PROCEEDINGS OF WORKSHOP ON

TRANSFER AND COMMERCIALIZATION OF AGRICULTURAL TECHNOLOGIES

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THEME

TRANSFER & COMMERCIALIZATION OF AGRICULTURAL TECHNOLOGIES: PROSEPECTS FOR SMALL AND MICRO SCALE ENTERPRISES DEVELOPMENT IN GHANA

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SUMMARY

Increasing agricultural productivity requires access to new and improved technologies. Agricultural research is the major activity through which such technologies can be generated. Substantial progress has been made in the development of technologies in Ghana and other sub-Saharan Africa countries but their impact on agricultural productivity has been minimal. Many analysts of this situation have attributed it to ineffective technology transfer mechanisms.

To help find solution to this problem, the Semi-Arid Food Grain Research and Development (SAFGRAD) of the Scientific, Technical and Research Commission of the Organization of African Unity (OAU/STRC) in collaboration with the national agricultural research systems (NARSs) of Ghana, Senegal and Burkina Faso started a programme in 1998 to promote the transfer and commercialization of agricultural technologies.

This workshop was organized as part of activities towards the achievement of objectives set under the programme. In a welcome and opening address Prof J. C. Norman, Deputy Director-General of the Agriculture, Forestry and Fisheries Sector, CSIR informed participants that the programme is based on the premise that there are constraints in the technology transfer system and that the major objective of the programme is to effect interventions for the transfer and commercialization of technologies. He noted however that very often such interventions by various organizations are mainly targeted at the farm sector and called for more or equal attention to be given also to the non-farm sector which is also essential for the development of agriculture.

Held under the theme "Transfer and Commercialization of Agricultural Technologies: Prospects for Small and Micro-Scale Enterprise Development in Ghana' the workshop was attended by 43 participants from research institutions, technology transfer agencies, non governmental organizations (NGOs) and small and micro-scale entrepreneurs. In all 16 papers were presented under three sub-themes. The proceedings are in three parts representing the sub-themes under which various papers were presented. Part One under the sub-theme of 'Technology as a Factor of Production: Ghana's Experience with Small and Micro Enterprises Development and Prospects for the 21st Century' has seven papers. The lead paper traces the history of the development of small and micro enterprises (SMEs) in Ghana after the attainment of independence in 1957. It notes that much has been achieved since then through the support provided by government by establishing various institutions to provide technical and managerial training, and generate and transfer technologies.

Some of the benefits that the country and many small and micro scale entrepreneurs have derived from this support are captured in one of the papers which focuses on the achievements of the Ghana Regional Appropriate Technology Industrial Service (GRATIS) since its establishment in 1987. Support for the development of SMEs has not come from the

Government of Ghana alone. Non governmental organizations (NGOs) have also been making significant contributions. And in another paper the provision of assistance in the export of non-traditional crops, palm oil processing, grain storage and marketing, rural finance intermediation and research and development are listed as some of the reasons why Technoserve (an NGO) is ranked among the country's top development institutions.

In spite of these efforts, SMEs still face various types of constraints. Some of these constraints which were highlighted in the papers are trade liberalization which has resulted in lack of markets for local products, the continuous devaluation of the cedi, lack of networking/linkages among government and non-governmental agencies and limited knowledge of technology which results in the production of low quality products. Others are lack of constant supply of raw materials for processing, difficulty in identifying and obtaining small scale equipment to mechanise labour-intensive processes, very high interest bank rates and intimidating borrowing systems which exclude small and micro scale entrepreneurs. However, the main message from all the papers is that technology is an indispensable element in the development of SMEs in Ghana. The Chapter concludes on progress made since June 1998 in two projects established under the Technology Transfer and Commercialization Programme as part of efforts to remove these constraints.

The importance of establishing linkages to assist in the removal of these constraints is given prominence in Part Two which features six papers under the sub-theme 'Building and Strengthening Linkages: The Crucial Needs of Technology Transfer and Commercialization'. The Chapter starts with a paper showing how linkages established with fish smokers at Chorkor by the Food Research Institute led to the design and development of the Chorkor Smoker which is now widely used in most fishing communities not only in Ghana but in other West African countries. The smoker has also received wide acceptance in Central and Eastern Africa. This high rate of adoption is attributed to the involvement of the beneficiaries from the beginning of the development of the oven and subesequent phases. Ghana's experience in efforts to improve research extension linkages through the formation of the Research Extension Liason Committees (RELCs) is the focus of one other paper whilst another one provides information on how the Adventist Development and Relief Agency (ADRA), an NGO has been able to improve research extension linkages resulting in increases in the adoption rates of an improved variety of orange, 'the Late Valencia Sweet Orange' and the yam mini-sett technique.

The rest of three papers in Part Two are on activities of three public sector technology transfer agencies. These agencies are the Directorate of Agricultural Extension Services (DAES) of the Ministry of Food and Agriculture (MOFA), the Development and Application of Appropriate Technology (DAPIT) of the Ministry of Environment, Science and Technology (MEST) and the Technology Consultancy Centre (TCC) of the University of Science and Technology. The activities of DAPIT portray an organization that is committed to the development of both the farm and non-farm sectors to enhance rural development, while those of the TCC emphasise the non-farm

sector and the development of entrepreneurial skills. The Chapter ends with a paper which brings to the fore progress being made in the improvement of technology transfer since the decentralization of MOFA in 1998.

Part Three held under the sub-theme 'Enhancing Technology Transfer and Commercialization Using Advances in Information Technologies' saw the presentation of two papers. The first drew the attention of participants to advances made by the Library System of the Council for Scientific and Industrial Research (CSIR) in the acquisition and dissemination of information for the improvement of technology transfer and entrepreneurial development. It called for regular and adequate funding so that the system can benefit from the latest innovations in information technologies. The second and last paper of the proceedings gave participants an insight into the INTERNET as the latest innovation in information technologies which is seeing improvements at very fast rates and its role as a powerful tool for accessing and transferring technologies for entrepreneurial development

WELCOME AND OPENING ADDRESS

BY

PROF J. C. NORMAN
DEPUTY DIRECTOR-GENERAL
AGRICULTURE, FORESTRY AND FISHERIES SECTOR OF THE CSIR

Directors of CSIR Research Institutes,
Dean of the Faculty of Agriculture, University of Ghana,
Heads and Representatives of Technology Transfer Agencies,
Small Scale Entrepreneurs,
Distinguished Guests,
Ladies and Gentlemen.

On behalf of the management teams of the Council for Scientific and Industrial Research (CSIR) and the Semi-Arid Food Grain Research and Development (SAFGRAD) of Ouagadougou, Burkina Faso I wish to extend a warm and cordial welcome to all of you to this two day workshop on Transfer and Commercialization of Agricultural Technologies. As you may be aware the CSIR and SAFGRAD signed a Memorandum of Understanding (MOU) in April, 1998 to promote the transfer and commercialization of agricultural technologies in Ghana. One of the specific roles of the two organizations as partners in the implementation of the MOU is to assist the Agriculture, Forestry and Fisheries Sector of the CSIR to organize annual mini-workshops to address issues of technology transfer, the development of agribusiness by the private sector in particular, and to strengthen partnership among stakeholders for enhancing commercialization in agriculture.

This workshop is therefore the first of a series of such mini-workshops. Other structures already put in place for the fulfillment of the terms of the MOU are the establishment of the National Stakeholders Committee and the appointment of a National Co-ordinator. In addition, SAFGRAD approved three projects last year. Two of these projects, 'Increasing Vegetable Oil Seed Production and Processing in Northern Ghana' and 'Promotion of Appropriate Household and Small-Scale Soybean Utilization Technologies for Selected Rural Communities in Ghana' were started in June, 1998 at the Savanna Agricultural Research Institute and the Food Research Institute respectively. During the course of the workshop we shall learn of progress already made in the transfer of existing technologies under these projects. The third project titled 'Appropriate Canning/Bottling System for Training Small-Scale Food Processors in Ghana with Particular Reference to Pepper Sauce (Shittor) Producers' is yet to take off as the beneficiary association, the Glass Jar Users Association, is still seeking further support from other organizations for the importation of cans so that the project can take off.

Distinguished Guests, Ladies and Gentlemen, these efforts undertaken so far by the CSIR and SAFGRAD are aimed at achieving the primary objective of the Technology Transfer Grant Programme which is to effect interventions for the transfer and commercialization of agricultural technologies. The goal of

the programme is therefore to enable our National Agricultural Research System and other partners to improve on their efficiency of technology transfer and to concurrently document the process and lessons that will lead to micro-enterprise development. It is based on the premise that productive technologies exist, but that there are constraints in the technology transfer system. The grants under the programme are therefore to be used to finance mainly activities which have known histories or evidence of practicability.

In Ghana after many years of research and the increasing use of on-farm trials in our research programmes, technologies with proven records of practicability no doubt abound. The promotion of such technologies have, however, been targeted at improving farming activities in crop production, animal husbandry and the like. So far not much has been done to propagate productive technologies in the non-farm sector. A recent study conducted by a consultant on micro enterprise development in Ghana found that most technologies developed by the Food Research Institute have been grossly under-utilised and commercialized. Some analysts of this situation have attributed it to pre-independence policies that had no concrete plans for developing viable rural industries in Africa. Whatever be the reasons, the situation is a reflection of the classical view of agriculture as one which centres on the farmer. But agricultural development cannot be brought about by farmers alone.

In 1966 A. G. Mosher argued that the following facilities and services are required for the development of agriculture:

- Markets
- Constantly Changing Technologies
- Transportation
- Production Incentives for Farmers
- Local Availability of Supplies and Equipment

Each one of these services is essential and agriculture does not develop in the absence of any one of them he further stated. The provision of these facilities and services accounted greatly for the development of the cocoa industry in Ghana ever since Tetteh Quarshie brought the first cocoa seeds from Fernando Po during the latter part of the 19th century. Markets, transportation, production incentives and inputs were provided by the Cocoa Marketing Board while the then West Africa Cocoa Research Institute now the Cocoa Research Institute of Ghana provided new technologies.

Another example of the interdependency of these five essentials in the development of agriculture may be seen in the recent developments in the oil palm industry around Twifo Praso, Benso and Kwae areas. In these areas Oil Palm Development Companies which provide essential markets for inputs and outputs for agricultural activities and production incentives for farmers have been set up while the Oil Palm Research Institute of the CSIR has been the source of most technologies. In addition many small scale oil palm processing

factories have sprung up in these areas to add value to the produce of the farmers before they are sent out to the urban areas for marketing.

