

**NATURAL RESOURCES SYSTEMS PROGRAMME**  
***FINAL TECHNICAL REPORT***

**DFID Project Number**

R7992

**Title**

Evaluation of 'Improved vegetable production in the forest-savanna transition zone, Ghana: With special reference to the maintenance of soil fertility' (An output from NRSP project R6789) for use by agricultural extension agents

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# **NATURAL RESOURCES SYSTEMS PROGRAMME (NRSP)**

## **FINAL TECHNICAL REPORT (FTR)**

**DFID Project Number R7992**

### **Project Title**

Evaluation of Improved Vegetable Production in the Forest-Savanna Transition Zone, Ghana: With Special Reference to the Maintenance of Soil Fertility' (An Output From NRSP Project R6789) for use by Agricultural Extension Agents.

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**Duration:** One year

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## Executive Summary

The publication is the Final Technical Report (FTR) of project R7992, entitled ‘Improved vegetable production in the forest-savanna transition zone, Ghana: with special reference to the maintenance of soil fertility’ (An Output From NRSP Project R6789) for use by Agricultural Extension Agents). Project R 7992 was designed to disseminate new knowledge and technologies that vegetable farmers can use to improve soil fertility, incomes and livelihoods. The report gives a summary of outputs against the stated purpose, objective verifiable indicators (OVIs) and milestones specified in the logframe. It provides information about achievements and problems encountered as well as lessons learnt during project implementation.

The manual, produced in collaboration with the Crop Post-Harvest Section of the Integrated Food Crops Systems Project and MOFA was meant for use as a training manual for extension workers of MOFA to train farmers (Kiff, *et al* 2000). The demand-led research addresses the gap between research and dissemination or knowledge and actual practice by farmers and it was designed to utilize the manual as an entry point to improve dissemination of new knowledge and technologies to vegetable farmers in Brong Ahafo Region.

The project purpose is to secure livelihoods of poor people dependent on agricultural systems at the FAI through soil fertility improvement. The project was designed to improve the technical knowledge and understanding of AEAs and farmers about new farming practices to improve soil fertility and thus contribute to DFID’s priority objectives of improving rural livelihoods and reducing poverty in FAI.

The target groups are MOFA extension agents and NGOs such as Women in Need Foundation Ghana (WINFOG), and dry season vegetable producers in Brong Ahafo Region. The dominant vegetables are tomatoes, chilli-pepper, garden-eggs and okra. The project outputs include:

- Review of the manual
- Training and development of technology promotional materials to improve knowledge, awareness and skills of AEAs and farmers.
- A curriculum developed for MOFA training

- Research reports produced by students of Sunyani Polytechnic

Most of the verifiable indicators have been achieved and the project has been able to inform policy makers about the need to provide adequate support to the extension service. The major achievements of the research include evaluation of the manual leading to training modules for training AEAs. Improved technology dissemination strategies have been developed and promoted.

Compost and animal manure suited to vegetable production have been assessed, field-tested with test farmers, along side neighbouring farmers. The potential of green manures, animal manure and compost has been established and vegetable producers have accepted these new technologies to improve soil fertility and productivity. A draft curriculum has been developed for MOFA training programmes. Training Guides are being developed for AEAs and farmers. Lastly, capacities for research and extension have been developed at Sunyani Polytechnic and within MOFA respectively.

## **Acknowledgements**

This demand-led research which aims to disseminate technology and ‘deliver new knowledge’ to improve vegetable production is designed to contribute to DFID’s goals within the RNRRS Production System, especially poverty eradication through improvement of soil fertility, incomes and livelihoods of poor people (NRSP-Programme logframe, 2001). The report is an output from a research project funded by the DFID of the United Kingdom that cannot accept responsibility for any information provided, errors made and views expressed by the author.

The research was carried out by a multi-disciplinary team of researchers consisting of Dr. Kwasi Nsiah-Gyabaah, (Principal investigator), and Dr. Christine Okali (Overseas research collaborator). Others include Dr. Agbeli (MOFA Veterinary Officer, Sunyani), Dr. Hans Adu-Dapaah- (Plant Breeder, CRI, Kumasi), Mr. Felix Blay (Regional Human Resource Development Officer, MOFA, Sunyani), Mr. Duut Nelson (Land And Water Management Project Officer, MFA Sunyani), Mr.J.K. Appiah (Regional Development Officer (Crops), MOFA Sunyani).

The rest are Mr. Stephen Awiti Kufforu (Post Harvest Officer, MOFA Sunyani), Mr. T.O. Larbi (Regional Plant Protection Development Officer, MOFA, Sunyani), Mrs. Ernestina Freduah Antoh Sociologist/ Gender Specialist (BIRD, KNUST- Kumasi), and Mr. Osei Fofie (Resource Planner, Sunyani Polytechnic). The interest and efforts of the resource personnel are acknowledged.

The research could not have been carried out without the research collaborators extension staff of MOFA and farmers. Grateful thanks are extended to all the stakeholders especially the Regional and District Directors of MOFA in Brong Ahafo Region and the extension officers who worked with contact farmers in the pilot project areas.

Most important of all, thanks go to the DFID for providing funds for the research not forgetting those who gave their time and volunteered to be used as ‘Contact Farmers’ and who helped either directly or indirectly to disseminate new technologies by sharing information with their colleagues and the general public as well as using their farms to serve as demonstration sites.

