> <p>3.1 Database established of vegetable varieties with preliminary assessment of quality attributes by March 1995</p> <p>4.1 Soil and water characteristics analysed their management system classified by March 1995;</p> <p>Participatory trials established for soil and water management in at least two sites in phase 2.</p> <p>5.1 Farmers pest and disease management practices and perceptions analysed. Participatory trials established for at least one priority pest by March 1995. Outline IPM manual completed ready for validation by end March 1995.</p>	<p>1.1 Progress reports</p> <p>2.1 Progress report</p> <p>3.1 Progress reports</p> <p>4.1 Progress reports</p> <p>5.1 Project report Outline manual</p>	<p>(Output to Purpose)</p> <p>1.1 Constraints identified are amenable to cost-effective reduction availability of subject specialists on time; participation by farmers and traders.</p> <p>2.1 Availability of relevant data; project continues into phase 2.</p> <p>3.1 Availability of quality seeds or plants; participation of farmers and traders.</p> <p>4.1 Participation by farmers</p> <p>5.1 Surrounding farmers will not destroy natural enemies by excessive spraying of their crops; improved pest management options affordable by farmers can be found and within project time frame; participation by farmers</p>

Step 2: Project Logical Framework GHANA

Narr. Summary (NS)	Measurable Indicators (OVI)	Means of Verification (MOV)	Important Assumptions
6 Develop strategies for improved harvesting, handling, distribution, marketing and processing.	6.1 Draft generic manual on post-harvest handling, storage and distribution completed by March 1995.	6.1 Project report Draft manual	6.1 Data on supplies and prices available Participation by traders and farmers. Continued in phase 2.
<p>Activities:</p> <p>1.1 Review existing literature on horticulture in shifting and permanent production systems with declining fertility and literature on vegetable commodity systems.</p> <p>1.2 Baseline survey of smallholders to characterize the production and marketing systems of vegetables.</p> <p>1.3 Prioritisation of major pre- and post harvest constraints in horticultural-based systems by smallholders.</p> <p>1.4 Case studies to determine nature and location of losses in vegetables with smallholders.</p> <p>2.1 Identify potential alternative crops/varieties based on information gathered in output 1.</p> <p>2.2 Analysis of net income from vegetable production and identification of alternative crops through selected case studies and construction of farm budgets where possible.</p> <p>3.1 Characterisation of local vegetable varieties by farmers, traders, consumers based on their own classification of quality attributes.</p> <p>3.2 Identification of potential new varieties based on information from 3.1</p> <p>4.1 Analysis of soil and water characteristics from case study sites.</p>	<p>Inputs/Resources:</p>	<p>1.1</p> <p>1.2</p> <p>1.3</p> <p>1.4</p> <p>2.1</p> <p>2.2</p> <p>3.1</p> <p>3.2</p> <p>4.1</p>	<p>(Activity to Output)</p> <p>1.1 -</p> <p>1.2 -</p> <p>1.3 -</p> <p>1.4 Case Studies continued in phase 2.</p> <p>2.1 -</p> <p>2.2 Continued through phase 2.</p> <p>3.1 -</p> <p>4.1 Analysis facilities available.</p> <p>4.2 -</p>

Appendix 3: Summary of expenditure (Phase I)

Item	Budget	Actual
Staff costs	£48,425	£43,427
Ghana staff costs	£ 7,830	£ 7,806
Capital costs	£20,120	£20,121
Consumables	£ 2,250	£ 2,412
Overseas Travel and subsistence	£16,370	£15,507
Total	£95,000	£89,273

Appendix 4: Summary of Project Outputs

Project definition phase

- ASHITEY, E.Z., BAKER, D., SUGLO, E.K.J. and WARBURTON, H. (1994)
Report on a rural appraisal of farming systems in Brong Ahafo Region, Ghana,
9 May - 15 June 1994. (Report R2153(S)).
- ORCHARD, J. (1994) Report on a visit to Ghana to discuss the programme definition
phase of the adaptive research initiative in Ghana, 20-25 March 1994.
- POULTER, G. and WARBURTON, H. (1993) Report on a visit to Ghana to discuss
adaptive research proposal with relevant Ghanaian organisations, 14-19
November 1993.
- WARBURTON, H. (1994) Ghana adaptive research initiative: preliminary appraisal
of market opportunities and issues arising from technical change associated
with the proposed adaptive research. (NRI File Note: ESD 92/94
937/097/017A)
- WARBURTON, H., KING, A., POULTER, N. and POULTER, R.G. (1994) File
Note: Visit to Ghana to continue programme definition phase of the adaptive
research initiative programme: 20-30 July 1994.

Phase I activities

- BOADI, S. (1995) Land and water management for vegetable production in Brong
Ahafo Region of Ghana. [Appended to HOLLAND, M.D. (1995) Report on a
soil and water input to the Integrated Food Crop Systems Project, Brong
Ahafo, Ghana: 12 - 26 February 1995].
- BOLFREY-ARKU, G.E-K (1994) Survey on weed management in vegetable
production in the Brong Ahafo Region.
- BRUCE, P. (1994) Agricultural marketing in Ghana [Appended to SCHIPPERS,
R.R., SUGLO, E.K.J., BRUCE, P. and KUFFOUR, S.A. (1994) Report on a
visit to Ghana to discuss the Integrated Food Crop Systems Project in Brong
Ahafo (11-29 October 1994)].
- BURDON, J. File note: Visit to Ghana to gather information for a post-harvest
management manual dealing with vegetables 22 February - 1 March 1995) [File
FS 9294 937/248/060A].
- BURDON, J. Draft Manual for the post-harvest management of vegetables in Brong
Ahafo Region of Ghana.