In contrast relatively little progress has been made in the development of most food crops due mainly to the absence of some of these five essentials. The lesson from these scenarios is that the viability of agriculture depends on undertaking it as a continuous process comprising input acquisition and distribution, on-farm production and off-farm activities including agro-processing, storage, transportation and marketing. Agricultural production is, therefore, a multi-stage process consisting of

- An input supply stage
- An on-farm stage, and
- An off-farm stage

Though the three stages are equally important for the rapid growth and development of agriculture, there is empirical evidence that research induced efficiency in off-farm activities, such as transportation and marketing results in a greater benefit to farmers and consumers than farm level induced efficiency. This is because as a rule, the consumer pays more for the services associated with farmers products than for the basic raw materials produced by the farmer. Available evidence in Ghana indicates that about 30% or less of consumer expenditure on food goes to the farmer or fisherman: the remainder goes to processing, packaging, transportation, storage, distribution and profits of non-farmers who provide services to convert farmers' output into food.

This evidence shows that in order to enhance food security in Ghana we need to pay more attention to the development of the non-farm sector such as the establishment of more small scale food processing factories. More significantly it provides support for the establishment of programmes such as the Technology Transfer Grant Programme which have the goal of promoting the development of micro enterprises.

We do realize that the achievement of this goal and objectives of this programme would depend on collaborative efforts between The Technology Transfer Grant Programme and other stakeholders. For this reason we have invited the Heads or representatives of Technology Transfer Agencies in Food Processing Technologies such as the National Board for Small Scale Industries (NBSSI), Technoserve, Adventist Development and Relief Agency (ADRA), Ghana Regional Appropriate Technology Industrial Service (GRATIS), the Development and Application of Intermediate Technologies (DAPIT), the Directorate of Agricultural Extension Services (DAES) and Women in Agriculture Development (WIAD) to this workshop. Also invited are representatives of AMEX International and the Opportunities Industrialization Centre International (OICI) who are involved in technology transfer and commercialization.

We believe that the interactions that they will have with the Directors of our Research Institutes, Heads of other Research Institutions and small scale

entrepreneurs will lay a strong foundation for the development of effective linkages for the promotion of productive technologies for the development of the non-farm sector. When this is done we shall be respecting the first law of ecology developed by Polybius some 2,000 years ago that everything is connected to everything else.

However, as in everything the times are changing. The world has within the last few years seen dramatic acceleration in the development and use of information and communication technologies. This development is affecting all aspects of our life and opening new opportunities and challenges for all. We shall be examining some of these opportunities and challenges during the workshop to see how we can use them to enhance transfer and commercialization of agricultural technologies.

Finally, Ladies and Gentlemen, let us remember that the process of getting food and fibre to all people in the right form at all times and at the right time is extremely complex. It cannot therefore be met through the provision of support to only farmers but through support to many others that form the link in the chain starting with researchers, suppliers of inputs to marketing produce, processing and ultimate sale to consumers.

On that note I wish to welcome all of you once again to the workshop on the Transfer and Commercialization of Agricultural Technologies and hope that your deliberations will help the Technology Transfer Grant Programme achieve its goal and objectives.

Thank you.

PART ONE

SUB-THEME

TECHNOLOGY AS A FACTOR OF PRODUCTION:
GHANA'S EXPERIENCE WITH SMALL AND MICRO ENTERPRISES
DEVELOPMENT AND PROSPECTS FOR THE 21ST CENTURY

TECHNOLOGY AS A FACTOR OF PRODUCTION: GHANA'S EXPERIENCE WITH SMALL AND MICRO ENTERPRISES DEVELOPMENT AND PROSPECTS FOR THE 21ST CENTURY

BY

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INTRODUCTION

Technology has always been viewed as an important factor of production. The efficient utilization of the resources of any nation depends on the level of technology. Technology has become an increasingly important dimension in economic growth. The rapid development and application of technology have impacted on production structures and organization with consequent effects on economic growth and income distribution in many countries.

The role of technology in the development of small-scale industry is very important. Without technologies capable of making small industries technically efficient and competitive in the production of goods and services, the promotion of small scale industry as a strategy for extensive income and employment generation cannot yield the desired results.

In Ghana's efforts to promote small-scale industries to enhance the prospects for equitable and employment-expanding economic development, many institutions had been set up with programmes to produce, adapt or transfer technology suitable for small-scale industries.

It is with this background that Ghana's development of small and micro enterprises development will be examined.

DEFINITION OF SMALL AND MICRO ENTERPRISES

Before I go further, I will pause to define what Small and Micro Enterprises are. There are many definitions for "small " and "micro" enterprises but for the purposes of this paper I will use the definition used by the National Board for Small-scale Industries, the Governmental apex body for Micro and Small enterprises development. **"Micro and Small Enterprises are defined as those Enterprises employing 29 or fewer employees. Micro Enterprises are those that employ between 1-5 people or with fixed assests of value not exceeding 25 million cedis excluding land and building. Small Enterprises employ between 6-29, or 250 million cedis, excluding land and building".**

THE HISTORY OF THE DEVELOPMENT OF SMALL AND MICRO ENTERPRISES IN GHANA

After independence Ghana embarked on a big push for economic development by investing in large scale industries which focused primarily on import-substitution production in order to break economic dependence on imported items. Local manufacturing industries set up by government depended heavily on imported capital goods and raw materials. This strategy enabled Ghana to experience rapid growth rates and by 1976 industry accounted for 21.1% of GDP with manufacturing accounting for 13.8% of GDP.

The economic decline of the 1970s generated balance of payment structural deficits and severe foreign exchange shortage and by 1984 the share of industry and manufacturing in GDP had declined to 11.6% and 7.2% respectively. In Ghana's initial efforts of rapid industrialization the role of free enterprise in economic development was played down or ignored resulting in the neglect of the entrepreneurial class as their advancement was hampered by unsympathetic policies towards private enterprise.

INSTITUTION FRAMEWORK TOWARDS SMALL AND MICRO ENTERPRISES DEVELOPMENT

Since the earlier government efforts in industrialization in the 1960s resulted in inefficient and unproductive large manufacturing industries, unemployment and shortage of essential goods, successive governments after that period paid more attention to the development of private small-scale enterprises.

In 1970 the then government established the Office of Business Promotion (OBP) which later became the Ghanaian Enterprises Development Commission (GEDC) in 1975 to promote and develop small scale enterprises by providing both financial and technical assistance. Also during that period, government created a Credit Guarantee Scheme to support institutional lending to the sector.

The Bank of Ghana managed this credit scheme. Although this achieved some measure of success the Bank of Ghana discontinued it partly because the lending banks were not rigorous in the screening and selection of borrowers. The Bank therefore became unwilling to assume the liabilities of defaulting borrowers under the Credit Guarantee Scheme.

In spite of some setbacks of these earlier schemes, Government continued to provide support to the micro and small enterprises (MSE) sector. The government established a number of institutions to provide much needed technical, research and development as well managerial training for the sector.

The Institutions established by the government which have been involved in the promotion and development of the industrial sector including the Micro and Small Enterprises are:

1. **The National Board for Small-Scale Industries** (NBSSI) was established in 1985 as government apex agency for the development of micro and small enterprises.

   The Board creates an enabling environment for the developing of Micro and Small Enterprises (MSE). Other functions are credit delivery, entreprenuership development and management training.

   The Board has 10 regional secretariats and 10 Business Advisory Centres (BACs) in all the regions. The Regional Secretariats offer credit and administrative support and the Business Advisory Centres offer non-financial services.

2. **The Ghana Regional Appropriate Technology Industrial Services** (GRATIS) was established in 1987 to promote the establishment of Intermediate Technology Transfer Units (ITTUs) in all the regions of Ghana.

3. **The Development and Application of Intermediate Technology Project** (DAPIT) was established in 1984 jointly by the Government of Ghana and the United States to provide a national mechanism for the demonstration and delivery to the rural sector, intermediate technology that can contribute to increased production and income of the rural small scale industries.

4. **The Institute of Industrial Research** (IIR) was established in 1964 to conduct research into the development and promotion of new and improved products and processes in manufacturing industries whether small or large scale. Research activities cover electrical, mechanical and chemical engineering, materials and techno-economic studies.

5. **The Food Research Institute** (FRI) was established in 1964 to carry out a co-ordinated programme of applied research in the storage, processing, preservation and utilization of food with the aim of contributing toward the development and improvement of Ghana's food industries.

6. **The Ghana Standards Board** (GSB) was established in 1967 to promote standardization in industry and commerce, with the objective of ensuring high quality level in goods produced in Ghana whether for domestic consumption or for export.

7. **The Ghana Export Promotion Council** (GEPC) is an autonomous body established by the Ghana government in 1969. It is a national institution for export promotion and development.

8. **THE EMPRETEC GHANA is a comprehensive technical co-operation programme designed and executed by the United Nations Centre for Transitional Corporation** (UNCTC), with funding from UNDP and local sponsorship by the Barclays Bank of Ghana Limited and the National Board for Small-Scale Industries (NBSSI). The programme is expected to be sustained over long term, through contributions to an Endowment Fund set up for that purpose and also through other income-generating sources.

The EMPRETEC programme is intended to act as a catalyst for private sector participation in national development by helping and supporting entrepreneurs operating in the sector and thereby encouraging private sector enterprise and job creation.

9. **The National Council for Women and Development** (NCWD) was established in 1975 as an official national machinery for promoting the advancement of women in Ghana by enhancing their participation in development. The NCWD undertakes programmes in areas of employment, income generating, education, vocational training, counseling, information dissemination and the establishment of agro-cattage industries.

10. **The Women In Agricultural Development** (WIAD) of the Ministry of Food and Agriculture provides technical advice and training technology development and transfer in agriculture. The department also promotes agro-business, particularly food processing.

In addition to these governmental organisations or institutions various non-governmental organisations (NGOs) both local and foreign have been supporting the development and promotion of micro and small enterprises in their activities. The NGOs activities range from poverty alleviation programmes, health and educational infrastructural projects to support income generating activities in the rural areas, sponsorship of programmes by small business support institutions and provision of credit and non-financial services such as training and technical assistance.