## **BACKGROUND**

In Ghana, many governmental non-governmental organizations (NGOs) have supported high quality research leading to development and evaluation of new technologies and improved practices in agriculture. However, a source of disappointment and frustration is that there is an enormous gap between technology development and dissemination. The vast majority of farmers, especially small-scale farmers in the rural areas, have no access to agricultural information about improved technology developed by research due to inefficiencies in the extension service. Consequently, research has had little or no impact on actual farmer practices or technologies used by small-scale farmers. This is believed to contribute to low crop yields, declining soil fertility and increased poverty especially among small-scale farmers.

Thus, in the context of DFID's objective to alleviate poverty, it is the gap between knowledge and practice that the research addresses. The research utilizes the manual as an entry point to improve information dissemination practices of extension workers in Ministry of Agriculture (MOFA) in Brong Ahafo Region in Ghana. The emphasis is on farming methods and technologies to improve and maintain soil fertility in order to improve vegetable production.

## **PROBLEM STATEMENT**

There is a major gap in the dissemination of new knowledge/ technology and research findings in respect to soil fertility for improved agricultural production in Ghana. The research fills this gap by developing initiatives to train and strengthen capacities within MOFA, improve dissemination strategies and ensure that appropriate and effective pathways are developed to improve vegetable production in Brong Ahafo Region.

## **GOAL**

The goal is to develop and promote strategies that would secure livelihoods of poor people dependent on agricultural systems near the receding forest margins (See NRSP Logframe).



## **PROJECT PURPOSE**

The overall objective of the research is to improve information dissemination practices for particular institutional, and socio-economic settings in Ghana, with a particular focus on soil fertility improvement for vegetable production. Other important objectives are:

- To evaluate and field-test the manual (output R6789) and make recommendations appropriate for different dissemination strategies for the manual or parts thereof
- Describe and analyze dissemination strategies within MOFA with a view to strengthening dissemination capacity within the institution
- Strengthen research capacities within Sunyani Polytechnic
- Develop a training curriculum for agricultural extension agents based on the manual.

## **OUTPUTS**

The research has contributed to the development, testing and evaluation of extension material and dissemination strategies including PTD&E, leaflets, bulletins, videos, radio programmes etc.

The project had four main outputs. These include:

1. Improved understanding of dissemination issues within government and NGOs in Ghana.
2. Specific dissemination strategy for MOFA developed and tested.
3. Research capacity of Sunyani Polytechnic and extension within MOFA enhanced.
4. Curriculum for MOFA training developed

An important output of the research is the establishment of a network of research partners. Recommendations based on the knowledge generated from the field-trials, demonstrations and farm visits and the promotion of Participatory Technology Development and Extension (PTD & E) methods for effective dissemination of information and transfer of technologies to AEs and farmers to improve vegetable production in Brong Ahafo Region. Through the project, farmers have acquired information and new knowledge of low-cost, viable alternatives to improve and maintain soil fertility using organic fertilizers (e.g. *mucuna*, compost, poultry manure etc.).

Another key output of the research is the description and analysis of dissemination strategies within extension institutions in Ghana and recommendations for policy and advocacy,

strengthening of capabilities to improve extension within MOFA, strengthening of research capacities in Sunyani Polytechnic and development of curriculum to train AEAs and farmers.

## **PROJECT ACTIVITIES**

The important activities undertaken during the inception phase were establishment of network of partners, review of the manual and development of modules for training AEAs and subsequently, farmers. The major activities include:

- (1) Description and analysis of present dissemination practices (extension strategy, media etc) of different organizations including MOFA, , Wenchi Farm Institute, CRI etc. (See logframe)
- (2) Review of material in the R 6789 manual and attached leaflets and prepared materials for field-testing and dissemination of information about new technologies and improved practices to farmers.
- (3) Preparation of MOFA strategy for dissemination (i.e. specific to MOFA resources and clients) of manual components; detail material testing approach including criteria for selecting pilot project districts, contact farmers and AEAs to pilot test the manual.
- (4) Testing of MOFA dissemination plan; testing materials in different organizations – MOFA, Farmer Field Schools (FFS), Wenchi Farm Institute.
- (5) Evaluation of MOFA dissemination plan, and materials for information transfer (efficacy of training using posters/ leaflets; plan viability in different institutional settings; comparative costs of alternative strategies (e.g. posters, FFS/ Contact farmers etc.).
- (6) Finalization of MOFA curriculum and agree on materials (form etc. for specific clients).
- (7) Preparation and documentation of lessons learnt, prepare paper for publication and writing of dissertations in partial fulfilment for the award of Higher National Diploma (HND).certificates to students of Sunyani Polytechnic.

## **CONTRIBUTIONS TO OUTPUT**

The contributions of the project outputs to poverty alleviation may be assessed from the research accomplishments (i.e. review of the manual) and the technologies disseminated to farmers. The research has contributed to the goal of improving vegetable production in target communities and introduced farmers' effective ways to improve soil fertility.

The main contribution of outputs to project goal is the dissemination of effective, low-cost technologies including the use of green and animal manures (mucuna, compost, poultry manure) to improve and maintain soil fertility. On-farm trials and demonstrations have broadened farmer's understanding and knowledge of organic fertilizers as alternatives to chemical fertilizers. It has also provided improved farmer's capacity to select seeds, apply chemical fertilizers and prevent post-harvest losses.