- CRITCHLEY, B. (1995a) File note: Visit to Ghana to gather material on the IPM of horticultural crops in the Brong Ahafo Region: 15-24 February 1995. (File: 937/097/009A).
- CRITCHLEY, B. (1995b) Draft Manual for the IPM of vegetables in Brong Ahafo, Ghana.
- DELIMINI, L. (1995) The Ghana Seed Industry.
- GOWAN, S.R. (1994) Visit to Ghana to the Integrated Food Crop Systems project in Brong Ahafo region to make a preliminary survey of the root crop nematode problems and identify locations for field work for their bio-control (6-16 November 1994).
- HEMENG, B.M.S. (1994) Nematode: Pests of four vegetable crops in the Brong Ahafo Region, Ghana.
- HOLLAND, M.D. (1995) Report on a soil and water input to the Integrated Food Crop Systems Project, Brong Ahafo, Ghana: 12 - 26 February 1995.
- LYON, F. (1994) Notes on the approaches for on-farm research on the integrated Food Crop System Project, Brong Ahafo, Ghana. File note: 2 December 1994.
- PROJECT MEMORANDUM (1994) Integrated food crop systems project: enhancing smallholder livelihoods through adding value to agricultural production in Brong Ahafo Region, Ghana.
- SCHIPPERS, R.R., SUGLO, E.K.J., BRUCE, P. and KUFFOUR, S.A. (1994) Report on a visit to Ghana to discuss the Integrated Food Crop Systems Project in Brong Ahafo (11-29 October 1994).
- SCHIPPERS, R.R. and DELIMINI, L. (1995) Report on a visit to Ghana for a preliminary study to investigate the possibilities for a vegetable seed industry.
- SHERINGTON, J. and SUGLO, E.K.J. (1994) Baseline survey of vegetable producers in Brong Ahafo Region, Ghana.
- SUGLO, E.K.J. (1994) Report on survey of pest, their importance and control on four vegetables in the Brong Ahafo Region of Ghana.
- SUGLO, E.K.J. (1995a) Integrated Food Crop Systems Project: Enhancing Smallholder Livelihoods through adding value to agricultural production. First quarter report August - December 1994. 30 January 1995.
- SUGLO, E.K.J. (1995b) Integrated Food Crop Systems Project: Enhancing Smallholder Livelihoods through adding value to agricultural production. Second quarter report January - April 1995.

TWUMASI, J.K. (1994) Survey report on the identities, importance, distribution, control/management options of diseases affecting vegetable production in the Brong Ahafo Region of Ghana.

WARBURTON, H. (1995) Visit to Ghana to carry out socio-economic studies for the integrated food crop systems project (26 March - 8 April 1995) [File 9294 937/097/025A].

WARBURTON, H. and LYON, F. (1995) Report on preliminary socio-economic studies for the Integrated Food Crop Systems Project in Brong Ahafo Region, Ghana. NRI Report.

Appendix 5: Terms of reference for Associate Professional Officer

TERMS OF REFERENCE - MR FERGUS LYON APO

NARP, BRONG AHAFO, GHANA, NOVEMBER 1994

Integrated Food Crop Systems Project

1. This adaptive research project managed by NRI is co-ordinated in Ghana in the Brong Ahafo region by the National Agricultural Research Programme (NARP) under the auspices of the Council for Scientific and Industrial Research (CSIR).
2. The project was established in August 1994 to develop and validate improved technical options which are sustainable and appropriate for small holders in Brong Ahafo. Thereby, increasing the returns on horticultural-based systems through reduction in losses and by adding value.
3. The project has appointed an in-country Project Co-ordinator and a Project Assistant who are based in the regional offices of the Ministry of Agriculture in Sunyani, Brong Ahafo. The project description and TOR for the Co-ordinator and Assistant are attached.
4. The APO placement will be for 18 months from November 1994, and will be based in Sunyani, Brong Ahafo. The APO will be directly responsible and managed by the In-country Project Co-ordinator (Mr Vespa Suglo). Supervision from the UK will be provided by Dr N Poulter (Programme Manager Horticulture and Tree Crops) and Dr A Westby (Manager Root and Tuber Crops Programme), with support from the NRI Social Sciences Group.
5. The project consists of various component activities (see appended project outline). The APO would provide support in some of these areas, to be defined following further discussions with the Project Co-ordinator and his team. Mr Lyon's training and experience is most appropriate in support of the participatory research activities which give emphasis to understanding the influences which effect the "research and development" activities of farmers and the utilisation of this knowledge in the development and dissemination of sustainable interventions.
6. Specific TOR will include:-
 - (a) liaison with natural and social scientists in the UK (NRI, UEA etc) and from relevant organisations in Ghana in the planning and implementation of components of the wider programme, expanding particularly on activities 1.1, 1.2 and 1.3 of the project outline.

(b) liaison with community and woman groups to gather more detailed data on the multi-variate social agro-ecological and marketing systems for horticultural produce so as to assist in the development of sustainable approaches to the development and introduction of appropriate technical interventions.

(c) the development of a detailed work programme one month following arrival in Ghana.

(d) preparation of brief, reports and other written materials, including dissemination of project activities as required. Three monthly reports on progress to be prepared in conjunction with Mr Suglo for evaluation by Dr Poulter/Dr Westby and copied to the British High Commission.

7. The APOS will cover the cost of Mr Lyon's stipend, return air travel and accommodation (actuals, estimated at US \$250 month) and appropriate personal and medical insurance. The project will provide all other in-country operational costs associated with project activities, including costs of local transportation, office and laboratory facilities and administration.

8. The British High Commission will seek Government of Ghana clearance, as required.

Nigel Poulter
Programme Manager, Horticulture and Tree Crops