CONSTRAINTS FACING MSEs

In spite of the above Institutional or governmental efforts to improve the development or micro and small enterprises (MSEs) the sector still faces a myriad of constraints. Among the constraints are the following:

- Trade liberalization has resulted in lack of markets for local products

- Dumping of cheap and shoddy goods and unfair competition from imported goods.

- Monetary Policy: The current exchange rate regime causes continuous devaluation of the cedi resulting in the need for bigger working capital. High interest rates coupled with insistence on collateral by banks prevent many from seeking bank credit thereby stifling investment.

- Some laws and regulations do not favour the growth of MSEs. For example registration of business which is over centralised.

- Lack of a uniform tax regime for the sector has resulted in multiplicity of levies and taxes.

- Inadequate information on the MSE sector at both the institutional and enterprise levels for meaningful planning of the sector's development.

- Lack of networking/linkages between government and non-governmental organisations.

- Attitudinal problem: Negative attitudes towards entrepreneurship, success and locally made products stifle growth of MSEs.

- The lack of an enterprise culture militates against the promotion of entrepreneurship in the country.

- Promotional agencies are not adequately equipped to address the needs of the sector.

- Dependency culture on the part of MSEs has prevented MSE operators from taking initiative and being innovative.

- Limited knowledge of technology has resulted in the production of low quality products by MSEs.

- MSEs encounter constraints in their efforts to access credit from the formal Sector.

These include:

- negative perception by banks, due to poor credit management by beneficiaries.
- weak credit delivery systems
- inadequate loanable funds, and
- the unresponsiveness of bank structure and orientation to MSE lending.

TECHNOLOGY DEVELOPMENT

i) **Factors Contributing to the Poor Use of Rudimentary Technology**

a) Poor linkages between research institutions and industry
b) Lack of co-ordination among research institutions
c) Inadequate funds for designing and developing marketable prototypes.
d) Weakness in the administration of science and technology at policy and implementation levels.

PROSPECTS FOR SME DEVELOPMENT IN THE 21ST CENTURY

As we move into the next millenium much will be expected of the Micro and Small enterprises sector. According to Ghana-**Vision 2020 document, "Small and Medium-scale Enterprises (SMEs) including micro enterprises, account for a significant share of economic activities in Ghana and can play an important role in achieving the development goals for production. The long-term goal is for SMEs to maximize their contribution to the country's economic and social development with respect to production, income distribution and employment and closer integration of women and people in rural areas into the national economy".**

On the question of Science and Technology the same Document enjoins Ghana among other measures to "**Adopt technologies, both local and foreign, which continuously improve efficiency in all types of production and make local production internationally competitive**".

With the above national vision on technology and the development of SMEs in view, the NBSSI in collaboration with Science and Technology institutions and other stakeholders will carry out its plan of activities in its Medium Term Plans to:

1. Upgrade indigenous technologies for adoption by local micro and small industries.

2. Establish Quality Information Centre for technological development

3. Provide industrial extension services to introduce Micro and Small Enterprises to modern processing technology.

4. Assist MSEs to acquire plant and equipment through hire-purchase schemes and leasing arrangements.

STRATEGIES AND ACHIEVEMENTS OF TECHNOSERVE IN SMALL AND MICRO ENTERPRISES DEVELOPMENT

BY

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ABSTRACT

Technoserve is a private non-profit, non-sectarian development agency founded in 1968 and operating in Ghana since 1971. Its organizational mission is to improve the economic and social well-being of low-income, rural people in developing countries through a process known as enterprise development. Technoserve and its development partners in Ghana believe that the following services, among others, are essential to overcome the existing constraints to improved market linkages and increased growth: in-depth analysis of potential agricultural subsectors to determine appropriate commodity/product focus and interventions, based on detailed market information; development of viable, replicable business models, based on such analysis; practical advice and assistance to small-scale farmers/processors on how to improve the effeiciency and quality of production to meet local industry and international standards; increase access to post harvest technologies to improve enterprise productivity and the quality of goods; training for micro enterprise owners and staff in business management and simple record keeping; development of innovative financial mechanism that can provide credit, advances from the private sector, and/or venture capital to rural enterpreneurs in a relatively low cost and low risk manner; training and incentives for relevant financial institutions to operate such financial scheme; and, formation and/or strengthening of producer and business associations in order to supply large-scale dependable buyers in a reliable and cost-effective manner.

Technoserve/Ghana programme of rural enterprise development consists of the following major components: Non-traditional export crop development; cereal crop storage and marketing; palm oil production and marketing; rural financial intermediation, and; research and development activities.

INTRODUCTION

What is Technoserve?

Technoserve is a private non-profit, non-sectarian international development agency founded in 1968 and operating in Ghana since 1971. Its organizational mission is to improve the economic and social well-being of low-income, rural people in developing countries through a process known as enterprise development. Specifically, TechnoServe fosters the establishment

[1] Paper presented on behalf of Dr Kwadzo by Mr W. Awoonor-Williams

and growth of small to medium-scale community based agricultural enterprises. It does so through an integrated approach assisting rural communities directly by providing them with managerial and technical assistance and training; and indirectly by providing similar services to various development institutions, government ministries, banks, technology centers and non-governmental organizations.

Working throughout Ghana, Technoserve assists organized groups of rural farmers and food processors to add value to agricultural products and, in so doing, to increase family incomes and local employment opportunities.

Technoserve currently maintains an extensive field presence for project implementation through twelve (12) locally staffed country offices in Africa, Latin America, and Eastern Europe. At Technoserve, the key to effectiveness is knowledge, capabilities, and motivation of its career staff of business and development professionals. Technoserve's staff of hand-on professionals are able to interact effectively with low-income rural populations, gaining the respect of both funding organizations and beneficiaries populations for the hard-work and dedication. Technoserve's current staff of business and development professionals consists of 300 highly qualified personnel, over 95 percent of whom are located in the field and are citizens of the countries in which they work.

Technoserve's Approach

Technoserve (TNS) believes that the key to promoting dynamic growth in the agricultural sector in Ghana is to develop viable small- and medium-scale rural enterprises, based on a thorough understanding of international and domestic market realities. TNS believes that small-scale producers will only be motivated to increase their production and productivity, and to supply products to local industries and exporters, if they are confident that they can sell their product at a reasonable profit to dependable buyers. While this statement may seem obvious, there are relatively few organizations promoting such linkages in Ghana today.

TNS and its development partners in Ghana believe that the following services, among others, are essential to overcome the existing constraints to improved market linkages and increased growth:

- in-depth analysis of potential agricultural subsectors to determine appropriate commodity/product focus and interventions, based on detailed market information;

- development of viable, replicable business models, based on such analysis; practical advice and assistance to small-scale farmers/processors on how to improve the efficiency and quality of production to meet local industry and international standards;

- increased access to post harvest technologies to improve enterprise productivity and the quality of goods;

- training for micro enterprise owners and staff in business management and simple record keeping;

- development of innovative financial mechanisms that can provide credit, advances from the private sector, and/or venture capital to rural entrepreneurs in a relatively low cost and low risk manner;

- training and incentives for relevant financial institutions to operate such financial schemes; formation and/or strengthening of producer and business associations in order to supply their outputs to larger-scale dependable buyers in a reliable and cost-effective manner.

TNS also believes it is essential for potential business owners to demonstrate a strong sense of commitment to the process of enterprise development. Therefore, it requires prospective rural clients to make "up front" contributions, in the form of cash and "in-kind" payments such as land, labour, materials and produce. In addition, prior to any TNS assistance, enterprise owners or members are required to attend regular meetings to plan enterprise operations and sign a management agreement, which includes a commitment to pay a modest management fee to TNS. This is done not only to underscore the mutual commitments involved, but also to prepare the businesses to pay for outside services when TNS eventually discontinues its support.

Finally, TNS also believes that in many instances these businesses will be best positioned to grow and prosper if they are able to establish marketing agreements with larger, more dependable buyers and firms. In this regard, TNS seeks to act as an "honest broker" to ensure that such linkages provide positive incentives for both parties and can therefore endure and grow.

In Ghana, Technoserve is currently providing assistance to small-scale farmers and food processors in the following agricultural subsectors:

- Non-traditional Exports, with a focus on cashew nut, shea nut, kola nut and pineapples;

- Palm Oil Processors, with a focus on oil for local food consumption and traditional soap manufacturing; and

- Grain Storage and Marketing, with a focus on community-level storage for local food sales and consumption.

Other areas of assistance are:

- Rural finance intermediation
- Research and development

TechnoServe is currently assisting 222 community-based rural enterprises with a combined total membership of 8,334, of whom 48% are women located throughout Ghana.

COLLABORATIONS

In order to build the capacity of rural producers to enable them to transform their operations into viable ventures, TechnoServe has been collaborating with other development partners.

Prominent among such partners are the International Institute for Tropical Agriculture (IITA) and Community Development Associations (CDAs) in Nigeria with which TechnoServe has collaborated to promote cassava and palm oil processing technologies.

Technoserve also co-ordinated a one year post-harvest pilot project to inform the implementation of that component of the larger Village Infrastructure Project (VIP), a major donor-funded initiative in Ghana. The pilot project was implemented in conjunction with Sasakawa Global 2000 (SG2000), the Sasakawa Africa Association (SAA), the Self-Help Foundation (SHF), the Ministry of Food and Agriculture (MOFA), the Department of Cooperatives (DOC), the Agricultural Development Bank (ADB) and four rural banks in Ghana's so-called 'maize triangle' located in the Brong Ahafo and Ashanti Regions. The organizations involved each provided a range of promising technologies to farmers and food processors.

TechnoServe provided basic business skills and records keeping training for groups which accessed inventory credit loans from the Agricultural Development Bank (ADB) to store and market maize. SG 2000 and the Ghana's Ministry of Food and Agriculture (MOFA) promoted the use of a package of agricultural inputs and provided training for participating farmers to plant in rows and construct maize storage cribs and drying patios.

SHF provided access to multi-purpose power tillers for farmers groups and provided training in their use and maintenance while, SAA promoted a range of small-scale post harvest technologies including cassava grating and pressing equipment and maize shellers and threshers developed by the IITA. The DOC provided training in cooperative principles and bookkeeping to participating cooperatives and ADB provided loans for agricultural inputs and inventory credit.

