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Semi-Arid Africa Agricultural Research and Development

Challenge Program on Water and Food (CPW&F):
Enhancing Rainwater and Nutrient use Efficiency for Improved Crop Productivity, Farm Income ane Rural Livelihoods in the Volta basin

Report on a comparative study on large scale extension methods used in Ghana

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Table of contents

Acronyms

$	Dollar
AEA	Agricultural Extension Agent
AgSSIP	Agricultural Services Sub-sector Investment Programme
ARI	Animal Research Institute
AU	African Union
CGAIR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CIDA	Canadian International Development Agency
CLW	Community Livestock Worker
CPW&F	Challenge Program on Water and Food
CRI	Crops Research Institute
CSIR	Council for Scientific and Industrial Research
DAES	Directorate of Agricultural Extension Services
DAO	District Agricultural Officer
DDA	District Director of Agriculture
DRD	Department of Research and Development
DRDA	Deputy Regional Director of Agriculture
FARMER	Farmer Responsive Mechanisms in Extension and Research
FAO	Food and Agriculture Organisation of the UN.

FFS	Farmer field school
FM	Frequency Modulation
FRI	Food Research Institute
FSR	Farming Systems Research
GDP	Gross Domestic Product
GLOWA	Global change in the hydrologic (Water) cycle
GoG	Government of Ghana
GTZ	German Technical Co-operation
ha	hectare
IARC	International Agricultural Research Centres
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IFDC	International Fertiliser Development Centre
INERA	Institut de l'Environnement et de Recherches Agricoles
IPG	International public goods
ITK	Indigenous technical knowledge
KIT	Royal Tropical Institute
km	kilometre
MDGs	Millennium Development Goals.
MEST	Ministry of Environment, Science and Technology
ML&RD	Ministry of Local Government and Rural Development
MOAP	Market-oriented Agricultural Programme
MOFA	Ministry of Food and Agriculture
mt	metric tonne
NAEP	National Agricultural Extension Project
NARS	National Agricultural Research System
NEPAD	New Partnership for Africa's Develoment
NGO	Non-Governmental Organization

OFAR	On-farm adaptive research
OFAT	On-farm adaptive trial
PTD&E	Participatory Technology Development and Extension
RAO	Regional Agricultural Officer
RDA	Regional Director of Agriculture
RELC	Research-Extension-Farmer Linkage Committee
SAFGRAD	Agricultural Research and Development in Semi Arid Areas of Africa
SARI	Savanna Agricultural Research Institute
SEF	Savannah Eco Farm
SRO	Scientific Research Organisation
T&V	Training and Visit
UDS	University for Development Studies
UN	United Nations
US	United States
VEW	Village Extension Worker
WRI	Water Research Institute

Executive Summary

The African Union Specialized Office for the Promotion of Agricultural Research and Development in Semi Arid Areas of Africa (AU/SAFGRAD) located in Ouagadougou, Burkina Faso, aims at contributing to the advancement of agricultural research, technology transfer and marketing as well as the management of natural resources by facilitating and coordinating the use of the scientific talents of National Agricultural Research Systems (NARS) and international Agricultural Research Centers (IARCs) and Scientific Research Organizations (SROs) to enhance food security, promote sustainable agriculture, development of irrigation agriculture, both in rural and per-urban areas of the semi arid zones of Africa.

In collaboration with international agricultural research institutions including ICRISAT and CIAT as well as NARS in Ghana (SARI) and Burkina Faso (INERA), AU/SAFGRAD has facilitated the implementation of project No. 5 of the «Challenge Program on Water and Food» entitled «Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin.» The project specific objectives include mainly the facilitation of large scale extension of the best agricultural technologies through efficient information and better management of dissemination mechanisms.

This report is an output of a comparative study on large scale extension methods used in Ghana and Burkina Faso. The study aimed to mainly to assess and compare the mechanisms for agricultural technologies dissemination for an optimal large scale extension of best practices.

A combination of methods was used to meet the requirements of the assignment. The main methods of information collection included primary data collection using questionnaire and structured interview of individual farmers and community members who participated in the project. Comprehensive literature review of project reports and online survey of Challenge Programme on Water and Food and other related documents provided secondary data for this report.

The CPW&F was implemented in two administrative districts (Kasena/Nakana and Tolon/Kumbungu) that represent two agro-ecological zones (Sudan and

Guinea Savannah respectively) of Ghana. CSIR/SARI was the lead facilitator for the implementation of the project. Principal participating stakeholders included Ministry of Food and Agriculture (Regional and District Directorates), the District Assemblies, NGOs and of course individual farmers and farmer groups. Using SARI's Farming Systems approach to research and the general stakeholder participatory approach (within MOFA-RELC system) to agricultural problem diagnosis for technology development and dissemination, two conditions of low but yet declining soil fertility and erratic rainfall pattern were identified amongst others as major constraints to agricultural production in the two agro-ecological zones(Guinea and Sudan Savannah) targeted for the Challenge project. The technologies agreed upon for development and or adaptation and dissemination included fertilizer micro-dosing, tied ridging and Savannah Eco-farm (SEF). Beyond these, CSIR/SARI also facilitated on-farm experimentation on improved and drought tolerant sorghum (Kapaala), high lysine maize (Obaatampa), and improved early maturing cowpea (Apagbaala).

Choice of agricultural extension approaches and or methodologies was informed by desired reach of farmers, "learning by doing" or experiential learning, community coverage and contact with formal extension agents. The study observed the use of a basket of approaches and or methodologies. They included farmer training sessions, on-station experiments, on-farm adaptive trials, Farmer Field School (FFS), Farmer-to-farmer extension, Field tours/exchange visits and use of rural radio.

The key lesson learnt of the CPW&F was that through the consultative and collaborative approaches and methods like FFS, on-farm adaptive trials, and radio programs, etc, researchers are now reaching more farmers than before. Researchers also drew on farmers' knowledge and ideas for the adaptation of the technologies available. Major constraint to project implementation was the sporadic, virtually untimely disbursement of funds which delayed provision of inputs for on-farm adaptive trials and demonstrations. The research team also faced the challenge of non-availability of project vehicle and equipment for operations and reporting. Inadequate capacity development of field AEAs for data collection and analysis was also recognised as a challenge during g project implementation.

For the way forward, enhancing strengthened institutional consultation and collaboration will allow for mainstreaming project activities into normal institutional programmes and assures sustainability beyond the life to the project.

The incorporation of regular participatory monitoring and evaluation tools and mechanisms of project activities can also permit stakeholders to appreciate outcomes and challenges of their own efforts and be prepared to strategise for improvement. Finally, it is recommended that an effort to reduce poverty, and improve food security, incomes and livelihoods of small-scale resource-poor farmers in the project area should adopt a holistic approach from the farmers' perspective. The integration of livestock aspects into the technologies being promoted would be most appropriate as the average farmer practises mixed farming: crop and livestock production.

Foreword

AU/SAFGRAD office is publishing this report as a part of achievement of its vision "to accelerate growth of agriculture by promoting the application of more productive technologies friendly to semi-arid environment" and its mandate "to contribute to the advancement of agricultural research , technology transfer and marketing as well as the management of natural resources by facilitating and coordinating the use of the scientific talents of National Agricultural Research Centers(NARCs), International Agricultural Research Centers(IARCs) and Scientific Research Organizations (SROs) to enhance food security, promote sustainable agriculture, development of irrigation agriculture, both in rural and peri-urban areas of the semi-arid zones of Africa".

The study is the outcome of successful three-party collaboration among AU/SAFGRAD, the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) and the National Agriculture Research Systems (SARI, Ghana and INERA, Burkina Faso). AU/SAFGRAD has facilitated the implementation of the project N5 of "**the challenge program on water and food" (CPW&F),** entitled **"Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta basin**". One of the specific objectives of this project is to promote and scale up and out the best agricultural technologies through more efficient information and better management of dissemination mechanisms.

Within the framework of this program AU/SAFGRAD has financed a study in two countries sharing the Volta Basin (Ghana and Burkina Faso). The study aims to mainly assess and compare the agricultural extension methods used in each country for a better scaling out of best practices. The present report reflects the results of the study done in Ghana.

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African Union Commission

1.0 Introduction and background

The livelihoods of most African families depend heavily on agriculture, as approximately 70% of the people lives in rural areas and 90% of this work in the agricultural sector. Agriculture contributes about 25% of Africa's GDP and the majority of its exports are agricultural products. Improvement in the productivity and competitiveness in agriculture remain a challenge for food security and cash incomes as well as for exports. In addition, promotion of development of rural areas where 65% to 90% of the African poor live is essential for poverty reduction – a critical priority and other goals under the Millennium Development Goals (MDGs).

Factors that contribute to the productivity of farming in Sub-Saharan Africa are many: poor soils, lack of improved crop varieties, highly variable rainfall and frequent droughts among others. African farming is characterised by "low-input, low-output" and "small-scale multi-crop" production, mostly by smallholders. While this ensures a minimisation of risks necessary for maintaining basic subsistence, it perpetuates low productivity and is susceptible to considerable yield fluctuations from year to year depending on variable precipitations. Ensuring food security through increased, stable production of staple food crops and improving land productivity are therefore matters of high priority for Africa.