Other landmark achievements include:

- Network of research partners and extension links established between MOFA, CRI and Sunyani Polytechnic
- Regular contacts of AEAs and farmers established
- Manual has been pilot-tested leading to increased knowledge and awareness of SMSs and AEAs about new technologies and practices to improve soil fertility
- Good nursery practices and post-harvest crop handling and storage promoted
- Pest and disease control measures identified and promoted
- Institutional Collaboration achieved and dissemination strategies in government institutions (e.g. MOFA) and non-governmental organizations (e.g. GOAN) described, analyzed and promoted
- Policy recommendations for effective extension education and advocacy to strengthen capacities within MOFA extension service established
- Research capacity in Sunyani Polytechnic strengthened and preparation towards commencement of HND General Agriculture in Sunyani Polytechnic has started.

## **ACHIEVEMENTS**

The project leaders have followed systematically the logical framework to achieve project objectives. The project inception phase set up a network of research collaborators and established contacts with stakeholders involving MOFA, Crops Research Institute (CRI), Sunyani Polytechnic) and NGOs (e.g. GOAN, WINFOG) and farmers. Following consultative meetings with the management team, the logframe was finalized and agreed, the manual was reviewed, and criteria for selecting pilot project districts, farmers and AEAs to pilot test the manual was outlined.

The landmark achievements of the research include:

### *Review of manual and development of training modules*

A manual entitled 'Improved vegetable production in the forest-savannah zone, Ghana: with special reference to maintenance of soil fertility' an attached leaflets, an output from NRSP R 6789 for use by AEAs, have been reviewed by a multidisciplinary team of experts including Subject Matter Specialists (SMSs) from MOFA.

Training modules have been developed and have been used to train AEA's in Nkoranza and Jaman Districts. The review identified many weaknesses of the manual. Firstly, the manual was found to be unsuitable in its original form for AEA training because it is too technical in content to be understood by AEAS and for it to be used as a guide for farmers. Secondly, the manual contains unnecessary and irrelevant details and some of the illustrations are not clear to enable farmers to do it your-self (DIY).

Thirdly, some of the technologies were not tested on farmers' fields under their own conditions. Fourthly, AEAS were not trained to use the manual as extension material. Finally, many AEAs lacked knowledge about some of the recommendations– e.g. the use of Mucuna, how to prepare compost, etc.

### *Training of AEAS*

Training was aimed to strengthen MOFA extension service by increasing the knowledge and skills of AEAs and designing effective strategies to disseminate technology and new knowledge to farmers.

### ***Pilot testing of manual***

Demonstrations, field visits and trials have been carried out to increase knowledge and capacity of AEAs to disseminate the technologies and new practices including composting, and incorporation of animal and green manure (e.g. *mucuna*) into farming systems in order to improve soil fertility. The pilot testing of the manual has facilitated technology dissemination and promotion of new practices to front line staff of MOFA.

### ***Extension services***

Appropriate technologies to improve productivity, select and store seed and improve post harvest handling packaged for farmers. Extension services within MOFA and in target districts strengthened

### ***Networking***

Networking among other project teams to alert them to the project objectives, to exchange ideas and information and to explore the scope for collaboration where possible.

### ***Capacity building***

Research capacity strengthening within MOFA and Sunyani Polytechnic through training workshops and research support to staff and students

### ***Workshop to develop a curriculum***

Curriculum has been developed which would be discussed and finalized at a final workshop. To ensure that the MOFA would use the curriculum in its training programmes, all the District Directors and the Regional Director of Agriculture were brought together to develop the curriculum. Experiences from previous training programmes were discussed and lessons learned were incorporated in the curriculum. The curriculum would be finalized after MOFA has been given the opportunity to use the curriculum for training in the districts. The final workshop, planned for the next phase of the project would finalize the curriculum.

### ***Sustainable technologies to improve soil fertility promoted***

Through the workshops and demonstrations, AEAs have been able to improve their knowledge and skills to improve soil fertility. The involvement of farmers in the evaluation, verification trials and dissemination of the technological packages has improved farmers' knowledge about the beneficial effects of compost, animal (poultry) and green manures in soil fertility improvement.

Through regular farm visits, AEAs have been offering extension advise to farmers during periodic visits, demonstrations and follow-ups. This has helped to upgrade the technical and managerial skills in managing their vegetable farms.

Farmers who did not use these technologies before have accepted them as viable alternatives to soil fertility improvement and a few have started preparing compost heaps while others have planted *mucuna* on their farms and are waiting for the next dry-season cropping period (October-March, 2002).

AEAS have shown keen interest in extending the new knowledge to farmers and they have themselves established demonstration plots where they are planting *mucuna* as cover crop to suppress stubborn weeds including spear grass. They are also applying and promoting animal manure (poultry) and establishing compost heaps for incorporation into the soil to improve soil fertility. AEAs have also improved their communication skills and in participatory strategies to promote and disseminate new technologies and improved practices to farmers.

### ***Good nursery practices, post-harvest crop handling and storage promoted***

Information about improved nursery practices have been disseminated. Spraying techniques and safe use of agro-chemicals have been disseminated to farmers. Good nursery practices and pest control using *neem* leaves are significant achievements in technology adoption. AEAs have also carried out verification trials and demonstrated improved crop varieties to farmers. Improved seed selection, extraction and post-harvest crop storage techniques including the construction and use of simple solar dryers have been promoted. There is increased awareness about the potential of *African merigold* to control nematodes.