Currently, TNS and Natural Resources Institute (NRI) are conducting a village level shea butter processing and marketing pilot project with rural women in Northern Ghana. The pilot is meant to assess whether small-scale shea butter processing can be a profitable and viable commercial business for rural women under appropriate conditions regarding technology, level of output, and profitable marketing channels. A key role will also be played by the Technology Consultancy Centre (TCC) at the Kwame Nkrumah University of Science and Technology in Kumasi. The TCC will test the technical viability

of various shea butter technologies for extracting shea butter, while determining their complexity of operation and suitability for field use.

SMALL-SCALE PALM OIL PROCESSING AND MARKETING

In 1985, a group of 10 farmers established a cooperative in Ntinanko to seek solutions to their oil palm fruit marketing problems. The group came into contact with Technoserve and an agreement was signed for Technoserve to provide assistance in identifying solutions to their problems. The first step was the undertaking of a subsector study of the palm oil industry, with the dual aim of determining the potential for small-scale producers and food processors to add greater value to their produce and identifying the constraints that would need to be addressed to make this possible. The study concluded that there was significant potential for increasing production and incomes through the introduction of enhanced technology and the adoption of appropriate management and organizational structures.

An appropriate small-scale, labour-intensive palm oil processing plant was identified. Technoserve provided assistance to the group in areas of organization, business management, and record keeping and also helped with the preparation of a business plan for the processing plant.

Members made their prescribed equity contributions of 25 per cent of the projected total capital costs, both in cash and in kind contributions in the form of labour and materials used in constructing the building to house the processing equipment. The members were also required to buy a minimum of one share each in the business and to agree to purchase additional shares in future. During this period, group membership increased and was expanded to include local palm oil processors, all of whom were women.

Even though Technoserve assisted the group to develop a credible, financially viable business plan, the group was unable to secure local bank financing. TechnoServe was convinced that the processing plant could be profitable and, as a last resort, decided to provide loan financing to the group in order to demonstrate the potential of the concept, and the plant was eventually commissioned in October 1987.

Despite thorough planning, initial operations were not encouraging. The original business plan was for group members to purchase palm fruits from local producers and then process and sell the palm oil collectively. However, the labour costs involved in purchasing and processing the palm fruits turned out to be much higher than projected. In addition, local farmers had a tendency to sell low-quality fruits to the mill while selling their high-quality fruits to larger institutional buyers. Furthermore, an unexpected increase from 10 to 25 per cent in sales tax on edible oils at the time had a severe negative impact on planned revenues.

Due to the maintenance of timely and accurate financial and production records, these key problems were identified at an early stage. The owners

held a special meeting with TechnoServe staff and made several key decisions regarding corrective action. They decided to (1) cease fruit purchases and instead to offer 'processing services' to growers and processors on the basis of a fixed fee per ton; and (2) to move to the use of a higher capacity hydraulic press.

RESULTS AND IMPACT

Both of these measures reduced the group's labour requirements significantly, simplified management operations, and eliminated the tendency by processors to supply poor quality fruit, as the individual processors were now responsible for marketing their own palm oil. The changes also had an immediate positive impact on plant throughput. The volume of fruit processed at the plant rose from 11 tons in January 1988 to 45 tons in June of the same year. The plant subsequently processed between 60 and 80 tons of fruit per month during the fruiting season, reaching a maximum of 93 tons in March 1989. By the end of 1990, the plant recorded a net profit of ¢820,785 ($2,350) at the exchange rate of 1 US$= ¢349.27.

The net income accruing to the processors and their employees during the first three years of operation was ¢6.64 million, while the Ntinanko mill employees received ¢1.27 million in wages (a total of ¢7.9 million or $22,595) i.e. (1 US$=¢349.63). In addition, a number of businesses have been established in the village to provide food, clothing and various services as a result of the increased volume of commercial activity in the community.

Net income increases accruing to farmers during the first three years of the project have been projected at ¢14.4 million ($41,150) at an exchange rate of 1 US$=¢349. 94). However, these figures assume that all oil palm production would have been sold on the fresh fruit market if the plant had not been established. In fact, given the irregular fruit purchases in the area prior to the mill's establishment, it can be conservatively estimated that about 40 per cent of the potential fruit sales would not have taken place. If these incremental sales are considered, the net value added increases to ¢18.8 million ($53,700).

The plant now operates profitably without any outside assistance. Further technological upgrading has been undertaken and a 30-acre oil palm plantation and oil palm nursery for improved-variety seedlings has been established. To diversify its operations, the cooperative has also recently become a buying agent for a large cocoa purchasing cooperative in Kumasi.

As might be expected, the costs associated with establishing the Ntinanko model were high and financial analysis showed costs exceeding benefits. However, analysis of the first replication of the model found that benefits exceeded project costs by a factor of more than five to one.

REPLICATION OF A SUCCESSFUL EXPERIMENT

Based on the success of the Ntinanko model, Technoserve expanded its assistance to four similar mills in different regions of the country. In 1992, the programme came to the attention of the Ghana Government which awarded TechnoServe a contract with funding from the World Bank to establish 23 palm oil processing mills in communities outside the buying catchment areas of the large-scale palm oil mills under the Intermediate Technology Small-Scale Palm Oil Mills (ITSPM) Project.

These community mills have come together to form a national association of palm oil producers, the Co-operative Palm Oil Millers Association (COPAMA), which currently has four regional chapters to which TechnoServe is providing assistance. It is anticipated that as the association develops, it will increasingly take over many of the roles that TechnoServe staff have played.

While the majority of the palm oil processing groups are still paying off their equipment loans, several enterprise groups that Technoserve assisted initially have fully repaid their loans and continue to operate profitably even though they no longer receive direct management assistance from Technoserve. As demand for palm oil production is high, the mills are able to sell all the oil they produce for local food consumption and traditional village-level soap manufacturing.

During the 1996 season, the Association's regional chapters started stockpiling palm oil in central locations in order to attract larger industrial buyers, such as soap manufacturers, who pay higher prices than local traders for palm oil. The Association is also promoting the development of village level oil palm nurseries to produce high-yielding, disease-resistant varieties, both to increase members income in the short term and to improve the quality and quantity of palm oil to enhance future earnings.

It is worth noting that TNS also tried to introduce the concept of inventory credit to these palm oil groups. Despite significant inter-seasonal price increases in palm oil in the previous years, the price did not increase sufficiently to make the loans profitable during the year the scheme was introduced. The trial scheme also suffered from management problems within the groups and communication difficulties with several of the bank branches.

Although the trial inventory credit program was discontinued, TechnoServe has subsequently assisted female members of several of the palm oil groups to obtain much needed working capital loans from Sinapi Aba Trust a local micro-finance institution that specializes in providing loans to low income people. This represents the first time that the urban-based institution has provided loans in the agricultural sector, so far with very promising results. The loans have resulted in significant increases in the volume of oil produced and the groups have maintained high on-time loan repayment rates.

In addition, TechnoServe is also assisting the newly created association of palm oil millers to promote a savings and credit scheme for its members. Over time, as the members become more familiar with savings and credit operations, TechnoServe will work with the association and the micro-finance institution to reintroduce inventory credit, albeit in a modified form, as the scheme would still be highly profitable for the members in most years, if managed properly.

Furthermore, Technoserve is exploring the possibility for the private sector and local equipment manufactures to provide equipment to association members on lease-hold or hire purchase basis, most probably with the association and Technoserve providing joint security for the initial hire purchase scheme until its viability can be demonstrated.

NON-TRADITIONAL EXPORT CROP DEVELOPMENT

With financing from USAID Ghana and the Ministry of Trade and Industry, and in close collaboration with the Ghana Export Promotion Council, TechnoServe/Ghana is working to improve the quality and quantity of export produce of small-scale producers. Currently, Technoserve/Ghana is working in 45 communities in seven of the country's ten regions to promote the production and marketing of cashews, shea nuts and pineapples. TechnoServe/Ghana is also training Ministry of Food and Agriculture staff to enhance their assistance to farmers in the production of these crops. With TechnoServe/Ghana assistance, participating farmers have moved from the position of "price takers" to that of "price setters", through innovations that include: auctioning their crop to the highest bidder via national newspaper advertisements rather than just relying on whoever happens to pass through their villages; and establishing production pre-financing linkages with TechnoServe/Ghana's client groups and several major exporters.

TechnoServe/Ghana's interventions directly benefits 28,745 farmers who currently produce over $1 million worth of non-traditional agricultural exports annually. TechnoServe has distributed about 14MT (7.5MT imported) of high-quality cashew seeds to farmers and these new plantings, from the year 2000, are expected to yield 3,500MT of cashew nuts to contribute an additional $2.6 million to exports annually.

In addition, Technoserve/Ghana is identifying communities with potential to produce high-value medicinal plants for export. It is expected that this new and growing export business could, within 5 years, generate about $5 million per annum from the export of medicinal herbs, seeds and extracts. TechnoServe/Ghana hopes to play a lead role in the development of this sector.

Technoserve encourages value-addition at the rural level, using appropriate, village-level technology to enhance earnings for small-scale farmers. In the Upper West region, TechnoServe groups have used profits from shea nut

sales to acquire shea butter processing machinery to increase productivity and profits as well as reduce the drudgery of traditional processing.

The first-ever rural cashew processing plant in Ghana has been set up by a TechnoServe-assisted group in Nsawkaw, Brong Ahafo. Processing of cashews improves profitability five-fold and also creates jobs for rural farmers, especially women. Two of such plants are planned to be established at Kabile and Sampa in the Brong Ahafo Region this year.

CEREAL CROP STORAGE AND MARKETING

With financing from USAID Ghana and the World Bank, and in close collaboration with the Ministry of Food and Agriculture, TechnoServe/Ghana is assisting groups of farmers to enhance incomes from cereal production via storage into the so-called "lean season" when prices escalate from 50-250 percent. Farmers store their grain at harvest and, using this grain as collateral, receive commercial loans ("inventory credit") to tide them over until they can release these stocks on the market.

TechnoServe/Ghana is currently working with 99 farmers groups in three regions on this activity. Recently completed grain sales netted participating farmers 66 percent more income than their neighbors who did not participate, even after paying the bank 42 percent per annum in interest and their cooperatives a fee for grain storage and management. Several of these groups are using profits to purchase maize threshers, cassava chippers and other agro-processing equipment.

As a spinoff of the success of the inventory credit program, several farmers' groups met to discuss ways to improve formal collaboration. The result was the formation and registration of a separate legal entity, the Farmer's Service Multipurpose Cooperative Union. To date the union has helped its members by identifying storage locations; collecting information from member groups on harvest projections to estimate loans needed; calculating the break-even price to cover all the costs of storing maize; and deciding on behalf of groups the price at which to sell their stored maize. In the future, the Union plans to increase its activities by helping to source inputs, services and loans for its member groups.