The African Union Specialized Office for the promotion of Agricultural Research and Development in Semi Arid Areas of Africa (AU SAFGRAD) located in Ouagadougou Burkina Faso aims at contributing to the advancement of agricultural research, technology transfer and marketing as well as the management of natural resources by facilitating and coordinating the use of the scientific talents of National Agricultural Research Systems (NARS) and International Agricultural Research Centres (IARCs) and Scientific Research Organizations (SROs) to enhance food security, promote sustainable agricul-

ture, development of irrigation agriculture, both in rural and peri-urban areas of the semi-arid zones of Africa.

In collaboration with international agricultural research institutions including International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Centro Internacional de Agricutura Tropical (CIAT) as well as National Agricultural Research System (NARS) in Ghana (Savanna Agricultural Research Institute(SARI) and Burkina Faso (Institut de l'Environnement et de Recherches Agricoles (INERA), AU SAFGRAD facilitated the implementation of project No. 5 of the "Challenge Program on Water and Food" entitled "Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin". The project's specific objectives include the facilitation of large scale extension of the "best bet" soil and water management technologies for increased water and nutrient use efficiencies using the most efficient information management and dissemination mechanisms.

1.1 Challenge Program on Water and Food (CPW&F)

The CPW&F is an international, multi-dimensional, research-for-development initiative. Its overarching goal is to contribute to the efforts by the global community to increase food production to achieve internationally adopted food security and poverty eradication targets by 2015, while simultaneously ensuring that the global diversions to agriculture are maintained at the level of the year 2000. It emphasizes south-south and north-south cooperation, partnership and knowledge exchange. Led by a consortium of 18 institutions, the CPW&F is working with a broad range of over 200 institutions in research and development, bringing together natural and social scientists, development specialists and river basin communities in Africa, Asia and Latin America[1].

The Volta Basin covers 400,000km, draining about 75% of Ghana, 67% of Burkina Faso, parts of Togo, Cote d'Ivoire, Mali and Benin. The majority of the population in the basin are small scale resource-poor farmers who rely on rain-fed agriculture for their livelihoods. Within the basin there are significant temporal and spatial variability in rainfall resulting in high risk of farming. In addition intensive cultivation of farmlands with low external inputs has led to significant decline in soil fertility. The resultant low agricultural productivity

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[1] External Evaluation of Challenge Program on Water and Food.

is the main cause of poverty and food insecurity in the basin. To reverse this situation there is need to improve water productivity through integrated approach to water, crop and nutrient management.

The Consultative Group on International Agricultural Research (CGAIR) Challenge Program on Water and Food (CPW&F) is an international, multi-institutional research initiative that brings together research scientists, development specialists, and river basin communities in Africa, Asia and Latin America to create and disseminate international public goods (IPGs) that improve the productivity of water in river basins in ways that are pro-poor, gender equitable and environmentally sustainable[2]. The programme is concerned with the way people use natural resources to support livelihoods and addresses the most fundamental constraint to African agriculture, low soil fertility, by applying a new paradigm for integrated natural resource management, and by applying it with all partners committed to jointly identifying and resolving problems with the full participation of the beneficiaries. The programme facilitates the formation of new partnerships of national agricultural research and extension systems, advanced research institutes, NGOs, farmer organisations and private enterprises in order to address problems by means of targeted and time-bound research projects with clear objectives and deliverables. The project entitled "Enhancing Rainwater and Nutrient use Efficiency for Improved Crop Productivity, Farm Income and Rural Livelihoods in the Volta Basin" (Challenge Programme No.5) is funded under the CPW&F and co-ordinated by ICRISAT.

1.1.1 Project Goal and Purpose

The project has an overall goal of reducing poverty, and improving food security, incomes and livelihoods of small-scale resource-poor farmers in the Volta Basin who rely on rain-fed agriculture for their livelihoods.

The purpose of the project is to overcome the constraints to sustainable use of sub-Saharan Africa's natural resources, particularly soils, with improved technologies and policies that will enable resource-poor smallholders and livestock producers to achieve sustainable improvements in their livelihood and secure futures for their children. It is assumed that using a systems approach that integrates water use efficiency, soil and nutrient management, and improved germplasm together with market opportunity identification and building the capacities of rural communities will result in significant benefits to the rural poor and the environment.

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[2] Ghana Progress Report: 2004-2006

1.1.2 Project objectives and outcomes

The five main objectives of the project include:

- The development and adaptation in partnership with farmers integrated technologies that improve water and nutrient use efficiency and increase crop yields in the Volta basin.
- The development and validation of methodologies e.g. remote sensing, GIS modelling for evaluating promising technologies.
- Improving market opportunities for smallholder farmers.
- The building of capacity of rural farmers to make effective demand to research and development and influence policies that promote adoption of sustainable water and nutrient use technologies.
- The promotion and scaling up of best bet crop, water and nutrient management strategies in the Volta Basin through effective information dissemination mechanisms.

1.1.3 Scope and key strategies of Challenge Programme No.5 in Ghana

The Challenge Programme No.5 was launched in Ghana in 2004 under CGAIR/CSIR-SARI/MOFA collaboration in about 20 communities in Tolon/Kumbungu and Kassena/Nankana Districts of the Northern and Upper East Regions of Ghana and had been on-going up to 2008.

The program in Ghana worked towards achieving key sectors in pursuance of its objectives. These sectors include:

- **Food security** for all at household level: All interventions sought to increase productivity of crops involved (maize, sorghum and cowpea) thereby assuring food availability at the household level.
- **Poverty alleviation** through increased sustainable livelihoods in rural and peri-urban areas.
- **Improved health** through better nutrition, lower agriculture-related pollution and reduced water-related diseases.
- **Environmental security** through improved water quality as well as maintenance of water-related ecosystems and biodiversity.

Four short-term results or outputs of the project realized in Ghana included:

1. The development, evaluation and adaptation of integrated technology options for improving water and nutrient use efficiency and increasing productivity
2. The development and validation of methodologies, approaches and modern tools for evaluating and promoting technology options
3. The identification and evaluation of market opportunities.
4. Building the capacities of farmers and rural communities to make effective demands to research and development organisations.

Key strategies adopted to fulfil these outputs included:

- growing more food with less water by developing water efficient and drought tolerant crops;
- introducing improved farming practices;
- enhancing management tools that give farmers timely access to water;
- promoting policies and institutions that help farmers take advantage of these interventions.

By growing crop varieties that can tolerate water stress and adopting improved water management methods farmers will reduce the risk of crop failure from drought, salinity, water logging and floods. This in turn will allow them to increase production on marginal lands and cope with short-term or medium-term water deficits under both irrigated and rain fed conditions.

It is under this program that AU/SAFGRAD is facilitating the conduct of a comparative study on large scale extension methods used in Ghana (and Burkina Faso).

2.0 The study process

2.1 Main objective of the study

2.1.1 Main and specific objectives of the study

This study aimed mainly "***to assess and compare the mechanisms for agricultural technologies dissemination for an optimal large-scale extension of best practices".***

Specific objectives for the consultant included:

- To identify various agricultural technologies promoted under the CPW&F in Ghana;
- To identify various extension strategies, approaches and or methodologies used in the promotion of the technologies;
- Identify existing extension structures and stakeholders/actors involved in the program;
- To assess the effectiveness and impact of the extension approaches/methods used;
- Outline lessons leant, constraints, potential and the way forward for the existing mechanisms.

2.1.2 Scope of work

The scope of work or key tasks spelt out for the consultant included the following:

- Make an inventory of and document the various approaches or methods of agricultural technologies such as *Zai, SEF, Warrantage, Micro-dosing, Tied ridging,* etc. which have been tested out in Ghana under the CPW&F program;
- Analyze the existing extension strategies and approaches, structures and actors involved in this domain in Ghana;
- Bring out the assets and limits of current mechanisms in Ghana;
- Propose the optimal improvement of existing mechanisms.

2.2 The study methodology

A proposed approach and itinerary to the study were reviewed by AU/SAFGRAD prior to the inception of the study.

2.2.1 Data gathering tools

A combination of methods was used to meet the requirements of the assignment. The main methods of information and data collection included:

◆ **For Secondary data**:

Literature and project report review. Comprehensive literature review on the key issues. A very extensive search into various reports by CSIR-SARI and online survey on Challenge Programme on Water and Food and other related documents was carried out. Literature on MOFA's extension structural organisation and agricultural technology dissemination methods was reviewed.

◆ **For Primary data:**

Use of questionnaire and structured interview of individual farmers and community members who participated in the project to solicit specific information.

Focus group discussion check list: focus group discussions conducted on entire community members and identifiable groups.

Personal interaction and discussions with key personnel of major CPW&F participants and stakeholder organisations and institutions including CSIR-SARI, MOFA, and UDS

Personal observation of community landscape and fields.

The checklist for focus group discussions and questionnaire were developed and reviewed before they were pre-tested with field extension officers for administering to farmers.

2.2.2 Field Study Team composition

A total of six (6) field extension agents were mobilised to carry out field data collection at the farmer and community level. The consultant followed up for community interviews and focus group discussions. Focus groups were mainly participating and non-participating farmers of the project.

2.2.3 Sampling

▪ *Community selection:* Due to time constraints nine (9) communities were sampled from project area to carry out field study and interview of both beneficiary and non-beneficiary farmers. The communities included three from Tamale area (Mbanayili, Nwodua and Kpilo) and five (Kandiga Junction, Doba, Yigwam, Nagalikania, Bembisi, and Kumbosiugo/Mirigu) from Navrongo area.

▪ *Farmers selection:* Using the guide for the focus group discussion, the entire community was engaged for about two hours to appraise pertinent issues required for the study – year of inception, interventions introduced, benefits, constraints; approaches and methodologies used for technology transfer and other observations about the interventions. This preceded the administration of the individual questionnaire to the randomly selected farmers who attended the focus group discussion.