### *Pest and disease control measures identified and promoted*

Vegetable diseases and pests have been managed mainly through the application of pesticides. Farmers have been introduced to the use of *neem* leaves for spraying and African Merigold to control nematodes.

### *Institutional collaboration*

Present dissemination practices (extension strategy, media etc) of different organizations including MOFA, Wenchi Farm Institute, Crops Research Institute (CRI) and NGOs have been described and analyzed. A high level of institutional collaboration and coordination has been developed between institutions that worked in isolation MOFA, Sunyani Polytechnic, an NGO, schools, Department of Co-operatives, farmer associations in project communities, CRI, BIRD have been brought together to work as a team to assist farmers to improve vegetable production.

### *Demonstrations to improve soil fertility*

Both pit and heap compost making methods have been carried out on communal sites with active participation of farmers. Verification trials and demonstration plots have been established in the pilot project communities and in Sunyani Polytechnic. The demonstration sites are not just places. They represent an association of farmers, extension agents and researchers and distinctive set of ideas about how to work with farmers in the management of land, and how to disseminate information to farmers. It is based on mutual respect, common purpose and drawing in the participation of farmers. The project disseminates new technologies through contact farmers and demonstrations.

Compost and animal manure suited to vegetable production have been assessed, field-tested with contact farmers. The potential of green manures, animal manure and compost to improve soil fertility has been established and vegetable producers are conducting trials with poultry manure, compost etc. to improve soil fertility and productivity.

### *Capacity building and institutional strengthening*

Research capacities in Sunyani Polytechnic have been developed through student participation in research activities related to development communication skills. Twenty students from the Marketing Department are being assisted to undertake research in various topics related to

marketing and storage of vegetables. The integration of Junior and senior secondary schools in project implementation is an important strategy to dissemination technologies to the youth in agriculture.

#### *Workshops for AEAS and farmers*

Training workshops have been organized to train AEAS to disseminate information on improved technologies to farmers. The training workshops involved theory/classroom work, group discussions and presentations. Demonstrations on compost, green manure, seed selection and processing were carried out. Among the topics of great interest to participants were the role of compost and green manures in soil management, the mode of preparation and application of compost, the importance of poultry manure in soil fertility management.

Field visits and verification trials for mucuna, poultry manure etc. were carried out to establish the positive effects of organic manures as opposed to inorganic with regard to soil fertility at the GTZ/ITCP and Sunyani Polytechnic demonstration sites. As a follow-up to the training, AEAs were encouraged to set up demonstrations in the villages where they reside and use that to create awareness and disseminate the technology to farmers in their operational areas.

#### *Management, monitoring and evaluation*

Financial management, monitoring and reporting and evaluation has progressed steadily.

### **PARTICULAR DIFFICULTIES ENCOUNTERED DURING PROJECT IMPLEMENTATION**

MOFA is poorly resourced and the staff is poorly paid. As a result, MOFA technical staff, who were being assisted to perform their roles effectively, were not prepared to work without being paid some allowances. It was therefore not surprising that MOFA technical staff preferred to attend other training workshops that gave high sitting, out-of-station and transport allowances to participants.

Lack of logistics especially transport impeded the movement of AEAs who had to be supported with basic agricultural tools and transport allowances. The limitations of weather, especially drought problems or water shortage, affected dry season- vegetable production by limiting the



period of monitoring and has delayed the testing and evaluation of the training and extension materials including the user guides/leaflets, radio programmes etc.

### **UNACHIEVABLE OBJECTIVE VERIFIABLE INDICATORS (OVIS)**

Three activities could not be carried out because of the short duration of the research and weather conditions that have limited the farmers to early dry season vegetable production.

The unachievable OVI's include:

- Assessment of impacts- of dissemination strategies and the leaflets
- Cost-benefit comparison of different strategies (e.g. farmer field schools vs. contact farmers).
- Final Workshop (see Logframe)

#### *Assessment of impacts*

Monitoring of perception and attitude changes has delayed because farmers have not been able to apply the new technologies under their own conditions. Due to water constraints, the farmers were unable farm beyond December. Consequently, the green manure and compost were not ready for incorporation into the soil before the early planting season was over. Thus, assessment of the impacts of the training and dissemination strategies on farmer practices and livelihoods has been delayed. Consequently, production of additional material in the form of guidelines for use by AEAs and farmers has been delayed.

#### *Cost-Benefit Analysis*

Cost-benefit analysis has been delayed due to our inability to observe and assess farmers' responses to the technologies and for 'best practices' included in the leaflets and guidelines to be evaluated.

#### *Final Workshop*

The final workshop would allow the districts to use the curriculum in their training programmes, AEAs and farmers to give feedback on the technologies and ensure end of project evaluation.

## **SIGNIFICANT FINDINGS AND LESSONS LEARNT FROM THE RESEARCH**

The series of consultative meetings and farmers assessment of the technologies show that farmers recognize the significant potential of compost, green and animal manures as viable alternatives to chemical fertilizers. The increased awareness of the potential of these technologies is important to facilitate widespread technology adoption.