Under the Village Infrastructure Project Pilot activity, TechnoServe/Ghana recently expanded its cereal/agro-processing development program into 30 new communities, with World Bank funding and in collaboration with Sasakawa Global 2000. It also included a component to strengthen the capacity of rural banks to provide appropriate credit packages to local communities.

RURAL FINANCIAL INTERMEDIATION

TechnoServe/Ghana is neither a formal bank nor a non-banking financial institution. However, through its work to develop viable group-owned

community enterprises, it is often involved in financial training or facilitating credit flows to those enterprises. TechnoServe/Ghana has evolved its own financial intermediation strategy by monitoring "best practices" in microenterprise financing. These practices have included group lending, mandatory savings, use of commercial interest rates, the provision of external guarantees and the use of produce as collateral. Between 1990 and 1998, TechnoServe/Ghana's assistance to enterprises leveraged approximately 860 million cedis. Recovery rates on loans range from 98 to 100 percent.

In addition, the World Bank's Rural Finance Group engaged TechnoServe/Ghana to coordinate and host the Microenterprise Finance Network (MFN) to promote innovative techniques and best practices in micro-finance. The MFN is comprised of nongovernmental organizations engaged in financial intermediation in Ghana, including Freedom From Hunger, Women's World Banking, Opportunity International, the Association of Rural Banks, and the Agricultural Development Bank, TNS, Nsoatreman Rural Bank, Sinapi Aba Trust, Ghana Cooperative SusuCollectors, ISODEC, Credit Union Association, NBSSI, GRATIS, Action Aid, Catholic Relief Services, SNV, Care International and CEDEP. The quarterly meetings of the MFN serve as a forum for the exchange and debate of credit information, and improvements in micro-financing policies and practices.

The MFN has thus far prepared case studies on the non-financing activities of a number of micro- finance institutions in Ghana.

RESEARCH AND DEVELOPMENT (R&D)

The TechnoServe/Ghana R&D Department is geared to provide two key services: quality assurance (including monitoring and evaluation and training) and new business development.

The quality control group handles enterprise monitoring and evaluation, providing the Country Director with data on enterprise performance and Business Advisors with best practices to be applied in their daily work.

The new business development group, comprised of full-time and consultant staff, provide analytical services to donor agencies and the Government, assisting both in the development of new projects. Examples include:

- a study on behalf of USAID and the World Bank on "The Role of NGOs in Rural Financial Intermediation" - a document that was used in the development of the World Bank's Agricultural Sector Investment Credit, UNDP, and other NGO micro-finance projects.

- a major assessment of a range of rural institutions (including farmers associations, banks and local NGOs) in Ghana on behalf of the World Bank and the Ministry of Food and Agriculture. This document contributed to the Government's Medium-Term Agricultural

Development Strategic Plan and the World Bank's Village Infrastructure Development Project.

- the Ministry of Food and Agriculture, once again with World Bank financing, asked TechnoServe to prepare for the Minister a series of concrete action plans to enhance the efficiency of agricultural marketing in Ghana. These action plans, submitted in mid-year, included both macro- and micro-level recommendations. There is need to establish a Department of Marketing Services to plan and bolster the cashew industry in Ghana.

As a results of its activities TechnoServe/Ghana is widely recognized among the country's top development institutions. As such, its managers and staff are regularly requested to (a) present papers on its experience and lessons-learned and to (b) provide advice to senior government officials in the design of new activities.

THE WAY FORWARD

Technoserve's drive to upgrade socio-economic conditions of the rural producers in developing countries is based on the promotion of enterprise development along four themes: *institutional capacity building, financial intermediation, marketing linkages and environmental enterprise development, and rural enterprise development.* TechnoServe's work along these themes are elaborated as they relate to strengthening of entrepreneurial capacity.

INSTITUTIONAL CAPACITY BUILDING

In Technoserve's view, fostering the capabilities of local institutions is vital to sustainability in the development process of providing local support for the rural poor to take control of their economies. Technoserve may assess institutional capabilities, help design, install, implement, and monitor general and financial accounting systems; and run seminars and workshops on appropriate topics in organizational development and management

Technoserve is currently providing technical assistance and management training to the Co-operative Palm Oil Millers Association, (COPAMA) and FASCU so that they can provide technical assistance and other services to their members and also represent their interests with commercial buyers, banks, equipment manufacturers, government extension staff, etc.

Technoserve passes on its own management, financial and quality assurance techniques to the association to demonstrate how to structure and manage businesses through keeping of proper records. This helps the entrepreneur to cost their production and identify areas to reduce cost and maximize profit.

FINANCIAL INTERMEDIATION

Formal financing for the rural poor is often non-existent with financial institutions reluctant to provide such agricultural lending. TechnoServe facilitates access to such services primarily by demonstrating to reluctant banks and other financial institutions that profitable opportunities do exist in rural areas. In other instances, Technoserve has helped to create new private financial intermediaries. Further, Technoserve has stepped in and taken either a creditor or a guarantor role during the first year or two to establish producer (and crop) credibility with local financial institutions: In other instances, Technoserve has identified creative credit mechanisms such as inventory credit which effectively lowers the threshold of formal sector lending in rural areas.

For example, in order to obtain working capital loans for the small-scale mills, TechnoServe is collaborating with the Sinapi Aba Trust, an NGO in the non-bank financial sector, based in Kumasi, to provide credit to enable the mills to purchase palm fruits for processing. Loans worth ¢86,265,000 ($35,500) have so far been disbursed by the Trust to nine mills in the Ashanti, Brong Ahafo and Central Regions since June 1997. The groups were expected to repay the loan in installments over a four-month period at an interest rate of 40% per annum. As a sign of their commitment to the program, the groups' repayment rate was 100%.

Market Linkages

People in rural areas are often left outside the economic mainstream because of difficulty in accessing markets for their products. TechnoServe is using its experience and resources to open markets to the small-scale agro-processors. Playing the role of honest broker, TechnoServe catalyzes relationships between the private sector and rural businesses, opening inroads and opportunities for entrepreneurs.

Finding markets for the products of small-scale producers can be a complex undertaking. To date, the small-scale mills have not been able to sell their oil to large scale food buyers, as they are unable to meet their volume and stringent quality specifications. They have been able to sell some of their palm oil to local commercial soap manufactures but have experienced problems in receiving full payment for their goods. Sales were made on credit and one of the firms involved has declared bankruptcy. Nevertheless, TechnoServe is assisting COPAMA to develop markets with the development of more detailed and legally binding contracts with future buyers. Surveys of local industries and exporters which use palm oil as a raw material are also being undertaken to create the necessary linkages between the processing groups and reliable large-scale buyers.

More recently, TechnoServe has assisted a number of groups to establish market linkages with a local firm that produces modified versions of traditional soap. Establishing the linkages required TechnoServe staff to devote

considerable time and energy to learn how to produce traditional soap with consistent physical and chemical proprieties to meet the buyer's quality standards.

RURAL ENTERPRISE DEVELOPMENT

Technoserve's pioneering methodology for enterprise development builds the capacity of clients groups through a participatory educational process. This Technoserve relationship with a client producer enterprise includes a time phased contractual understanding that sets forth obligations and expectations and provision for a modest but important fee for service. All of these activities have the objective of full cost recovery.

FUTURE ROLE: INCREASING THE MANAGEMENT CAPACITY OF AGRO PROCESSORS

In July 1998, Technoserve began the implementation of a five-year Microenterprise Development Assistance Program (MIDAS) under the new Trade and Investment Reform Program (TIRP) which is a follow-up on to the previous Trade and Investment Program (TIP) funded by the USAID.

Under this new program, Technoserve proposes to strengthen its Business Support Service to small enterprises. These Business Support Services generally consists of the following assistance provided in the following sequence in order to overcome the barriers and constraints which small agro-processors face:

- explanation of group dynamics and business principles for agro-processing groups either already involved in a given subsector or with good potential for investment.
- explanation of the roles and responsibility of group enterprise executives.
- calculation of current cost of production (where relevant) using different technologies to microenterprises.
- introduction of simple bookkeeping and financial analysis.
- development of business plan.
- assistance in mobilizing investment and working capital, if necessary.
- assistance in obtaining, installing and operating equipment, if necessary.
- marketing assistance and advice.
- ongoing training and assistance in simple records keeping and financial analysis.

STRATEGIES FOR SUCCESS IN THE DEVELOPMENT OF MICRO, SMALL AND MEDIUM ENTERPRISES: THE GRATIS EXPERIENCE

BY

AMA BADU ASANTE
BUSINESS DEVELOPMENT AND MARKETING UNIT SECOM
GRATIS/ITTUS NETWORK

INTRODUCTION

Micro, small and medium enterprises (MSMEs) play an important role in the economic and social development of Ghana. Their activities cover the formal and informal sectors and a wide range of activities including food and agro-processing, manufacturing and repair of metal product, wood-related industries, vehicle fitting and body works, black and gold smithing, tailoring, bakeries, shoemaking and repair, electrical repairs, handicraft, pottery, printing, and diverse manufacturing activities.

However, these enterprises encounter a number of difficulties which hinder their growth and development. These difficulties are financial, economic, technological and social. They include: increased prices of imported and domestic inputs because of inflation; the breakdown of previous supplier and customer credit arrangements resulting in severe shortages of working capital; as well as falling real incomes and depressed purchasing power among the poorer segments of the society which are the traditional customers of micro and small enterprises. Lack of technical and managerial know-how, mediocrity of production techniques, lack of access to new and improved technologies and lack of technical assistance, among others, also constitute constraints to the development of micro and small enterprises. Despite these bottlenecks, MSMEs provide much of the private employment in the country as well as supplementary incomes to the increasing population.

In the era of globalization of markets and changing consumer trends, these enterprises are required to be innovative and to produce quality goods and services to satisfy the changing demands of consumers. In 1987, the Ghana Regional Appropriate Technology Industrial Service (GRATIS) was established to provide support to industry in Ghana by responding to their technological needs. The development of micro, small and medium enterprises through technological improvements does not only constitute an employment generation strategy but also a strategy for improving the productivity of enterprises and increasing their revenues.