2.3 Validation Workshop

The consultant presented preliminary findings of the study at a validation workshop organised in Ouagadougou on 9th June, 2009 by AU/SAFGRAD. Workshop participants provided useful comments and oberservations on the results and these were further used to enrich entire results of the study.

3.0 Findings of the tudy

3.1 Introduction

The findings and discussions are presented in accordance with the specific objectives of the assignment. They are therefore discussed in the ensuing sections in the following order:

- Existing extension structures and stakeholders/actors involved in the program;
- Agricultural technologies promoted under the CPW&F in Ghana;
- Extension strategies, approaches and or methodologies used in the promotion of the technologies;
- Effectiveness and impact of the extension approaches/ methods used.

Lessons leant constraints (or challenges), and potential (the way forward or recommendations) for the existing mechanisms are discussed in Chapters 4, 5 and 6 respectively of the report.

The findings are however discussed within the context of the general agricultural extension structure and research systems of Ghana. In this regards an overview of the agricultural extension and research systems is presented in the ensuing section.

3.2 An overview of agricultural extension and research systems in Ghana

3.2.1 The Public Extension System – A brief historical perspective

A historical perspective of agricultural extension activities in Ghana indicates that agricultural extension delivery was initiated in the nineteenth century by the early missionaries and foreign-owned companies involved in the production

of export crops such as coffee, cocoa and rubber. After independence, Ghana tried various extension approaches including extension under the farmers' co-operative movement and several donor-assisted projects. In the 1970s and 80s, all the departments of the Ministry of Food and Agricultural (MOFA) undertook separate extension services. Agricultural extension was therefore fragmented among the various departments within the same ministry. In 1987 however, MOFA established the Directorate of Agricultural Extension Services (DAES) to bring all splinter MOFA extension services under one umbrella.

Since the beginning of the 1990s, DAES adopted the Training and Visit (T&V) extension system nationwide. This extension initiative was supported with World Bank funding through the National Agricultural Extension Project (NAEP), which was implemented between 1992 and 1999**.** This project was set up and implemented to help (a) improve the efficiency in the management and delivery of extension services (b) improve the relevance of technologies available to farmers and (c) strengthen the technical departments of MOFA.

Ministry of Food and Agriculture has also been experimenting with various alternative extension approaches such as Participatory Technology Development and Extension (PTD&E), Farmer Field Schools (FFS) and Market-oriented Agriculture Programme (MOAP) among others, in collaboration with development agencies like the German Technical Co-operation (GTZ) and the Food and Agriculture Organisation (FAO) of the United Nations (UN).

The role of the Agricultural Extension Agent (AEA) under these approaches is one of facilitating learning among farmers instead of only transferring technology. The results of these experimental projects have resulted in enhanced knowledge and skills among farmers. This has been attributed to the fact that farmers have become part of the decision-making process. MOFA is therefore encouraged to continue with such initiatives in order to empower farmers to make better judgment of their own performance.

3.2.2 Structural organisation of agricultural extension delivery in Ghana

The Ministry of Food and Agriculture (MOFA), through the Directorate of Agricultural Extension Services (DAES) at the national level provides extension services in Ghana. In each administrative district, between 20 and 30 Agricultural Extension Agents (AEAs) provide the community-level extension service. Between 5 and 8 AEAs report to a District Agricultural Officer (DAO) who supervises and supports the community extension services delivery. There are

usually four (4) DAOs per district. The DAO reports to the District Director of Agriculture (DDA) who is responsible for the overall agricultural program in the district and plays a coordinating role. The DDA reports to the Regional Director of Agriculture (RDA) through a Deputy Regional Director of Agriculture (DRDA). AEAs and DAOs are technically backstopped by Regional Agricultural Officers (RAO). RAOs are located at the regional capitals of Ghana, e.g. Tamale (Northern Region), Bolgatanga (Upper East Region) and Wa (Upper West Region).

◆ **The role of the Private Sector in Extension Delivery**

The last decade has seen an upsurge in private sector involvement in the provision of agricultural extension services in the country. Producer organizations, buyers, processing and export companies provide extension services for specific agriculture commodities on cost recovery basis, where costs are recovered through service charges deducted from payments to farmers at the time of sale. This extension system however, tends to focus on high value crops like cocoa, cotton, oil palm, cashew, pineapple and vegetables.

There has also been an increase in the involvement of Non-Governmental Organisations (NGOs) in the funding and delivery of extension services in Ghana. Their services generally address the needs of specific client groups and are often commodity focused in most cases. NGOs complement the activities of the public services and work in partnership with the publicly funded extension agents. Alternative models such as volunteer extension workers (VEW) and Community Livestock Workers (CLW), are operational in some areas but under the supervision of staff of the Ministry of Food and Agriculture. VEW and CLW are community-based extension service providers. Agents of these groups are often nominated by their respective communities for MOFA to train on basic extension methods (and common technologies) and primary animal health care and husbandry practices (in the case of CLW). The agents return to their communities to render services for free. MOFA provides them with basic logistics – means of transport and equipment for them to do their work.

MOFA experimented (or indeed facilitated) on pilot basis public-private partnership for agricultural extension delivery[3] under the Agricultural Services Sub-sector Investment Programme (AgSSIP). However experiences of this were rather mixed hence the process was halted.

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[3] Public-private partnership for extension delivery: the public sector (government) providing funds to the private sector (e.g. NGOs) to deliver extension services on behalf of government

3.2.3 Agricultural Research in Ghana

Working independently from MOFA and its extension service are a number of agricultural research institutes. The research institutes fall under the responsibility of the Council for Scientific and Industrial Research (CSIR) of the Ministry of Environment, Science and Technology (MEST). About 70% of the thirteen (13) CSIR-affiliated institutes do conduct agriculture or agric-related research. A few of these institutes are Savanna Agriculture Research Institute (SARI), Water Research Institute (WRI), Crops Research Institute (CRI) Food Research Institute (FRI) and Animal Research Institute (ARI). It must be indicated that all Universities in Ghana also do conduct agricultural research relevant to their respective catchment areas.

For research and development, agricultural research institutes in Ghana and MOFA do experiment with various alternative extension approaches, methods and strategies such as participatory extension methods, Farmer Field Schools (FSS), integrated crop/pest management, etc, all of which aim at ensuring high level of farmers' participation. MOFA staff especially the AEAs play a facilitating role instead of transferring technology. By this, farmers' knowledge and skills are enhanced as they take part in the decision-making process. These systems need to be further fine-tuned and sustained to empower farmers to make better judgment of their own actions, inactions and performance.

3.2.4 Research-Extension-Farmer Linkage

Formal research and development partnership with farmers and farmers' organisations aim to enhance the demand for innovation by bringing farmers' voices into the decision-making process. Collective action of this sort can identify constraints, pool indigenous knowledge and aggregate technological demands. Most agricultural research in Ghana is under the supervision of the Council for Scientific and Industrial Research (CSIR), which is under the Ministry of Environment, Science and Technology (MEST), while extension is carried out by MOFA. The Research-Extension-Farmer Linkage Committees (RELCs) were formed in 1991. RELC as a structure is located within MOFA and CSIR wherein the Regional Director of Agriculture serves as the Chair to the committee whiles a researcher from a CSIR-affiliated institute within the region Cordinates the activities of the RELC. RELCs operate in each administrative region to forge a close working relationship between research, extension and farmers and to provide a mechanism for including farmers in the process.

The responsibility of these RELCs is to assess the adoption of technologies by farmers, review research and extension programmes; assess their relevance to agricultural development in the various regions and make appropriate recommendations.

MOFA has over the years sought the strongest form of farmers' participation in the area of collaboration where stakeholders jointly identify an issue of common interest, pool resources and share the benefits. Partnership under the RELC system helps to scale up adaptive research, testing and dissemination, while facilitating access to agricultural inputs, markets and finance for new technologies.

The RELCs have played a significant role in staff training and have influenced the quality of research and extension programmes by promoting technologies that are relevant to the needs of farmers. However, a major shortcoming of the RELCs, is their inability to respond to the specific needs of the regions and districts. This has primarily been due to difficulties in funding the operations of the structure. Over the years, projects e.g Farmer Responsive Mechanisms in Extension and Research (FARMER (2003-2007) Project, Agricultural Services Sub-sector Investment Programme (AgSSIP (2000-2005), National Agricultural Extension Project (NAEP (1992-1999), have been the major sources of funding for the operations of RELCs, with some support from central government. In recent times, budgetary constraints from MOFA and CSIR do not allow operationalisation of RELCs beyond regional levels. To date, the RELCs have been marginally effective, largely because they are not fully functional at district levels. By and large, effort has always been to strengthen linkage between formal research and extension on the one hand and informal service providers (NGOs) on the other with farmers coming on as centre stage for all agricultural development interventions in the communities.

3.2.5 Conventional extension programme planning process

Planning of agricultural extension programmes in Ghana takes place at three main stages/levels. The planning process is designed to allow effective contribution of all stakeholders in agricultural development including production, processing, distribution and marketing. The process reflects the bottom-up approach to problem identification while making use of Indigenous Technical Know-how (ITK) of farmers.