### **INFORMATION GAPS**

Two main weaknesses in information dissemination were identified. These include:

- The gap between technologies developed to improve soil fertility and indigenous technical knowledge (ITK) or actual practices by smallholder vegetable producers.
- Lack of suitable methods to communicate and transfer the available knowledge to users, particularly illiterate farmers.

### **THE MANUAL**

Two lessons were learnt from the review of the manual:

- Printed instructions that take the form of appropriate or suitable illustrations can cover considerable gap in information dissemination and technology transfer
- Aspects of the manual, is synthesized and the illustrations improved for specific target group, could be an effective, low-cost method to disseminate technology and new practices to farmers.
- The manual cannot be used for training farmers in its original form.

Although the manual was found to be unsuitable for training farmers in its original form, it is a useful reference material for senior and technical staff of MOFA. It is also a useful source of reference for researchers, teachers and research students pursuing programmes in Agriculture, soil science, and environment. It is therefore recommended that the manual may be distributed to relevant institutions and libraries including:

- Universities- Faculties of Agriculture and libraries at KNUST, University of Ghana, Legon, UDS, UCC, Winneba, KSTCs
- Agricultural Colleges-Wenchi Farm Institute, Kwadaso Agricultural College.
- CSIR – Crops Research Institute (CRI), Soil Research Institute (SRI) and Savannah

- Agricultural Research Institute (SARI).
- FAO Documentation Centre (ACCRA)
- UNDP Library, Accra
- Regional and District Directors of Agriculture
- Polytechnic Libraries, Sunyani, Tamale, Kumasi, Koforidua, Takoradi, Cape Coast, Ho
- British Council Library, Accra
- NGOss- GOAN, WINFOG, IWMI

## **VEGETABLE PRODUCTION**

The research showed that dry season vegetable production is an important agricultural activity that provides employment and income for poor households in Brong Ahafo Region. Two local tomato varieties, 'Raino' and 'Power' are the most important vegetables produced by farmers. Other vegetables produced include garden eggs, pepper, okra and onions. Major factors that limit the yields of dry season vegetables are low soil fertility and stress resulting from inadequate soil moisture (water) and high temperatures.

## **STATUS OF SOIL FERTILITY AND AGRO-CHEMICAL USAGE**

The field reports have confirmed that soil fertility has been declining and this is related to low organic matter, low phosphorous levels and high acidity. To increase crop yields, farmers use inorganic fertilizers, which have the advantage of relatively obvious, immediate effects on crop yields but long-term destructive effects on soil productivity. Farmers are aware of the limitations of the farming systems (continuous soil mining) but are constrained to address the problem by financial and land tenure constraints and, to some extent, by lack of knowledge about simple techniques to solve the problem.

## **PESTS AND DISEASE CONTROL**

Pests and diseases constitute a serious limitation to vegetable production. During the farm visits, the tomato farms showed symptoms of various diseases particularly leafspots and early blight indicating the presence of nematodes and the presence of the fungal pathogen *Septoria lycopersia* and *Alternaria solani* (Critchley, 1988). However, farmers could not determine whether the pests and diseases were seed-borne viruses or the result of poor quality seed. Consequently,

indiscriminate usage of agro-chemicals especially Karate for tomato and garden eggs is common in the region.

It was also observed that there was unnecessary use of pesticides when diseases rather than insects were the major pests. Farmers could not tell whether the problem was caused by nutrient deficiencies in the soil or were due to other problems unrelated to soil fertility decline. There is the need to undertake further research and intensify information about other technologies such as crop rotation, development and cultivation of disease and pest resistant varieties.

The farmers indicated that without application of fertilizers and pesticides, they would not get satisfactory yields or vegetables of good quality to sell during the dry season because vegetable production is a risky business in the dry season due to pests and water limitations. Farmers complained about the high cost of agro-chemicals and pesticides for disease control (Critchley, 1988, 2000; Moss *et al*, 2001).

There is much to be concerned about indiscriminate use of fertilizers without recourse to soil testing to improve soil fertility and pesticides to control pests and diseases. Although many farmers are aware that pesticides are poisonous, they do not use protective clothing or gloves and shoes when applying chemicals. Farmers need more education and advice on the dangers of mixing pesticides with their hands and safer agro-chemical application procedures. The high cost of fertilizers and pesticides provides a great opportunity to promote new low-cost technologies to improve soil fertility and increase yields.

## **INSTITUTIONAL WEAKNESSES AND INFORMATION DISSEMINATION**

At present, MOFA operates under serious resource constraints. There are not enough AEAs and many do not have sufficient training. The extension officer/farmer ratio is low (average 1:1,500). Low salaries, lack of transport, incentives for extension agents and logistic support (such as stationery, computers, etc) are institutional constraints that consign extension workers to low achievement and performance in farmer education.

Although a major interest of MOFA is directed towards more information and better education of farmers, MOFA cannot sustain the interest of farmers beyond the pilot phase of the project without adequate resources and logistic support to carry out its extension work. A solution to the

problem of inefficiencies within MOFA extension service is beyond this project but it is up to government to address the resource constraint under which MOFA is currently operating.

### **KNOWLEDGE ABOUT ORGANIC FARMING AND USE OF INORGANIC FERTILIZERS**

The use of organic fertilizers especially compost, green manure, poultry manure was not widespread because farmers were not aware of the potential of organic fertilizers in long-term maintenance of soil fertility. Now, the farmers participating in the project are aware that poultry manure can be used as an alternative to fertilizers in the production of vegetables. They use, general management and integration of organic fertilizers into their farming system and are deriving maximum benefits.