STRATEGIES

The GRATIS/ITTU (Intermediate Technology Transfer Unit) network does it development work in Ghana by offering technology transfer and other services to a wide range of beneficiaries. Transferring technology to MSMEs helps entrepreneurs to improve their techniques of production, have access to

information on new technologies and develop their technical and managerial know-how. Technology transfer constitutes an indispensable element in the development of MSMEs in Ghana.

Providing individuals and small businesses with appropriate and sustainable technologies gives them the capacity to increase their incomes. Evidence from field research supports the idea that once individuals are supplied with appropriate technology, they can make effective use of it by its commercial exploitation. In doing so, these individuals and firms benefit themselves, their families and their communities. The Ghana Regional Appropriate Technology Industrial Service is dedicated to encouraging this process by providing support to the technological development of Small and Micro-Enterprises.

GRATIS has an integrated approach to developing viable, micro, small and medium enterprises and supporting the nation's industrialisation process. GRATIS therefore provides its beneficiaries with both the soft and hardware aspects of technology, namely: technical and managerial training as well as improved machines and equipment. GRATIS provides the following services to its beneficiaries as a means of developing the MSME sector in Ghana.

- **Technical Apprentice Training in:**

  Metal machining;
  Welding and fabrication;
  Woodworking and pattern making;
  Foundry; and
  Blacksmithing

- **Textiles Training Programmes:**

  Batik and tie/dye fabrics; and
  Broadloom weaving fabrics

- **Outreach Training/Gender and Development (GAD) Programmes:**

  Food processing;
  Manufacture, operation and maintenance of agro processing equipment and machinery;
  Beekeeping for honey production;
  Pottery, beads making, brass casting.

- **Credit facilities**

  Hire purchase scheme;
  Working Capital Scheme; and
  Turnkey package.

- **Client Skills and Outreach Programes:**

  Training in specific skills such as MIG & TIG welding, technical drawing, etc.
  Training in business management;
  Pre-loan entrepreneurship training for clients;
  Career days to promote technical trade careers among JSS students; and
  Extension visits by GAD officers and ITTU officers.

These training programmes and credit facilities equip entrepreneurs to start their own businesses or develop existing ones. As a result, GRATIS services contribute positively on employment creation, income generation and poverty reduction, which is a very critical issue in the economic and social development of Ghana.

By the end of 1998, 103 Ghanaians had graduated from the GRATIS/ITTU technical apprentice training. This number may seem small when we take into consideration the number of ITTUs making up the network and the date of establishment of GRATIS; but it is worth notng that the Technical Apprentice Training is a four year programme which started in 1989 in three ITTUs established in 1988. The other six ITTUs were established between 1990 and 1996. Moreover, due to the ITTUs production activities, each can take only five apprentices in a year. This is to ensure adequate amount of machine time and individual instruction for each apprentice as well as the practical exposure to real jobs.

More than 90% of the graduates are employed in their field of interest whilst 30% have set up their own businesses. The high level of success of graduates with respect to employment is attributed to several factors including the following:

- Holistic training for self-employment, which includes business and entrepreneurial training and practical attachment in industry (often with mature ITTU clients);
- The careful selection of trainees;
- Restricted number of trainees allowing for individual instruction;
- Adequate machine time to master their craft; and
- Hands-on training on live jobs.

During the next five years, the quality of technical apprentice training is to be improved by:

- Engaging qualified training officers for those ITTUs that do not have them;

- Providing and equipping training bays for all ITTUs;
- Reviewing and improving training syllabus and curriculum; and
- Introducing annual assessment, evaluation and certification at the end of training.

With the recruitment of training, officers and establishment of training bays, it is expected that the annual intake per ITTU will be increased from 5 to 10 by 2000 and the programme will be reduced from four years to three years, with a pre-qualification year added for applicants in disadvantaged regions (or groups, e.g. women) who need to upgrade their skills and theoretical knowledge in order to pass the entrance examination.

In addition, new skill areas will be added, such as upholstery, goldsmithing and jewellery making, boat building, industrial ceramics and leatherworks including tanning. New products will also be introduced such as solar water heaters, cookers and dryers. These areas will be introduced in regional ITTU's that have comparative advantage in terms of demand, availability of raw materials, existing facilities and opportunities.

COMMERCIALIZATION DRIVE

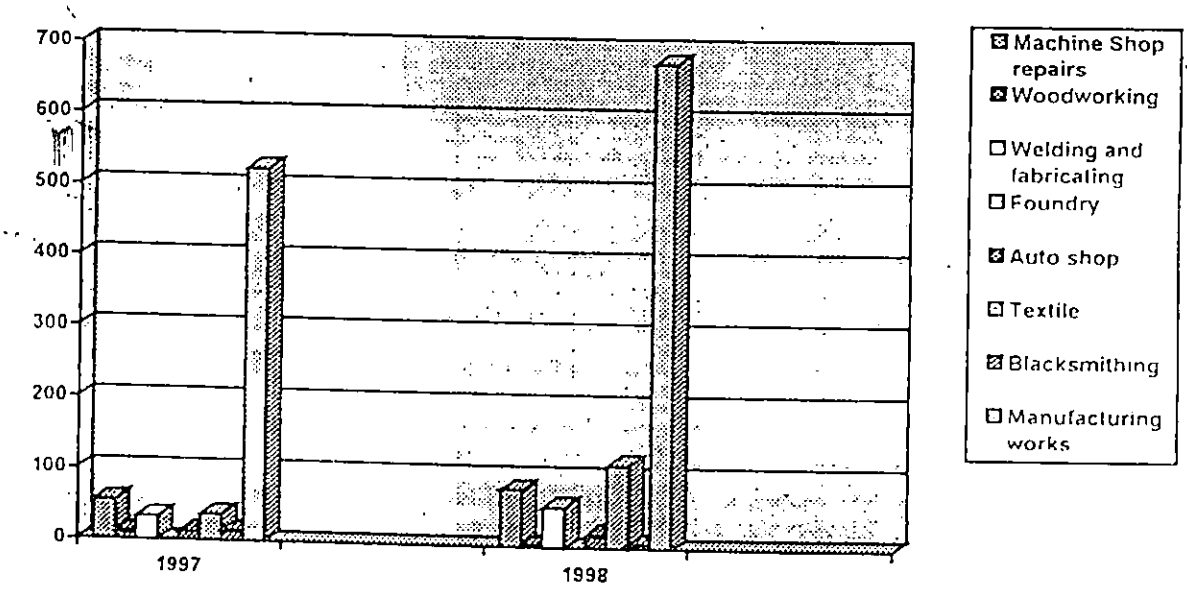
Manufacturing

Manufacturing in the ITTUs serves not only as a technology transfer strategy in the technical apprentice training programme but as a strategy for commercialisation in the ITTUs. The ITTUs undertake several income generating activities through their various sections including.

- Machine shop repairs.
- Woodworking;
- Welding and fabrication;
- Foundry repairs;
- Auto shop;
- Textiles;
- Blacksmithing; and
- Manufacturing works

Manufacturing works however constitute the main source of income for the ITTUs. The graph below shows income generated by the ITTUs by section in 1998, compared to that of 1997.

INCOME GENERATED BY ITTUS BY SECTION



The ITTUs manufacture a wide range of products including water pumps, potters wheel, sandcrete block making machines, roof tile presses, broad and narrow looms and cotton spinning wheels as well as processing equipment including:

- Corn mills;
- Cassava graters;
- Maize shellers;
- Double screw press;
- Nut cracker;
- Palm fruit digester;
- Palm oil digester;
- Palm oil clarifier;
- Pepper/tomato grinder;
- Rice huller;
- Grain cleaner; etc

GRATIS/ITTUs sells these machines to several customers including women's groups and co-operative involved in micro and small businesses. Most of these machines are geared towards the improvement of the agricultural sector. Access to these machines, as well as training on their use, enable entrepreneurs to improve their production methods and techniques as a means of satisfying the needs of their customers and broaden their customer base. It also enables the ITTUs to cover the cost of production activities and also support other development activities. GRATIS/ITTUs are basically service organizations. For commercialization, mark-ups are placed on services rendered to help sustain the project financially, and to ensure that GRATIS/ITTU products do not unfairly compete with private businesses.

RESEARCH AND DEVELOPMENT ACTIVITIES

GRATIS, through its Engineering Design Centre (EDC), undertakes periodic R&D activities, such as product design and development (including prototyping and testing) in its commercialization drive. These activities are a major source of income for GRATIS. In 1998, EDC undertook the design of 8 new products: a 7.5 ton Trailer for Lever Brothers, a Pusher Truck, a Salt Refinery Plant, a Weighing Scale, an Orange Juice Press and a sawdust briquette machine. A bicycle trailer and donkey cart were also developed under the Intermediate Means of Transport project.

Three new products developed at the Engineering Design Centre (EDC) were sold during the year, a Chalk Making machine, Blow moulds for ice cream and a set of moulds for aluminum utensils.

PROFESSIONAL SERVICES/CONSULTANCY

Apart from providing support services to clients. GRATIS also undertakes consultancy assignments as part of its commercialisation process. In 1998, GRATIS undertook 3 major assignments in support of its development activities. These include: completion of a national directory of over 100 government programmes, NGOs, projects, agencies and institutions which support micro to medium size enterprises in Ghana, technology assessment and monitoring of the Brong Ahafo and Ahafo and Ashanti regions, and a national baseline survey for the Intermediate Means of Transportation (IMT) project of the Ministry of Food and Agriculture (MOFA).

Under the IMT consultancy, the Socio-Economic and Marketing Division prepared a Training Manual for the operation and maintenance of IMT and organised a National Review Workshop on the IMT and a Review meeting of the IMT Baseline Survey Consultancy assignments during 1998 brought in 285.4 million cedis, slightly lower than consultancy income for 1997 which was 302 million cedis.

TRAINING

By training many apprentices and supporting them to set up their own businesses, they become GRATIS/ITTU clients and they benefit from comprehensive training programmes which build the capacity of Ghana's micro and small businesses while generating income for GRATIS. These programmes include:

- Modern design and drawing tools for rapid design, modeling, prototyping and modifications;
- Computer aided design training programmes;
- Quality assurance and productivity improvement methods;
- Environmental training; and
- Occupational health and safety methods.

These programmes attract a fee of about 620,000 cedis per beneficiary. In the beginning of the year a training programme in Auto-CAD (Computer Aided Design) was organised for eight people from which GRATIS earned about two million cedis. These programmes are done throughout the whole year at the Engineering Design Centre of GRATIS, and at the regional ITTUs.