MOFA undertakes three levels of planning. These are:

▪ *Operational Area:* (OA): Each agricultural extension agent (AEA) conducts planning meetings with individual farmers and/or in groups of farmers, involving all other agricultural stakeholders in his operational area (normally 8-10 or more contiguous communities or villages). Collaboratively all stakeholders participate in the analysis of the agricultural or farming situation in the area with the view to identifying constraints to agriculture. The AEA's supervisor, the District Agricultural Officer (DAO) attends this planning session.

▪ *District Level:* With the DDA facilitating, district staff (i.e. AEAs and DAOs) and other agricultural stakeholders in the district (farmers, NGOs, agribusiness representatives) collect and collate agricultural data gathered at the operational area level planning. Major outputs of planning at this level include prioritized district–based agricultural constraints, and AEAs training needs, the latter often determined by farmers' constraints and AEA's level of knowledge as to how to address these constraints. Researchers, Regional Agricultural Officers (RAOs), attend the district level planning sessions.

▪ *Regional Level planning:* Representatives of all stakeholders in agricultural development in the region as a whole (farmers, researchers, agriculturists, agribusiness and agric-related NGOs) review performance of preceding agricultural programme, collect, collate and help fine-tune current district extension programmes. Outcomes of this level/stage of the planning process is the regional level plan which identifies (a) areas that Districts would require technical backstopping from the RAOs; (b) Agricultural problem areas that would require further research, and (c) consolidation of training topics for AEAs for each district. National agricultural policy interventions are also brought to the fore at the regional level planning for incorporation in the regional or district level plans as may be appropriate.

Final outputs of all three levels of extension planning are:

- Farmers' constraints with respect to production, processing and marketing;
- Farmers' training needs or requirements;
- Technological interventions that need to be transferred to address farmers' constraints. Technology transfer may be done through demonstrations, farmer trainings or other relevant extension methods known to AEAs;
- Training requirements of AEAs that would provide them with the required skills to enable them deliver extension services more effectively and efficiently;

- Gray areas for which technologies may or may not be available. Technologies that are available but not applicable may require further research refinement through on-farm adaptive trials or otherwise. Where the required technologies are not available, research will have to be initiated to get applicable solutions.

Utilising the above, District Agricultural Directorates then develop their various annual agricultural programs which are used to source funds from central government for their implementation, monitoring and evaluation.

3.3 Existing extension structures and stakeholders/ actors involved in the Challenge Program on Water and Food in Ghana

The selection of the pilot sites was based on presence of active research and possibility of linkage with on-going projects. Tolon/Kumbungu and Kassena/ Nankana Districts were selected as GLOWA[4] Volta Project was very active in these areas and CPW&F could benefit from data already gathered. The main objective of GLOWA was to provide scientific support for sustainable management of the water resources of the Volta Basin. The choice of districts for the implementation of the Challenge Program on Water and Food in Ghana was to ensure an interaction between the program and a GLOWA Project implemented over the years.

While Kassena/Nakana District of the Upper East Region falls within the Sudan Savannah eco-system, Tolon/Kumbungu of the Northern Region lies in the Guinea Savannah eco-system; both districts however are within the Volta Basin – the basin of choice for the Challenge Program on Water and Food (CPW&F) in Africa.

In conformity with existing research and extension systems discussed above, the Challenge Programme in Ghana utilised all relevant stakeholders for agricultural research and development in northern Ghana[5] in pursuance of its objectives.

3.3.1 Regional Agricultural Directorates

The Ministry of Food and Agriculture represented by the Regional and District Directorates of Agriculture for Northern and Upper East Regions were key players

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[4] GLOWA is a German acronym for Global change in the hydrologic (Water) cycle.

[5] Northern Ghana: Northern, Upper East and Upper West Regions

and actors for the programme. The Regional Agricultural Directorates (Upper East and Northern Regions) provided a broad framework for agricultural development in the region as a whole considering the prevailing ecosystem, natural and human resources available. This provided the Challenge Programme the opportunity to contribute to the region's agricultural development through the pursuance of its own objectives. The Regional Directorates also committed adequate resource persons (Regional Agricultural Officers) to provide adequate technical backst opping for programme implementation. Interaction with Regional Directorates indicated the support provided in the conduct of Farmer Field Schools at the project community level. Regional Officers besides serving as resource persons for some training sessions also conducted periodic supervisory visits to project sites as part of their regular tasks of monitoring agricultural services delivery in the districts.

3.3.2 District Agricultural Directorates

District Agricultural Directorates (Tolon/Kumbungu and Kassena/Nankana) facilitated direct implementation, monitoring and evaluation of the programme with farmers who constituted direct beneficiaries or collaborators of the programme. At the inception phase of CPW&F, District Directorates outlined district-specific constraints to agricultural development – this was critical in directing the focus of the Challenge Program on Water and Food. They also contributed to the identification of communities for the programme to be implemented. Field extension agents constituted the main channel for technology development and dissemination to farmers. They contributed to the identification of individual farmer collaborators, established contact farmer and farmer groups, established on-farm demonstrations, arranged field days with contact groups and assessed results of these demonstrations. They also conducted on-farm adaptive trials and collected relevant data for analysis. To ensure effective delivery, all agricultural extension agents involved in the programme participated in annual pre-season technical training on subject matters they were to deal with. AEAs facilitated and co-ordinated all stakeholder meetings, fora and training sessions for farmers. They were valuable resource persons at farmers' training sessions.

3.3.3 Savanna Agricultural Research Institute

CSIR-SARI is mandated to conduct agricultural research, particularly as it relates to food and fibre crop farming in northern Ghana for the purpose of

introducing improved technologies to enhance agricultural productivity. The specific objectives of the institute are to:

- Develop in close collaboration with typical households in the various agro-ecological zones, options of production techniques which are compatible with farm households, and which enhance the capacity of farm families to increase crop production per unit area without injury to the environment;
- Introduce varieties of crops which address the production problems of farmers and meet consumption needs and preferences, as well as market demands;
- Generate data to enhance policy makers' understanding of the decision-making patterns of farmers, and thereby permit the formulation of appropriate agricultural policies;
- Build capacity for, and institutionalise, farming systems research (FSR) as a research approach.

CSIR-SARI has programs for all major crops cultivated in northern Ghana including sorghum, millet, maize, rice, bambara beans, groundnuts, cowpea, soy bean, yam, cassava and cotton. It also has programs covering onions, tomatoes, and other vegetables.

The Savannah Agricultural Research Institute (SARI) which is one of the thirteen (13) Institutes under Council for Scientific and Industrial Research (CSIR) is the main crops research centre for the Guinea and Sudan savannah agro-climatic zones of the north of Ghana. It has developed its programs on a Farming Systems Research[6] (FSR) basis and uses multidisciplinary teams comprised of an agronomist, a soil scientist, a socio-economist/extensionist and a crop protection specialist in each of the three regions of northern Ghana. These scientists who work with farmers, MOFA staff and NGOs in each region are supported by scientists known as Scientific Support Group (SSG) members based at the main station at Nyankpala in the Northern Region. Dokpong (near Wa) in the Upper West Region and Manga (near Bawku) in the Upper East Region are sub-stations of SARI where the respective Regional Farming Systems Teams outside Northern Region are based.

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[6] van den Ban and Hawkins (1996) define FSR as a type of research through which an inter-disciplinary research team tries to gain as complete knowledge as possible of the existing farming system in order to assess whether a new technology helps farmers in achieving their goals under those environmental conditions.

Under the CGAIR Challenge Programme on water and food, the CSIR-SARI acted as the main co-ordinating institution. It facilitated the implementation of project No. 5 of the "Challenge Program on Water and Food" entitled "Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin".

3.3.4 Non-governmental Organisations (NGOs)

The contribution of the informal extension delivery sector – by non-governmental organisations (NGOs) was also recognised. Two NGOs, ADRA (Ghana) and Technoserve expressed keen interest and participated in most of the activities undertaken by the districts on the Challenge Program on Water and Food in Ghana. It was indicated that some of the technologies that were being promoted by the programme were similar to some that these NGOs were promoting in their operational areas – some of these operational areas being where the Challenge Programme was being implemented. The collaboration of these NGOs and MOFA in this sector was obvious as some of the NGO agents of extension delivery were mainly the same MOFA staff engaged in the Challenge Programme. The demonstrated MOFA-NGO collaborations on the programme opened up for sharing of experiences and avoided duplication while fostering strong synergy between the two organisations for agricultural development.

3.3.5 District Assemblies

In 1992, the national constitution made provision for the decentralization of Ghanaian government administration and for decision-making in development programs. Though decentralization is still very much a work in progress, and has different implications and applications within different ministries, under the Ministry of Local Government and Rural Development (ML & RD), District Assemblies and associated district core staff are mandated to plan and implement rural development, at the district level, in collaboration with the decentralized staff of other line ministries, such as MOFA. Decentra-lization of MOFA, initiated in 1997, has been aimed at empowering districts to plan and implement agricultural extension activities and using all available resources within the framework of a national policy.

In conformity with structural and administrative decentralisation policy of the Government of Ghana (GOG), and therefore MOFA, the Challenge Program on Water and Food in Ghana collaborated with the two District Assemblies of

Tolon/Kumbungu (Northern Region) and Kassena/Nankana (Upper East Region) to seek their political will and court their commitment to the project. It has been reported that both district assemblies pledged their full support for the implementation of the programme and were represented at planning meetings and field days.

3.3.6 Research-Extension-Farmer Linkage Committees (RELCs)

The Research-Extension-Farmer Linkage Committees (RELCs), one in each for the five ecological[7] zones of Ghana were formed in 1991. They currently operate as Regional RELCs, one in each administrative region to forge close working relationship between research, extension and farmers and to provide a mechanism for including farmers in the process *(see text box1)*. The responsibility of these RELCs is to assess the adoption of technologies by farmers, review research and extension programmes; assess their relevance to agricultural development in the various regions and make appropriate recommendations.