The value of poultry manure has been established and the general view of farmers is that the poultry manure plots are better in terms of growth and yield. However, transporting the manure is too labour demanding especially where the farms are located far away from the village (e.g. 3km).

### **USE AND HANDLING OF CHEMICAL FERTILIZERS**

Firstly, chemical fertilizers are commonly used in vegetable production. However, farmers lack adequate knowledge about their handling. While the AEAS are educating farmers to use organic fertilizers, they are also educating farmers on the negative effect of fertilizers. They are also training the farmers to handle and manage them to prevent the negative effect of fertilizers on their health and on the environment.

Secondly, chemical fertilizers are expensive and at present the returns are so poor (due to poor food prices) that farmers would use organic matter as an alternative fertility enhancement strategy.

### **SEED SELECTION AND INTRODUCTION AND USE OF MUCUNA**

While farmers have been introduced to sources of reliable seed supply, they have been trained to do their own selection and process seeds for planting. This has led to reduction in production cost. The benefit of cover crops especially Mucuna for weed control and soil fertility improvement was unknown. Now farmers have been taught to use Mucuna to control weed such

as spear grass. Mucuna trial fields have been established at both Jaman and Nkoranza districts by ‘contact farmers’.

### **PROBLEMS FACING VEGETABLE FARMERS:**

Although dry season vegetable production attracts high prices and there is a ready market for farmers, the extremely variable weather conditions make vegetable production a risky enterprise. Because of the weather conditions, farmers need reliable source of water supply. Farmers identified and ranked the problems facing them as follows:

1. Inadequate supply of water during the dry season
2. Poverty, lack of capital and credit
3. Low price and poor marketing facilities especially during bumper harvests
4. High cost of agro-chemicals (fertilizers and insecticides)
5. Poor extension services
6. Lack of seeds of improved vegetable varieties

### **POVERTY**

It was also realized that the poverty level of the districts is very high and this affects the adoption rate of technologies by farmers. There is therefore the need to introduce technologies that do not put additional financial burden on farm households. MOFA has not been effective in farmer education because it is constrained by lack of qualified personnel, effective dissemination strategies and weak research extension linkage and poor logistic support. In Brong Ahafo region, extension officer farmer ratio is low (1:1,500). This has made it difficult for some farmers to be reached by extension staff.

### **PREVIOUS ACHIEVEMENTS**

A detailed PRA study of four representative but contrasting dry season vegetable growing areas in Brong Ahafo region identified declining soil fertility as a major constraint in dry –season vegetable-based systems (David Jackson, Lizkiff, 1999). However, the issue of water, a critical factor, in dry-season vegetable production has been ignored with very serious consequences on producers ability to take advantage of ready market and high producer prices of vegetables in the dry season.

## **LIMITATIONS OF THE RESEARCH**

The main constraints that affected project implementation but which were outside the control of extension officers were:

- Water shortage
- Poor pricing and marketing facilities

The research has confirmed that declining soil fertility and lack of water are the major problems facing dry season vegetable producers in Brong Ahafo Region. However, the technologies disseminated address the soil fertility constraint. The problem of water has not been solved and remains a serious constraint to improved vegetable production. Unless research efforts are made to strengthen community and farmers capacities to manage water (common pool resources) in wetlands, technology dissemination to improve dry season vegetable production to benefit poor people in the FAI would prove illusive.

## **FOLLOW-UP ACTIVITIES AND THE WAY FORWARD**

Three main areas for future research identified include:

- Development and Promotion of Farmers Guidelines for Soil Fertility Improvement
- Technology Monitoring and Evaluation

## **SUSTAINABLE MANAGEMENT OF WATER IN WETLANDS FOR IMPROVED PRODUCTION OF VEGETABLES**

Development and Promotion of User Guides (Leaflets) on Soil Fertility Improvement

The project is expected to develop, pilot test, disseminate and promote easy-to-read extension literature on appropriate technologies, best practices' and improved agricultural practices (e.g. composting, land preparation, seed selection, safe handling and application of agro-chemicals and post-harvest handling of crops etc.) with graphics and pictures for easy reading and understanding to enhance adoption of viable technologies.

Video clips of extension activities would be taken and 'best practice guidelines' would be documented and used as a reference source for farmers and AEAs.

## **TECHNOLOGY MONITORING AND EVALUATION**

We need to understand the effects of technology on vegetable production, yields, incomes and livelihoods of farmers. We also need to understand the difficulties associated dissemination and adoption based on the leaflets and training guides as well as farmers' interests in adopting and sustaining the technologies especially during the dry season.

Therefore, more work needs to be done on the development, preparation of leaflets and dissemination of information in the leaflets. The aim is threefold:

- To disseminate key practical findings and 'best practices' from the project directly to farmers and extension agents.
- To strengthen MOFA staff capacity to produce suitable extension materials for dissemination to literate and non-literate farmers.
- To provide a source of reference material for extension agents and farmers.

One set of leaflets would be developed for AEAs to train farmers and another for use by farmers. The farmers guide should be well illustrated and easy- to –use by farmers without assistance. Farmers and AEAs must be given the opportunity to comment on the leaflets (suitability of the illustrations) so that the content will reflect their perspectives, and feel part of its development and design so that the leaflets would be more acceptable to them.