GRATIS services have a ripple effect not only on employment creation but also on our client base which increases the demand for GRATIS' services. After graduating and setting up on their own, apprentices in turn employ and train other people who are also able to go into business and eventually become clients of GRATIS/ITTUs. Regular training programme can thus ensure a continuous flow of income to support GRATIS activities.

COST RECOVERY

Using all these strategies, GRATIS is able to commercialise to recover about 50% of its costs. At the end of 1996, cost recovery for the GRATIS/ITTU network was 40%, increasing to 46% in 1997 and to 56% in 1998. With a comprehensive development service commercialisation programme, GRATIS hopes to recover more than 75% of its costs by the end of 2001.

DEVELOPMENT SERVICES AND GRATIS' NEW DIRECTION

In the past, GRATIS has rendered services including technical apprentice training, practical attachment, and GAD services, as well as extension training to many beneficiaries free of charge. GRATIS is now negotiating with the EU, JICA, CIDA and the Government of Ghana to pay for development services. These are highlighted in the five year Business Plan which aims at transforming GRATIS into a Non-Profit Development Foundation by the end of December, 1999. GRATIS has therefore been developing proposals for funding of some of our numerous projects to some identified funding agencies.

A proposal was recently made to the Agricultural Services Subsector Investment Project (AgSSIP) – which is receiving consideration from Donors and the Government of Ghana - for the funding of the practical attachment programme for students from the tertiary institutions under the Human Resource and Capacity Building Programme.

Practical attachments for University, Polytechnic and Technical/Vocational school graduates are provided by the ITTUs at the request of the Ministry of Education, to provide them with short term training opportunities. It has become important for the GRATIS/ITTU Network to incorporate practical attachments in its programmes due to the lack of machine tools and equipment in most tertiary institutions in the country. Consequently, most technical students in Ghana complete their technical education without the requisite knowledge in engineering drawing, specifications and standards, quality control and assurance, productivity improvement, occupational health and safety and environmental awareness.

Since the practical attachment programme was introduced in 1987, the ITTUs have been accommodating 10 students per quarter on average and demand for placements has increased by 30%. This shows that more and more students need to undertake practical attachments to complement their theoretical training.

In this proposal, we established that the number of people to come on attachment at the ITTUs and EDC to be 500 during the first year and the estimated net income was 600 million cedis. The number will be increased in subsequent years depending on the availability of funds and the necessary logistic support. If GRATIS is able to achieve the support, the amount earned will go a long way to support our technology transfer and development programme. In this way we hope to achieve a sustainable level of commercialization.

OTHER ACHIEVEMENTS

Over the years, the GRATIS/ITTUs network has been reaching out to more and more people as demand for its services increase. In 1998, GRATIS/ITTUs reached 15,756 beneficiaries compared to 11,287 in 1997. These beneficiaries comprised 4,497 paying customers, 4,917 micro to medium scale entrepreneurs who are members of the ITTU Client's Association and 6,342 trainees including 225 textile trainees and visiting apprentices, 187 technical apprentices, 152 beneficiaries of GAD extension services and 120 beneficiaries of EDC training services. Apart from customer services, women constituted 53% of the beneficiaries (clients and trainees), up from 39% at the end of 1997.

CONCLUSION

From the GRATIS experience, it is clear that the availability of production units contribute considerably to enhancing the commercialisation drive. These production units enable the ITTUs to manufacture a wide range of products to support MSMEs while generating income for GRATIS. The provision of consultancy services also enable GRATIS to earn income to cover some its costs. Finally, in the light of GRATIS new drive, the sale of development services to donors, funding agencies and the Government of Ghana will be the main focus. The objective is to seek funding for the provision of training programmes and other projects aimed at developing the MSME sector and enabling more Ghanaians to benefit from GRATIS/ITTU services.

DISCUSSION

Prof. Norman: There is very little collaboration between NBSSI, GRATIS, and Technoserve and the Research Institutes and Universities. What is the problem? Secondly, GRATIS undertakes training programmes but there are no adverts in the papers. How do they get participants?

Mr. Boateng: We collaborate with some research institutions, but it is not to a maximum. This year there is upgrading of indigenous technologies where there is room for improvement. We have contacted some institutions. In our Medium Term Action Plan we would have a lot of collaboration with such institutions.

Dr. Prakah-Asante: We do collaborate with the Research Institutes/ Universities but not to the maximum. We normally fall on them for resource persons.

Rev. Dr. Marfo: I do not think there is much collaboration between the three and the universities and research institutes. I will like to suggest that a meeting be held among all the research institutions and the technology transfer agencies to plan how they can co-operate with each other to help solve national problems.

Dr. Prakah-Asante: I agree with Rev. Dr. Marfo. GRATIS is thinking together with IIR and with KNUST in Engineering Design. Besides, Dr. Owusu-Ansah, Director of Institute of industrial Research (IIR) serves on my management board and I serve on his. A new project proposal has been written and this includes IIR and NBSSI. The collaboration is not to the level we expect. Our sponsors have particular areas of emphasis. On the GRATIS training programmes, we recently advertised Computer Engineering and Computer Aided Design (CAD) course. The courses are always overbooked so there is no need to advertise.

Mrs. Kordylas: Are your ITTUs employed by GRATIS or autonomous?

Dr. Prakah-Asante: They are not autonomous. They were established by GRATIS. They form the network. They employ staff at a certain level but at the managerial level by GRATIS. They are paid by GRATIS. They send quarterly performance indicators and they are sometimes paid by performance.

Mr. Odzeyem: It seems GRATIS does a lot of things and would like to know if they have hand-outs which they give out. Are the prices affordable and do you give credit facilities? Do you have a processing machine for cashew fruits as well as mangoes? The question of cashew fruit is crucial because now farmers throw away the fruit. It is only the nuts that are exported raw.

Dr. Prakah-Asante: This has been our main criticism, that is we do not let people know what is going on in the ITTUs. Yes, we have hand-outs to let people know what is going on.. We have an equipment for processing fruits and it is affordable. We try to even up the prices not to the disadvantage of the consumer. There is an equipment for cashew processing but you have to make the request to the prototype unit. Our services are demand-driven. It has been difficult raising funds. A new product will need research work. We have appealed to sponsors for funds for prototype development. If you have the money, you can request for the equipment to be manufactured for you.

Mr. A.-Williams: TNS collaborates with a number of institutions in Ghana especially those in the agricultural and financial sectors. These are the Department of Co-operatives, Ministry of Food and Agriculture, Agricultural Development Bank, Rural Banks and Agricultural Research Institutions and other NGOs.

Comment: All the three speakers mentioned the effort to develop machines but our locally made machines do not have standardised parts.

Mrs. Marfo: The institutions which are trying to produce some machines need to work together and get standardised parts so that the users can easily get parts to change worn-out ones.

Dr. Prakah-Asante: We recently developed the aspect of Engineering drawing. I hope that the ITTUs which are manufacturing to specification can do that. There can also be intermediary companies that can manufacture the parts. The problem will persist until standardization is in place. It will be difficult.

The Ghana Standards Board developed specification standards for manufacturing. Specification is very important. I agree that the ITTUs can do that to a

particular specification. The quality of the material is very important.

Mrs. Andah: In response to the question on whether any machinery has been developed for the processing of cashew apple, I wish to inform the meeting that the Food Research Institute has developed low cost technologies for processing and preservation of cashew apple into various food products. Two training sessions have been conducted for 20 and 24 extension agents in the Brong Ahafo and Nortern Regions respectively in the use of these technologies for cashew apple.

Dr. J. P. Tetteh: Mr. Boateng in his presentation stated the influx of shoddy goods into the country has been a major constraint to the growth of small scale industry in Ghana. What are we going to do about this?

Rev. Dr. Marfo: Now that we have so many cheap and shoddy products in the country what happens to locally produced products which are expensive. Shoddiness and cheapness of products are not synonymous. A product may be cheap and of good quality while some products can be expensive and of poor quality. My advise to all is that our local manufacturers may pool their resources together so that they can improve upon the technologies they are using.

Prof. Otchere: Technoserve is working on crops only. Didn't their THINK TANK in discussions with farmers find any need for assisting with their clients who have livestock?

Mr. A.-Williams: We are not helping them for now, but it will be pretty soon.

Dr. K. O. Marfo: Are there any hidden problems with the credit inventory system which prevent a massive adoption by the normal banking system?

Mr. A.-Williams: I know that the Agricultural Development Bank (ADB) and Barclays have tried and faced a few problems. This is being done on a small scale by Technoserve. There is the need for constant tracking of prices. The mistake is that they wait for the price to reach the peak before putting the crops on the market. Technoserve's view is that there is no need for prices to get to the peak before putting the commodity on the market.

Dr. Asante: There is an absence of an independent collateral manager or a warehousing operator. In addition there is also an absence of rules and regulations of a commercial collateral management scheme. It has also been observed that collateral managers and banking officials abuse the system and there is poor market information.

Dr Wonkyi-Appiah: I want to know the collaboration between GRATIS and NBSSI. In the Kade area people use all kinds of equipment for milling. Is Technoserve operating in the area?

Mr. A.-Williams: We are not in the Kade area. We try to avoid the large scale palm oil processing catchment area. For equipment, see GRATIS or any other unit.

Dr. Prakah-Asante: Koforidua ITTU is producing a lot of oil palm equipment and they collaborate at the district level. Techiman ITTU is sponsored by the International Fund for Agricultural Development (IFAD). There is collaboration at the District level.

Mr. Boateng: NBSSI serves on the Advisory Committee of ITTU at the regional level.

THE EXPERIENCE OF ARKLOYD'S: A SMALL-SCALE ENTERPRISE IN THE USE OF SCIENCE AND TECHNOLOGY TO ENHANCE PRODUCTION

BY

J. MAUD KORDYLAS
ARKLOYD'S NATURAL AND GENERAL PRODUCTS LTD.

ABSTRACT

Problems that hinder the establishment and growth of food processing industries in Africa, as revealed through interactions made with enterpreneurs and through international conferences and workshops, motivated a search for answers to some of the problems. During this search, information was collected that led to the publication of a book entitled "**Processing and Preservation of Tropical and Sub-Tropical Foods**", Macmillan, London, 1990.