TEXT BOX 1 - DRD/KIT, 2003

The participation of stakeholders and clients in the agricultural research and development agenda is not new. In particular the Farming Systems Approach and the formation of research- stakeholder committees has contributed to a more demand-driven research agenda.

The RELCs are intended to oversee the annual review and planning of research and extension activities in each region. This would include the identification and prioritization of agricultural development constraints, training for farmer-based organisations (FBOs) and AEAs in participatory methodologies, and management of research trials and demonstrations in the districts. The RELCs are also intended to be responsible for monitoring and evaluating district and regional activities, for documenting and distributing extension materials, and for ensuring that information is accessible to all stakeholders. In theory, the processes are to be started at the district level, collated at the regional level and culminated at the national level, with all stages of planning, implementation

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[7] Five ecological zones of Ghana: Coastal Savannah, Forest belt, Transition zone, Guinea Savannah, and Sudan Savannah

and evaluation being participatory. In both theory and practice, these processes are used to define the annual on-station and on-farm research programs.

As part of its entry to the regions with technology development and dissemination objective, the Challenge Program on Water and Food in Ghana utilised outputs of Annual Regional Planning Sessions to identify salient agricultural development constraints upon which relevant technologies could be identified and promoted. The composition of regional RELCs including major stakeholders of agricultural development (MOFA, research, informal agricultural extension services sector (NGOs), other agricultural service providers – input dealers, marketers, and indeed farmers; and the associated three tier levels of planning agricultural programs make them very suitable structures for the programme to make in-roads to ensure the relevance and sustainability of the programme.

3.3.7 Contact Farmer, farmer groups and farmer-based organisations (FBOs)

Contact farmers, farmer groups and farmer-based organisations (FBOs) constitute the most important structure in agricultural extension delivery system in Ghana. These groups do not only constitute the beneficiary groups of extension services, but they are important collaborators and indeed agents for technology development and dissemination. The contribution of farmers and farmers groups in the form of informal research for agricultural development cannot be overemphasised, thus efforts to incorporate indigenous technical know-how in the development and dissemination of agricultural technologies is well recognised and tapped through their involvement in the RELC operating system. Further the involvement of farmers as clients and stakeholders in the RELC system is to ensure that they have assess to a wide range of information, knowledge and skills that will empower them to make rational and informed decisions. Due to a rather fairly high extension agent to farmer ratio (1:1200) in Ghana, MOFA's extension system evolved from the individual farmer approach to contact farmer and then to farmer group approach to extension services delivery for the sake of cost-effectiveness.

It is in the light of the foregoing that the Challenge Program on Water and Food in Ghana based its selection of farmers on "their willingness to participate, gender, readiness to and willingness to share experiences"[8] CPW&F utilised existing dynamic autonomous groups for the introduction and implementation of the project.

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[8] Report on FFS conducted in Kandiga Bimbissi in Kassena/Nankana District of the Upper East Region of Ghana, 2007.

Where these were absent, spontaneous groups were formed to facilitate technology delivery under the project.

The use of existing extension structures for the development and dissemination of agricultural technologies under the Challenge Program on Water and Food in Ghana was to ensure that the programme was mainstreamed in the normal MOFA activities. The strategy specifically avoided creating parallel systems to the fullest extent possible. The collaborative identification of technologies to be developed and disseminated provided for joint responsibility, on the part of MOFA, research and farmers, but gave MOFA and farmers the majority of the responsibility for achievement of outputs results. The structure and management processes of the Challenge Programme provided for the implementation of the most substantive portion of the programme by MOFA and farmers, with research (SARI) playing a facilitating role.

3.4 Agricultural technologies promoted under the CPW&F in Ghana

Using SARI's Farming Systems approach to research and the general stakeholder participatory approach to agricultural problem diagnosis for technology development and dissemination, two conditions: low but yet declining soil fertility and erratic rainfall pattern were identified amongst others as major constraints to agricultural production in the two agro-ecological zones targeted for the Challenge project *(see text box 2)*. The low but yet declining soil fertility status of agricultural lands in Africa is widely acknowledged. At the Africa Fertiliser Summit of 2006, it was observed that Africa's soils have become the poorest in the world due to decades of soil nutrient mining; hence a move towards reducing hunger on the continent must begin by addressing its severely depleted soils.

TEXT BOX 2 - 2007 Report on FFS conducted in Kandiga Bimbissi in Kassena/Nankana District of the Upper East Region:

"Farmers participating in the Annual Regional Planning Sessions under the auspices of the Research Extension Farmer Linkage Committee in the Upper East Region have always identified low soil fertility as the most significant constraint to food production in the regions".

To increase food production in the target communities, these two conditions needed to be addressed. Armed with a basket of technologies compiled form annual reports and journal publications on northern Ghana, the research team together with MOFA's extension agents discussed with farmers in eleven communities of the target districts (Kassena/Nankana – 5 & Tolon/Kumbungu – 6) the technological options available and those that could be adapted to improve agricultural production in line with the objectives of the project.

The technologies agreed upon for development and or adaptation and dissemination included:

- fertilizer micro-dosing;
- tied ridging and;
- Savannah Eco-farm (SEF).

Beyond these, nearly 640 farmers from 11 communities of the two agro-ecological zones (Guinea and Sudan savannah) annually participated in on-farm experimentation on improved and drought tolerant sorghum (*kapaala),* high lysine maize (*Obaatampa),* and improved early maturing cowpea (*Apagbaala).* Two experiments were also conducted in the Guinea Savannah zone (Tolon/Kumbungu) to evaluate the effect of slope and time of tied ridging on maize yield. Run-off infiltration plots were also established at Navrongo to conduct studies on Payment of Environmental Services (PES); with access tubes installed at three landscapes per plot to monitor soil water content.

There were two basic reasons for introducing crop varieties such as *Kapaala*, *Apagbaala* and *Obaatampa* to the farmers in these communities. The first reason is these varieties are either drought tolerant or high yielding, and the second is to disseminate these newly released varieties for adoption.

The introduction of *Kapaala* and *Apagbaala* which are drought resistant and short duration varieties was meant to cope with the ever declining rainfall pattern in the north of Ghana especially the Sudan agro-ecological zone. The short duration characteristic of *Apagbaala* also allows for early harvest of the crop to supplement household food requirements during annual periods of household food deficits around June-July. The high yielding maize *(Obaatampa)* has in addition some amino-acids *(*especially *Lysine)* which can help address the low protein intake of the farm families.

It must be emphasised that without adequate inputs farmers cannot often meet the food needs of their own families. They will need to shift from low-yielding, extensive land practices to more intensive, high yielding practices with increased use of improved seed, fertilisers and soil and water conservation practices on their fields.

3.4.1 Fertiliser Micro-dosing

Micro-dosing is the strategic application of fertilizers (plant nutrients) in small quantities per hill during planting instead of broadcasting. The objective of this technique is to increase fertilizer-use efficiency, reduce production cost for resource-poor small scale farmers thereby increasing crop growth and productivity. Farmers interviewed reported that results of this technology were very positive in terms of increase in yields of maize, sorghum and millet as against the non-application of fertiliser *(see text box 3)*.

It must be emphasised that this technology has become more relevant now than ever in view of the constant increase in cost of farm inputs especially (mineral fertiliser) over and above the means of the average farmer in the project's catchment area – Northern Ghana. In response to this Government of Ghana through the Ministry of Food and Agriculture intervened by subsidising cost of mineral fertilisers to farmers for the 2008 farming season. Government took up about 50% of the 2008 Ghana market price of fertilisers just to enable the average farmer to buy and use fertiliser. It was a strategy applauded by the average Ghanaian farmer; hence farmers currently look forward to a continuation of this intervention since cost of farm inputs and availability and cost of credit continue to be problematic for the average farmer.

Text Box 3 - Micro-dose 2006:

Where maize (var. Obaatampa) was the test crop, micro dose (25% of recommended rate) almost doubled the yield of the control (no fertiliser). Net returns were negative for the "no fertiliser treatment" and the highest Nitrogen Use Efficiency (NUE) was obtained with micro-dose treatment.

Nevertheless, fertiliser micro dosing technology could further assure the farmer of value for money if well adopted. It will not only ensure fertiliser use efficiency,

but will also reduce cost of production while increasing crop productivity (*see text box 3)*. It was adequately demonstrated to farmers that small amounts of fertiliser strategically applied to cereals especially sorghum and millet (crops which are often traditionally not fertilised) can increase yields substantially. Micro-dose fertiliser application is a low-cost investment that has a high profitability to increase grain yields across northern Ghana.

3.4.2 Tied ridging

In response to erratic rainfall pattern experienced in northern Ghana – whereby crop productivity is hampered due to lack of soil moisture at the critical stage of crop plant growth, the **Tied ridging** technology was also introduced under the Challenge programme. The objective of this technology is to harvest rainwater on-farm in order to increase rainwater productivity for crops.