The leaflets would be designed around the following topics:

1. Farmers Guidelines to Compost Production
2. Farmers Guidelines to Green manure Preparation
3. Farmers Guidelines to Seed Selection
4. Farmers Guidelines to Nursery Establishment
5. Farmers Guidelines to crop storage
6. Farmers Guidelines to Application of Agro-chemicals

Perception changes can be monitored and evaluated if farmers have the opportunity to try technologies introduced to them under their own conditions. There is therefore a strong justification for the project to be extended to Phase Two so that follow-up evaluations can be carried out of the leaflets and technologies being disseminated.



This purpose is to monitor technology performance and perception changes, assess the effects of the technologies on farmer practices, changes in farmers' attitudes and the knowledge gained by participating farmers from the farm trials and demonstrations.

## **RECOMMENDATIONS**

Although demonstrations have shown that the technologies being disseminated (i.e., compost, green and animal manures) have the potential to improve soil fertility and increase productivity, more on-farm experimentation by and with farmers and FFS are required to broaden the farmer's understanding of farm management and improve his skills in adapting the technologies to meet their needs.

## **EDUCATION**

Promote intensive education, training and extension programmes in soil conservation, water management at community, district and regional levels using various communication media electronic print, radio, FFS, videos, seminars/workshops etc. Collaboration with pre tertiary and tertiary institutions would lead to wider dissemination of the technologies and new practices in the target communities.

## **STRENGTHEN MOFA EXTENSION SERVICE**

The accomplishment of the tasks and DFID priority objectives calls for well-trained, well equipped and motivated personnel capable of developing, adapting and dissemination technologies that promote the sustainable use of land and water resources. One way to forge links between extension workers and farmers is to encourage extension agents to visit farmers regularly and organize community forum before the crop season. This will help farmers to overcome problems before they get out of hands. However, building the needed capacity and strengthening MOFA extension service requires more logistic support to the sector by government.

Government and NGOs should support and improve infrastructure (financial, physical, personnel and administration), provide incentives for AEAs and develop initiatives to train and support extension services especially MOFA

MOFA extension agents need further training to be able to transfer the technologies in the manual to farmers. They need training in communication skills and clear understanding about new technologies and improved practices.

### **ENFORCEMENT OF BY-LAWS**

Increase awareness and enforce by-laws regarding farming at the watershed level. Educate farmers to stop farming close to rivers and streams (allow farming at least 50 meters away from the stream).

### **SCHOOL CURRICULUM**

Encourage and support pre-tertiary and tertiary institutions to promote sustainable agricultural practices by including it in the curriculum. Support Farmers Field Schools because they have been identified as important tools for closing the information gaps.

### **DEVELOP AND PROMOTE SIMPLE PROCESSING AND STORAGE TECHNOLOGIES**

Improving soil fertility to improve vegetable production may only provide substantial cash benefits to farmers if they are able to process or store their vegetables (e.g. tomatoes) and wait until the price rises before selling it. This requires adequate storage and processing technologies that may increase the shelf life and minimize post harvest losses.

### **FOLLOW-UP RESEARCH PROJECTS**

From the workshops and farmer training programmes, two research projects have been identified.

There include:

- Management of water resources in wetlands for improved dry season vegetable production
- Development and dissemination of rain-harvesting technologies for dry season vegetable production

#### **Project Title**

**SUSTAINABLE MANAGEMENT OF WATER (COMMON POOL RESOURCE) FOR IMPROVED VEGETABLE PRODUCTION IN WETLANDS**

The sustainable management of water is crucial for a large number of vegetable producers in Brong Ahafo Region. During the dry season, vegetable production takes place in bottomlands or wetlands because farmers face the problem of inadequate water supply. Scarcity of water shortens the period of cultivation to the early part of the dry season (October-December).

Competing demands for water for irrigation, watering of vegetables and domestic purposes and farming close to water bodies create conflicts between vegetable producers and other consumers. Unfortunately, research to understand the competing demands, the conflicts and institutional processes for regulating water utilization and resulting conflicts are lacking.

Although rain harvesting technologies have been used for decades to provide water for irrigation and consumption, the technology is not used by farmers who live in the semi-arid areas where insufficiency of rainfall and moisture limit crop production to the main rainy season. The dissemination and promotion of rain-harvesting techniques would go a long way to improve water supply for dry season vegetable production in the forest-savannah transition zone.

## **CONCLUSION**

The research has clearly demonstrated that vegetable production is a very important and desirable economic activity with many advantages for producers and consumers. It contributes to food security, creates employment especially during the main off-farming season, and provides income for poor households. Given adequate support, MOFA extension agents can assist farmers to adopt new technologies that can improve soil fertility, improve yields and income and reduce poverty.

However, dry season vegetable production is a risky business because of limitations of water. Farmers' access to water should therefore be given urgent attention with support to research into sustainable management of micro-water catchments for improved vegetable production.

Lastly, changes in the extension policy require a pro-active approach to the retraining of extension staff presently in the field. SMSSs and AEAs with livestock bias would need further training in crops and those in crops would need training in livestock so that the technical staff of MOFA would be able to understand and be able to deal with agricultural issues in its entirety.