Tied ridging is a type of surface configuration whereby ridges are tied to each other at regular intervals by cross-dams blocking the furrows. This is mostly used to conserve water in the dry areas or prevent surface run-off. This technology has been successfully used in West Africa especially in Niger, Mali and Burkina Faso to improve soil moisture conditions and physical properties with sufficient benefit for cotton, maize, cowpea, millet and sorghum producers in the semi-arid area. Water harvesting has been shown to increase crop yields over traditional systems. Experience shows clearly that investment in simple on-farm water harvesting techniques often produce immediate results (Reij and Steeds 2003; IFAD, 1992; Critchley, et al. 1992). While acknowledging that tied-ridging technology was labour intensive, some farmers relied on use of draught animals as a remedy. Use of traction animals for field preparation in the Kassena/Nakana District is not uncommon. This faicilated the adoption of the technology by farmers who used these animals.

3.4.3 Savannah Eco-farm (SEF)

The **Savannah Eco-farm** is an integrated agricultural production system which seeks to improve soil fertility, water use efficiency, increase household incomes and diversify small-scale agriculture. The system involves the planting of two tree crops (one a fruit tree and the other a leguminous tree) on the same piece of land in such a way as to allow continuous cropping or rotational cropping of cereals and legumes. Under the programme the fruit tree used was *Ziziphus*

mauritiana and the leguminous tree being *Acacia coli.* Food crops planted alongside these trees were maize and sorghum. The object was to allow the farmer to produce his normal food crop, and at the same time harvest some fruits (from the fruit tree) either for direct household consumption or for sale (to provide extra farm income). The leguminous tree was to improve the soil fertility of the farmer's plot (through nitrogen fixation). Prunings from the leguminous tree (*Acacia coli)* were incorporated at the time of land preparation to help increase soil organic matter within the cereal and legume plots. Firewood obtained from the pruning of *A. coli* also came as a side benefit to the household in terms of domestic energy source for the household. Fosu et al reported that in 2006, the firewood obtained from *A. coli* pruning was 3.6 mt/ha and in 2007 it was 3.1 mt/ha valued at US$78.1 and US$62.0 respectively.

Text Box 4 - SEF On-farm 2006:

The yield of maize and sorghum were not affected by the presence or absence of A. coli and Z. mauritiana. However, maize and sorghum yields were highest when rotated with cowpea.

SEF has been demonstrated as an improvement to the traditional agro forestry system through the incorporation of a third factor – the fruit tree. The system demonstrates a very useful strategy to contribute to food security within the farm family as well as improving upon the vegetation especially in the Sudan agro ecological zone. If well managed the otherwise advancing desertification could be put to check through the provision of the tree cover.

3.5 Extension strategies, approaches and or metho-dologies used in the promotion of the technologies

3.5.1 Extension Strategy

In conformity with MOFA's extension strategy involving stakeholder relationships for extension planning and execution as outlined in the RELC structure, vis-à-vis SARI's farming systems approach to research, the main strategy

adopted for the implementation of the Challenge Programme on Water and Food in Ghana was principally that of stakeholder consultations and collaboration at all levels with the view to mainstreaming project activities. Major stakeholders for the CPW&F in Ghana as discussed above included:

- SARI as the principal facilitator of CPW&F;
- MOFA (Regional and District Directorates);
- District Assemblies;
- NGOs and;
- Farmers.

The ensuing sections briefly describe specific strategic activities undertaken to implement the project.

◆ Stakeholder Forum

Stakeholder fora were held in Navrongo and Tamale (for the two respective agro-ecological zones: Sudan and Guinea respectively) to introduce the project to the regions (Upper East and Northern Regions) and districts (Kassena/Nankana & Tolon/Kumbungu Districts). While MOFA's District Agricultural Directorates provided general overview of agriculture emphasising on major constraints to agricultural production in the districts, the District Assemblies pledged their political will and support to the project. Participating NGOs also explored possible areas of collaboration.

◆ Community workshops, meetings and fora

CSIR-SARI as the lead facilitator conducted a documentary review of annual reports and scientific publications on northern Ghana to compile technological options that were available to address the two critical constraints to agricultural production in the target area: erratic rainfall and low soil fertility. In order to make technology development and dissemination demand-driven, the research team from SARI together with extension agents from MOFA met with farmers in eleven (11) communities (5&6 communities in Navrongo and Tamale zones respectively) to discuss the compiled technologies and select those that could be adapted to improve agricultural production in line with the project's objectives. The Community workshops and fora also provided the opportunity for

research and MOFA to assess farmers' practices within the respective communities with the view to harnessing locally available resources for efficient use of water and soil nutrients. They also afforded the opportunities for identifying possibilities of improving on crop production practices overtime through the identification and prioritisation of production constraints to be addressed. The team of facilitators utilised the opportunity to examine entire household livelihood systems and intervention strategies to enable a meaningful contribution to household food security to be made through the CPW&F.

Another important output of the community workshops, meetings and fora was the definition of stakeholder roles and responsibilities. The research team was mindful of the fact that "technology implementation process can only succeed when and if all partners – including facilitating organisations and target groups are equally committed".

To further enhance collaboration where stakeholders jointly identify an issue of common interest, pool resources and share the benefits, meetings and fora made farmers and other stakeholders to commit their resources for CPW&F implementation, while anticipa-ting benefits which could be derived after an extended time period. Lastly community workshops enabled the resource team and farmers to agree on technologies to try out in the various communities to address their production constraints. Community meetings, workshops and fora did not only provide dialogue amongst stakeholders, they also afforded a feedback mechanism (farmers to resource persons and vice versa) with non-participating farmers benefiting from participating farmers.

- **Pre-season planning meetings**

For each of the years (2004, 2005, 2006 and 2007) of CPW&F implementation, pre-season planning meetings were conducted with all stakeholders – farmers, MOFA (regional and district supervisory level representation) and agricultural extension agents. The primary purpose of the planning meetings was to select types of farm trials to be conducted, locations of these trials and the farmers to be directly involved in the conduct of the trials. Secondary to this was the elaboration of each stakeholder's responsibilities in the annual program. With this strategy, stakeholder commitment was guaranteed.

◆ **MOFA staff training sessions**

For effective conduct of farm trials and demonstrations, the facilitating research team (from CSIR-SARI) conducted training for agricultural extension agents on the various protocols to be used for the season. These training sessions were required both to teach and to discuss with extension agents the specific production recommendations required by farmers to address farmers' prioritised problems of low soil fertility and low water availability and use within crop fields amongst others. The sessions also afforded AEAs the opportunity to exchange information amongst them and learn from each other's experiences.

3.5.2 Extension Approaches/Methodologies

Guided by the consultative, collaborative and mainstreaming strategy adopted for the implementation of the CPW&F in Ghana, extension approaches and or methodologies deployed were basically participatory, providing more responsibilities to farmers and extension agents for the dissemination of technological interventions jointly agreed upon.

The ensuing sections of this report discuss extension approaches used for the dissemination of technologies under the project. Choice of approaches and or methodologies was informed by reach of farmers, "learning by doing" or experiential learning, community coverage and contact with formal extension agents. The study observed the following as approaches and or methodologies having been used:

- Farmer training sessions
- On-station experiments
- On-farm adaptive trials
- Farmer Field School (FFS)
- Farmer-to-farmer extension
- Field tours/exchange visits
- Rural radio

◆ **Farmer training sessions**

The research team supported by MOFA staff conducted training sessions for farmers in small groups on the implementation of selected technologies. These training sessions did not only outline processes for the establishment of on-farm trials and demonstrations but they provided farmers with in-depth information on the entire

technological packages that were being delivered. Beyond providing thorough understanding of these packages the training sessions also allowed farmers to conduct the trials and demonstrations in the context of their socio-economic and ecological environment. The sessions provided capacity building opportunities of farmers not only for the program but also for their economic activities. Interaction between farmers on the one hand and extension agents and researchers on the other at these sessions allowed researchers and extension agents to have a better understanding of farmers' problems and socio-economic situation for the adaptation of the technological packages.

- **On-Station experiments**

On-station experiments are often deployed for the development of new technologies and their verification under different agro-ecological conditions. For all three technological interventions, CSIR-SARI conducted on station experiments at Navrongo and Tamale zones to verify their usefulness in addressing low soil fertility and inadequate soil moisture constraints in the agro ecological zones of CPW&F. Though these sites were for technology verification the research team utilised them as means of reaching out to farmers with the technologies through conduct of open and field days when farmers visited the sites. Further, at stakeholder fora and meetings, the research team exposed or shared with participants (extension agents and farmers) results of these experiments to confirm the effectiveness and applicability of the technologies in addressing farmers' constraints.

- **On-farm Adaptive trials**

On-farm adaptive research (OFAR) which is sometimes referred to as on-farm adaptive trial (OFAT) is the validation and or adaptation of general recommendations (developed elsewhere (on-station or otherwise) under controlled experimental conditions) to specific farming situations, in particular to farmers' resources and abilities, cropping patterns and actual farm conditions. They are planned by extension, research and farmers together, executed by extension with farmers (on farmers' fields) and analysed by extension, research and the farmers. On-farm adaptive trials provide opportunities for farmers to examine indigenous ideas or alternatives to the problem at stake and making the necessary adjustments to ensure the final technological recommendation becomes more relevant and applicable by the participating farmers.

Reports indicate that CPW&F in Ghana utilised on-farm adaptive trials methodology (in 11 communities in the two zones: Tamale and Navrongo) to allow farmers to understand, adopt and adapt all three technological interventions including mineral fertiliser micro-dose, tied ridging for soil water conservation and the integrated cropping system of the savannah eco-farm. Field days and or open days were organised to enable stakeholders to have first hand assessment of the trials while affording them the opportunity to interact and share experiences.

- **Farmer Field School (FFS)**

Farmer Field School is an "alternative learning and problem-solving" approach for extension delivery. CPW&F in Ghana utilised this approach in Kandiga and Wayamba to "educate farmers on fertilizer micro dosing and tied-ridging". Participants of the school were taken through practical demonstration of sorghum and maize production – from seed and field selection, planting, agronomic practices including water harvesting through tied ridging, chemical fertiliser micro dosing through to harvesting and post-harvest management of sorghum (*var. Kapaala)* and maize (var. *Obaatampa*).

This approach can significantly improve farmers' knowledge of new technological options through a purely "hands-on" approach. Nevertheless the cost-effectiveness of this approach as an alternative methodology for extension service delivery need be assessed. Beyond experiential learning and sharing that FFS provides to participants, benefits from management skills acquired need to be observed for a long time.

- **Farmer-to-farmer extension**

Informal networks among farmers have always been powerful channels for exchanging information and agricultural inputs especially seed in the developing countries such as Ghana. Several programs and projects are formalising and linking such networks for knowledge sharing and learning. This extension methodology cannot be underrated in closed communities and especially for graduates of FFS as carried out by the research team and other resource personnel of CPW&F in Ghana. Farmer-to-farmer extension approach may involve the use of individual and or group extension communication methods.

Interaction with farmers involved in the CPW&F revealed that they utilised this methodology in sharing information and experiences and even resources of seed. From each of the thirty (30) individual participating farmers interviewed, an average

of five (5) non-participating farmers was indicated as having benefited from CPW&F interventions through farmer-to-farmer extension contact. The distribution of improved planting material (*kapaala, obaatampa,* and *apagbaala)* amongst farmers was the highest of farmer-to-farmer activities beyond informal discussions on benefits of tied ridging, SEF and micro-dose of mineral fertiliser interventions.

◆ Field tours and Exchange visits

The facilitating research team utilised exchange visits and field tours by project partners to different experiments and on-station as well as on-farm adaptive trial sites. This approach further strengthened collaborative work through interactions and exchange of experiences amongst participating farmers and extension agents. It also afforded farmers and other participants to observe the applicability of technologies demonstrated in specific environments. It is on record that a total of 24 farmers from ten communities participated in organised field tours and exchange visits.

◆ Radio discussions

The use of radio as an extension approach is becoming very important as a common source of information across the width and breadth of Ghana. Almost all communities under the CPW&F have access to one radio station or another. Community members reached during this study indicated their being in possession of FM radio sets and tuning in regularly to FM broadcasts during the day.

Atengdem (2007) observed that occasionally MOFA and the NGOs use FM stations for regional level programmes – e.g. broadcasting epidemics, livestock immunization schedules and one-time policy messages. He further indicated that regional directorates of MOFA in all three regions (Northern, Upper East and Upper West Regions) sponsored regular and periodic broadcasts especially when pilot and special projects are being undertaken in the regions. Research facilitators of CPW&F in Ghana utilized radio to create awareness of the project, discussed technologies tested and provided a feedback mechanism through "phone-in" facilities for questions and clarifications. English and some of the local languages e.g. *Dagbani,* and *Kassem* were used at Radio Savannah (Tamale) and URA Radio (Bolgatanga) respectively. Resource persons for such radio programs included research resource team, MOFA extension agents and participating farmers of the CPW&F. This provided farmers with the opportunity to give testimony of their experiences and achievements in the project. To

a smaller extent the radio afforded policy makers to hear about the project and its contribution to household food security. It was remarkable to note that some of the radio discussions were recorded and played back to farmer groups at the community level.

The study observed that with the farming systems approach to research backed by use of existing MOFA structures for extension delivery with the view to mainstreaming CPW&F, the choice of the afore-discussed extension approaches and methodologies was to afford farmers and extension agents take on the main responsibility of technology adaptation, adoption and dissemination. These approaches, consultative and collaborative as they were under the CPW&F smacked the otherwise normal "transfer of technology", "top-down approach" where "outsiders" (research and extension) believe they know what is best and farmers are expected to accept and implement ideas they receive, whether or not they see the need for it.

3.6 Effectiveness and impact of the extension approaches/methodologies used

The study observed that the strong stakeholder consultations and collaborations adopted as the main strategy to implement the CPW&F was in effect to connect, join or unite stakeholders through clearly defined mechanisms with the purpose of exchanging knowledge, information and experiences or expertise. This enhanced the adaptation and dissemination of the technologies that could address the declining soil fertility and inadequate soil water for efficient crop production.

3.6.1 Training sessions

The sessions provided capacity building opportunities of farmers not only for the program but also for their economic activities. Beneficiaries of the training sessions indicated the fact that they were empowered through the learning process thereby improving their performance. Interaction between farmers on the one hand and extension agents and researchers on the other at these sessions allowed researchers and extension agents to have a better understanding of farmers' problems within their socio-economic environment thereby allowing for the adaptation of the technological packages.

Pre-season training sessions continued to build the capacities of extension agents to enable them facilitate the conduct of on-farm adaptive trials and demonstrations beyond solving the many and varied farmers' problems.

3.6.2 On-farm adaptive trials and On-station experiments

The annual conduct of on-farm adaptive trials and on-station experiments continued to confirm/validate the potential of soil, water, nutrient and crop management to improve resource use efficiency and improve crop yields. Whereas the on-farm adaptive trials were farmer-managed (with AEA providing guidance) the on-station experiments were AEA managed with research supervision.

3.6.3 FFS

The farmer field school approach significantly improved farmers' knowledge of the new technological options to address low soil fertility and erratic rainfall pattern through a purely "hands-on" approach to crop production system. This indeed was experiential learning by participating farmers and they confirmed it empowered them to improve their performance not only for CPW&F but their approach to farming as a whole.

3.6.4 Farmer-to-farmer extension

Though not widely recognised as a formal extension approach, the impact of farmer-to-farmer extension methodology cannot be under-rated. Beyond sharing of resources especially newly introduced crop varieties, it affords farmers to share their experiences without an external facilitating agent. Since community members know themselves they tend to have more trust for this network of information sharing than the systems that are externally manipulated or facilitated. Farmers tend to have more trust for their peers than an external facilitator. It was therefore common to learn that some non-participating farmers used some improved seed of *obaatampa* (maize) and *apagbaala* (cowpea); while others practised tied ridging on their own..

3.6.5 Field tours/exchange visits

The interactions between project partners, farmers and other stakeholders during field visits provided encouragement particularly to farmers and also opportunities for partners to improve on the implementation of the program where ever necessary.

Field tours and exchange visits afforded participating partners to observe the applicability of the technologies under varied conditions both within the same agro-ecological zone and outside.

3.6.6 Rural radio

The impact of rural radio as an extension methodology requires no elaboration. While enhancing a wider coverage (reach to farmers) with agricultural information and technologies, the use of participating colleague farmers for radio discussions on experiences could not have been more convincing to other farmers than ever. The major advantage of this is that farmers' experiences with the technologies involved are often readily acceptable by their fellow farmers and are site-specific. Besides resource farmers indicted that some sense of pride was felt as they reacted to colleague farmers' questions through the "phone-in" programs and discussions.

4.0 Lessons learnt

The implementation of the CPW&F in Ghana provided opportunity for stakeholders to learn a few lessons which could inform subsequent agricultural programming in the project area or outside. This section attempts to summarise some of the key lessons learnt.

4.1 Farmer Field Schools (FFS)

Both farmers and facilitating resource team for the CPW&F observed that the farmer field school extension methodology was very exciting as it provided opportunity for all to express themselves. The resource team particularly noted that women were specially observed to be very vocal; making very good observations, indicating some level of empowerment has been achieved. It is worth noting that in some parts of the project catchment area it is very uncommon to have women freely interacting with their male counterparts; hence this observation at the FFS was a breakthrough of the norm.

4.2 On-farm adaptive trials

The research resource team noted that it demanded frequent visits to on-farm adaptive trial sites to collect data. Nevertheless, the conduct of on-farm adaptive trials combined with stakeholder fora and meetings forged direct links between research and farmers; making research to respond to client needs and the development and adaptation of technologies that the farmers could adopt. "Through the consultative and collaborative methods like FFS, on-farm adaptive trials, and radio programs, etc, researchers are now reaching more farmers than before" stressed Dr. Kanton. Researchers also drew on farmers' knowledge and ideas for the adaptation of the technologies available.

4.3 Radio Programs

It was generally reported that radio programs were very useful as farmers who facilitated radio discussions shared experiences with other farmers through phone-in facilities. Farmers who participated in some of the discussions indicted the sense of pride instilled in them while they facilitated the program.

4.4 Stakeholder participation

Involvement of stakeholders of CPW&F right from project inception throughout implementation, monitoring and evaluation provided the desired effect. Staff of MOFA (at all levels), the research resource team and farmers understood their respective roles and responsibilities to the project and demonstrated commitment to achieving results. Farmers readily committed their time and fields for meetings, activities and experiments to be conducted. MOFA staff acknowledged the project was a contributory intervention to address the most outstanding constraints of water and soil infertility to agricultural production in the area; hence it was part and parcel of their responsibility to see the project through – mainstreaming the project. Research found it their responsibility to address agricultural constraints through the development and adaptation of technologies. Links between research and their clients – farmers and technology transfer agents are vital for technology development and delivery.

5.0 Challenges

While a number of lessons were learnt, some challenges were also noted in the course of project implementation.