## ANNEX A

### Log frame activity reference and purpose addressed

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
<p><b>Goal:</b> Strategies to secure the livelihoods of poor people dependent on agricultural systems near the receding forest margin developed and promoted.</p>	<p>By 2002 new approaches to improve fragile soils of low fertility in humid forest zones validated.</p>	<p>Data collected and collated by the programme manager</p>	<p>Enabling environment for farmer investment exists.</p>
<p><b>Purpose:</b> Improved information dissemination practices for particular institutional and social and economic settings in Ghana.</p>	<p>By March 2002</p> <ul style="list-style-type: none"> <li>- Information on improved soil and water management practices for different categories of farmers in the FAI integrated into a dissemination strategy for at least one organization.</li> <li>- Information on improved soil and water management assessed by at least three different organizations, 10 trainers, 100 field staff and 500 farmers.</li> <li>- Capacity of one regional organization to develop and research information materials and dissemination strategies enhanced.</li> </ul>	<p>Project reports</p>	<p>Organizations have some resources (financial, social etc.) for dissemination.</p>
<p><b>Outputs:</b></p> <p>1. Improved understanding of dissemination issues within government and non-governmental organizations in Ghana.</p> <p>2. Specific dissemination strategy for MOFA developed and tested.</p>	<ul style="list-style-type: none"> <li>- Report on present dissemination practices in at least two agricultural service organizations prepared by end July 2001.</li> <li>- Dissemination materials (e.g. from other organizations) covering the subjects within the R6789 manual assembled by end July 2001.</li> <li>- Lessons for MOFA and dissemination in general prepared by March 2002.</li> <li>- Dissemination plan for R6789 manual information agreed and materials prepared by July 2001 (training modules/ materials for EAs and farmers; poster; leaflets etc.) for testing.</li> <li>- Max. of 100 MOFA and other EAs trained by end of August 2001 and</li> </ul>	<p>Project report</p> <p>List of materials collected</p> <p>Project report to NRSP</p> <p>Project reports Dissemination materials</p> <p>Training reports</p> <p>Project</p>	

<p>3. Research capacity of Sunyani Polytechnic enhanced.</p>	<p>assessment initiated.  - Cost-benefit comparison of different strategies completed by end December 2001 (e.g. farmer field schools vs. contact farmers).  - Dissemination strategy and material for wider dissemination through MOFA agreed by March 2002.</p> <p>By end of project:  -Dissemination assessments at the level of organizations, trainers, field staff and farmers made by Sunyani Polytechnic students and staff and report completed.  -One article drafted by Sunyani Polytechnic staff.  - At least two undergraduate dissertations prepared using project information.</p>	<p>reports</p> <p>Project reports</p> <p>Draft article</p> <p>Dissertations</p>	
<p>Activities</p> <ul style="list-style-type: none"> <li>- Describe &amp; analyse present dissemination practices (extension strategy, media etc) of different organizations (MOFA, FAO-FFS, Bonsu, Wenchi Farm Institute, commercial sector).</li> <li>- Review material in the manual (R6789) and attached leaflets &amp; agree on &amp; prepare dissemination materials for testing.</li> <li>- Prepare MOFA strategy for dissemination (specific to MOFA resources and clients) of manual components; detail material testing approach including criteria.</li> <li>- Test MOFA dissemination plan; test materials (in different</li> </ul>	<p>Budget and resources</p>		

<p>organizations – MOFA, FAO-Farmer Field School activities, Bunsu, commercial sector, Wenchi Farm Institute).</p> <ul style="list-style-type: none"> <li>- Evaluate MOFA dissemination plan, and materials for information transfer (efficacy of person-person training/ posters/ leaflets; plan viability in different institutional settings; comparative costs of alternative strategies (Eas, posters, Farmer Field Schools/ contact farmers etc.).</li> <li>- Finalise MOFA curriculum and agree on materials (form etc. for specific clients).</li> <li>- Prepare lessons learnt, paper &amp; dissertations.</li> </ul>			
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## **ANNEX B.**

### **Criteria for Selecting AEAs**

A number of factors were used to select AEAs to train farmers selected to pilot-test the manual.

These were:

1. The AEA must be mobile (i.e. he must have a motor bike or bicycle to enable him maintain regular contact with farmers in his operational area;
2. The AEA must be located in a vegetable growing area and must be resident in one of the Communities
3. The Communities in the operational area of the AEA must be accessible
4. The AEA must be hardworking and able to meet set targets
5. The AEA must be able to report periodically
6. The AEA must be a respected officer, of good standing in the community, whose opinions are likely to be respected and his advice followed by farmers

### **Criteria for Selecting Farmers**

1. The farmer must be a vegetable producer with a minimum of 4 years experience in vegetable production
2. The farmer must be engaged in dry season vegetable production
3. He must be prepared and willing to co-operate with his colleague farmers and prepared to accept the advice of the AEAS to try new practices
4. The He must be prepared to serve as a contact farmer who is willing to exchange information with his colleagues and be willing to learn from others
5. He must be trustworthy or dependable and show promise to use resources judiciously
6. The participating farmers should include woman (It is expected that about 50% of farmers would be women)
7. Since land tenure system determines, to some extent, the willingness of farmers to adopt soil fertility improvement technologies, both migrants who rent land for cultivation and land-owning farmers should be included in the sample.
8. The farmers must have their farms either close to the village or on the roadside to serve as demonstration sites.

## REFERENCES

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