5.1 Unpredictable weather

The CPW&F sought to address the constraint of water to agricultural production. The research facilitating team observed that the tied ridging technology was most appropriate for agro-ecological zones with about 600mm of rainfall. Thus for the 2007 and 2008 season where the project area for the CPW&F experienced exceptionally high rainfall, the purpose of the technology was almost defeated. Fields that were tied ridged were ponded temporally resulting in leaching of plant nutrients. The development of a very reliable weather forecasting system alongside inputs of Meteorological Services Department could help scientists identify strategic technologies to be promoted at the farmer level.

5.2 Logistics

Logistical constraint such as the lack of dedicated pro-ject vehicle was identified by the research team as a major constraint to the effective and efficient implementation of the project. The team members indicated some level of frustrations they encountered due to frequent breakdown of old vehicles in the course of project implementation. In the same vein inadequate equipment including soil moisture monitoring devices was also indicated as a challenge to the research team.

5.3 Data Collection

While acknowledging the advantages of stakeholder collaboration for the implementation of the CPW&F, the co-operation of MOFA AEAs in data collection for

the on-farm adaptive trials fell below expectation. The research team indicated that despite AEA pre-season trainings provided to guide them on how to carry out the trials, some data collected could hardly be analysed. Besides some AEAs were not timely available for some programs to be executed. It is here proposed that some technicians from the research stations could be mobilized to provide technical backstopping to MOFA AEAs for such critical areas like field data collection from on-farm adaptive trails. It was also a challenge for research team with respect to frequent visits to project sites for data collection as well as monitoring of field activities.

5.4 Funding

Stakeholders acknowledged funding provided for CPW&F implementation as an intervention to meet major constraints of water and soil infertility for agricultural production in the project area. Nevertheless, key facilitators–research and MOFA observed that the release of funds was "sporadic, virtually untimely, and not considering the cropping season of the project area". This delayed availability of funds to research team and consequently delayed provision of inputs for on-farm adaptive trials and demonstrations.

5.5 SEF Program

The seedlings of the tree species - *Ziziphus mauritiana* and *Acacia coli*- used for the Savannah Eco Farm system were imported. Key stakeholders: MOFA, farmers and the research facilitators observed the non-sustainability of this strategy: annual importation of tree species seedlings, noting the rather low survival rate of the seedlings under farmer management. It resulted in loss of resources. Participating farmers indicated their preference for local tree species especially grafted mango to replace *Ziziphus mauritiana.* This reflects a rather top-down approach to technology introduction as it appears there was not adequate consultation with farmers and alternatives given to them with respect to incorporation of fruit tree species in their cropping system with the view to providing extra farm income from fruits harvested.

5.6 Fertiliser micro-dose

A very common challenge experienced with the chemical fertilizer micro-dose intervention was the fact that farmers preferred dropping the fertilizer by the

crop stand instead of dibbling it as recommended by research. Besides this challenge, farmers contacted expressed their desire to apply fertilizer to their maize crop rather than sorghum which they did not normally fertilise. This was regardless of benefits demonstrated from micro-dosing of the sorghum crop *(Kapaala)*. Farmers indeed recognised the rather lower response of local sorghum variety to chemical fertiliser than the *kapaala*. However, to the farmers maize was a better and preferred valued crop than sorghum hence their desire to use fertilizer on maize.

Much as consultative approaches were deployed to allow for farmers' input and contribution to the implementation of CPW&F, use of fertiliser on sorghum appeared contrary to farmers' normal practice. Demonstrations (on-farm and adaptive trials) on chemical fertiliser micro-dose were meant to further convince farmers' of the technology. Nevertheless, adoption of the technology (for sorghum) was not widespread. This is normal as studies have shown that farmers sometimes do take quite some time to assess the benefits or otherwise of a technology before they adopt it. Farmers do go through self-examination processes – adoption process- to accept a new practice.

6.0 Recommendations

6.1 Institutional collaboration

Institutional collaboration sought to bring key stakeholders of CPW&F together to enhance effective and efficient participation for the attainment of project goals. The clear definition of roles and responsibilities of stakeholders at the initial launch of the project is worth acknowledging, and this is therefore recommended for future projects and programs. This strategy does not only allow for mainstreaming of project activities into normal work programs of stakeholders, it also assures some sustainability.

6.2 Participatory monitoring and evaluation

Reij and Steeds (2003) stated that success is not always underpinned by hard data about impacts or costs and benefits but rather adequate monitoring and evaluation of inputs and outputs and above all, outcomes remains a weakness to be addressed by many projects and programs. The institutional collaboration and mainstreaming strategy of CPW&F should go beyond definition of roles and responsibilities (for effective participation) to institutionalise participatory monitoring and evaluation of field activities. It is only by this that stakeholders can appreciate outcomes and challenges of their own efforts and be prepared to strategise for improvement. Regular participatory monitoring and evaluation is recommended.

6.3 FFS

The impact of Farmer Field School as an extension approach was acknowledged by farmers, MOFA staff and research facilitators as the most effective "hands-on" methodology to guide farmers through new interventions. Key stakeholders have further recommended that this should be the main approach for subsequent

programs but it needs to focus on a few strategic locations and adopting an integrated approach, i. e. demonstrating tied ridging alongside fertiliser micro-dose and using improved varieties.

6.4 SEF Program

It has already been highlighted earlier on that the SEF program could chalk better success if local tree species were identified and used for the SEF program as against the annual importation of exotic tree species which failed to thrive under farmer management at the seedling level.

6.5 Capacity building

Capacity building of AEAs should be intensified to enable them understand what is involved and required of them in the conduct of demonstrations and guiding farmers for the on-farm adaptive trials. This will forestall improved data collection for analysis.

6.6 Integration of livestock

It was observed that most farmers participating in the CPW&F practised mixed farming –livestock rearing and crop production. In an effort to reduce poverty, and improve food security, incomes and livelihoods of small-scale resource-poor farmers, a holistic approach should be considered. The integration of live-stock aspects into the technologies being promoted would be most appropriate.

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Appendix

Appendix 1

List of contacts made

Civil and public servants

LOCATION	ORGANISATION	NAME	POSITION	REMARK
Kassena/ Nankana District	MOFA/DADU	1. Gregory Awekeya	AEA – Doba	
		2. Banape Asigibe	AEA – Navrongo Central	
		3. James Atarigiya	DAO–Kandiga	
		4. James Ayana	AEA-Nangalikania	
		5. David Aduku	AEA–Tono	On-station
Bolgatanga	MOFA/RADU	6. Roy Ayariga	RDA	
		7. A. R. Z. Salifu	DRDA/RAO Extension	
		8. Lantana Osman	Projects' Officer	
Tolon/ Kumbungu	MOFA/DADU	9. Hawa Musah	DDA	
		10. Dr. James Kombiok	Agronomist	
	CSIR/SARI	11. Dr. Mathias Fosu	Soil Scientist	
Wa Bawku		12. Dr. S. S. Buah	Agronomist	
		13. Dr. R. Kanton	Agronomist	
Tamale	MOFA/DADU	14. Paul Niendow	DAO	
		15. Mr. Akorfor Kwame	DDA	
		16. Mr. S. A. Adongo	RDA	
	MOFA/RADU	17. Mr. M. A. Addah	DRDA	
		18. Mr. Ahmed Tijani	RAO- Crops	
Accra	MOFA/DAES	19. Dr. Kwame Amezah	National Director	

Individual farmers

Name Of Farmer	Community	District
1. Ibrahim Nemdow	Mbanayih	Tolon/Kumbungu
2. Sule Tahiru	Mbanayih	
3. Abukari Dokurugu	Mbanayih	
4. Alhassan Dokurugu	Nwodua	
5. Abukari Mahama	Nwodua	
6. Mohammed Abdulla	Nwodua	
7. Mohammed Baporow	Kpilo	
8. Alhassan A. Hamuna	Kpilo	
9. Iddi Abdul-Rahaman	Kpilo	
10. Margowet Agobumo	Kandiga Junction	Kassena/Nankana
11. Atorim Asakeya	Kandiga Junction	
12. Abiro Atubiga	Kandiga Junction	
13. Atea Azarido	Doba	
14. Regis Ayomba	Doba	
15. Adibura Alanke	Yigwama	
16. Apiri Chaporo	Nangalikinia	
17. Aneba Akatayire	Nangalikinia	
18. Anetrive Akelumva	Kandiga Bembisi	
19. Adoku Akande	Kandiga Bembisi	
20. Azaare Akantugiya	Kumbusiugo/Mirigu	
21. Agnes Apuriywwre	Kumbusiugu/Mirigu	
22. Paul Avalmbuno	Kandiga/Bembisi	
23. Madam Agws Apuriyure	Kumbusiugu Mirigu	
24. Azaare Akuntugiya	Kumbusiugu/Mirigu	
25. Paul Avalum Bono	Bembisi/Kandiga	
26. Kaba Namoho	Navrongo	
27. Apialore Banyow	Navrongo	
28. Wemulore Nyangaa	Navrongo	
29. Sauwuye Bawiu	Navrongo	

Farmer groups

Name of Group	Location
1. Kumbusiugu Women's Group	Kumbusiugu/Mirigu
2. Adiginongo Farmers' Group	Kumbuisugu/Mirigu
3. Bembisi Vegetable Growers	Bembisi/Kandiga
4. Yigwania farmers' association	Yigwania/Nangalikania
5. Atababa vegetable Farmers' Association	Kandiga Junction
6. Agrumalia Farmers	Kandiga Junction
7. Gayingo Youth farmers	Doba