It also led to the setting up of a trial project on sustainable crop production using a combination of the traditional multiple cropping system and the organic method of production. Sufficient crops were produced on sustainable basis to enable a laboratory to be set up to carry out experiments and to evolve formulations for the production of tropical fruit jams, wines and fruit juices. ARKLOYD'S, a small-scale food processing enterprise, has been established to commercialize the products of the project.

INTRODUCTION

Problems of Food Industry Development in Africa

Experiences gained at the Food Research Institute of the C.S.I.R. and at numerous international conferences and workshops exposed me to various aspects of the development of Food Industries in Africa. I became acutely aware of the problems, difficulties, limitations and numerous obstacles blocking the way forward for African countries in the development and growth of food industries in general, and of local small-scale food industries in particular.

Some of the problems and difficulties faced by those involved in small-scale food processing enterprises involve the following :-

1. Lack of constant supply of raw materials for processing.

2. Lack of appropriate low level affordable scientific processes that small-scale processors can adopt.

3. Difficulty in identifying and obtaining small-scale equipment to help mechanize labour-intensive processes.

4. Lack of appropriate packaging materials.

5. Lack of technological and managerial skills.

6. Untrained and indisciplined local labour force.

7. Hostile environment for small-scale food processors due to laid down official policies geared towards the development of large-scale industries with no clear-cut policies aimed at local small-scale enterprises, their development and growth.

8. Very high interest bank rates and intimidating borrowing systems which exclude small borrowers.

Attempts Made at Finding Some Answers

Having become acutely aware of the problems facing small-scale food industries, I felt the Food Research Institute, of which I was then the Director, could play a vital role in finding answers to some of the problems, especially problems 2 and 3. Consequently, projects were set up to be handled by multidisciplinary teams to:

a. Collect information on traditional processes used in processing and preservation of all major food crops with the aim of evolving affordable scientific processes based on familiar traditional and indigenous processing and preservation methods.

b. Search for labour-saving devices and equipment available locally and from all over the world, and identify technologies and devices used by rural people which could help the Institute put together some affordable, workable and scientifically viable systems for small-scale food processors to adopt.

Unfortunately, I left for Cameroon and did not stay with the Food Research Institute to establish and see these projects through. What follows were attempts made to find some of the answers and experiences gained from those attempts which led to the establishment of ARKLOYD'S.

PROCESSES LEADING TO ESTABLIMENT OF ARKLOYD'S

Collecting Information for a Book

Betwen 1982 and 1986, attempts were made to collect information on:

a. Traditional and indigenous methods, equipment and devices used for processing and preservation of the major tropical foods with particular reference to those used in Africa.

b. Conventional and domestic methods, devices and equipment used for processing foods in general.

c. Processes, devices and equipment available for use by small-scale food industries.

The aim of the exercise was:

* to collect the type of information that, although available, might not have been documented or might not be easy to obtain because of their being scattered in isolated reports or in limited publications,

* to organize the information into a reference book that could be used by individuals, schools, colleges, universities and scientific institutions.

To obtain such information, research was carried out at various markets and traditional food processing sites in a number of countries in Africa. Indigenous people were interviewed and pictures taken of their activities. Visits were made to Non-Governmental Organizations project sites, Research Institutions, University departments and Libraries. Countries visited were Cameroon, Benin, Togo, Ghana, Ivory Coast and Senegal. International conferences attended also presented opportunities to collect further information, not only at the conferences but also at markets and from other relevant sources. Information was collected from the Philippines, Kenya and Ethiopia. Appropriate magazines were subscribed to and a number of books found useful were bought from local and overseas bookshops during the information collection period.

Arkloyd's Food Laboratory

As the information collected was being organized for a manuscript, it became necessary that few of the precessing information collected be tested for workability. A laboratory was needed for such tests. Some form of identity was needed to make it easy to correspond, not only locally but also internationally. ARKLOYD'S, anagramme of Kordylas, was coined and "Arkloyd's Food Laboratory" came into being.

Letter headed papers were printed with the name, address, telephone and fax numbers for the new laboratory. Catalogues were requested from manufacturers and small gadgets, devices, domestic level equipment and few laboratory instruments (scales, dryer, thermometer, pippets, pH meter, hydrometer, etc.) were obtained to equip the laboratory.

Root and tuber crops, green plantain and green bananas and oil seeds were purchased. Flours and pastes were made from these and were used to make formulations for biscuits, breads, pasta and weaning foods. These were fortified with eggshell powder as a source of minerals.

Writing of the Book

Soon, it became clear during writing of the manuscript that experience in writing scientific papers and scientific reports was not enough to enable writing of readable, understandable and professionally formated books for individuals, schools and colleges or for the general public. I signed up for a correspondence course offered in the United States for people interested in writing for children and teenagers. I obtained a diploma at the end of the course which equiped me to write on various topics and fiction for children and teenagers. The reformated manuscript was accepted for publication and a book entitled "*Processing and Preservation of Tropical and Sub-Tropical Foods*" was published by Macmillan Publishers in 1990.

Problems with Small-Scale Jam Production in Nigeria

During the preparation of the manuscipt, my sister, Mrs Edwards who was working at the Federal Institute of Industrial Research, Nigeria, started a small production of tropical fruit jams for the Nigeraian market. She soon started experiencing some of the problems faced by other small-scale food processors in Africa. She complained about the lack of constant supply of raw materials due to the seasonality of fruit crops and the wide variability of parameters in fruit used for processing due to non selection of uniform crop varieties for planting with most fruit growing wild. This made standardization of products very difficult. She was forced therefore to import pectin to help standardize her jams. At this stage, I promised to use my backyard to help evolve some system of sustainable crop production which she could adopt to help her with constant supply of uniform fruits.

Trial Crop Production System in Cameroon

During collection of information for the book, information on organic or biological method of crop production was also collected. I was greatly convinced that the system could be very useful for the tropics. I had also been convinced, with a number of studies conducted on multiple cropping used by small traditional crop producers in Africa, that multiple cropping may well be the best low input system available that allowed farmers to cope with the high-risk tropical environment in which they find themselves.

An attempt was therefore made to trial-test a combination of multiple cropping and organic system as a low input method of crop production. The aim of the trial was to ascertain whether supplementation of the traditional cropping system with organic methods of production would improve crop yields on sustainable basis.

Cameroon has a rainfall pattern which provide rains during nine months of the year. Organic matter was available in large quantities throughout the year for composting. In February 1984, a two compartment wooden structure was constructed to hold two piles of composting material. The compost obtained was used to prepare selected sites in a backyard plot measuring 9x20 meters

(180 sq m) that was originally filled with clay soil. The clay soil was removed and mixed with the compost. The mixture was placed into the holes from where the clay soil had been removed to form raised beds for planting. By mid-1986, the backyard plot was planted with six sour sops, five guavas, four pawpaws, eight carambola, one mango, one avocado pear and few plantains. The fruit trees were interplanted, at various periods, with tomatoes, cocoyam, pepper, winged beans, garden eggs and okro to form a multi-story scheme as usually obtained in the traditional cropping systems in Africa.

Sufficient compost was applied regularly to the soil to encourage micro-organisms and other soil dwellers to function and to enhance mycorrhizal fungi association with root hairs, so that nourishment and protection would be provided for the well-being of the plants. Two to three wheel-barrow full of compost were distributed evenly around the roots and covered with the top soil leaving a holow in the center of the raised bed around the trunk. Dried leaves raked from the yard were used to cover the top of the raised beds to protect the soil from eroding away during the heavy rains.

Fertility of the soil around the the growing plants were regularly monitored using a two-prong fertilizer analyzer that indicated wether the soil had sufficient nitrogen, potassium and phosporus. Where less than normal levels were indicated, more compost was applied to the soil.

During the long heavy rainy season, the edges of the raised beds were lifted slightly with a fork to allow air in without disturbing the soil unnecessarily. Improvement in soil fertility over the years, the physical appearance of the growing trees, the lack of disease and, later, the fruit yield were used as parameters to indicate whether or not optimum conditions had been achieved in the soil. Fruit harvests were recorded daily.

RESULTS

Effects of Compost Application

It took about 12 months of composting to arrive at the number of turnings needed and the correct ratios of high-carbon materials to nitrogenous materials required to prepare a compost pile which had no offensive ammonia odour. When the correct proportions were used, the compost was completed within three weeks during the hot dry weather and in four to five weeks during the cool rainy season. Sufficient heat was generated to sterilize the compost pile and no unpleasant odor was detected.

It took two to five years of regular application of compost to the soil for the clay in the planted sites to change into dark fluffy soil. Earthworms were seen in the soil after three to four applications of compost to the bed. During the first three years, the growing plants were constantly affected with plant diseases. The infections, however, diminished as the soil fertility improved. None of the infections were serious enough to require action. The attacks increased during periods when the rains were long and heavy.

YIELDS

Interplanted Vegetables

The vegetables interplanted among the tree crops provided sufficiently good yields. The tomatoes, pepper, okro, garden eggs and winged beans responded well to compost supplementation. This continuously provided high yields before the fruit trees grew tall enough to over shadow the soil from the sunlight. The following harvests were recorded in 1986:

18 bunches of plantain were collected from 6 suckers planted in 1984,
43 kg cocoyam from 4 cocoyam plants that grew from peelings in the compost applied to the soil,
13 kg cherry pepper harvested from 3 plants planted in 1986,
15 kg garden eggs obtained from 6 plants planted in 1986,
24 kg winged beans collected from a total of 10 vines planted in 1985/86.

Pepper planted among guava and carambola bushes had access to sunlight and continued to yield well for further three years until the plants were uprooted and discarded in December 1989 due to lack of space to store the produce. Most of the pepper harvested was dried. Some were used in experiments on pickling, onion-pepper relish and red pepper sauce.

Fruits

Since 1986, the recorded total yields for fruits increased gradually. After their first bearing, most of the trees lost their seasonability and continued to flower, set fruit, mature and ripen fruit as long as the weather and soil conditions remained favourable. The beginning of the yearly rains enhanced fruiting and yields. Thereafter fruit yields were affected by how heavy the rains were and how long the season lasted. Flowering and fruit setting were greatly diminished in the guava and sour sop during heavy rains. They were, however, resumed as soon as there was a break in the rains. The next harvests were delayed if the rains were heavy and lasted for a long time. The carambola, however, continued to flower and set fruit during the rainy season as long as there was periodic sunlight.

Fruit quality was high in guava and sour sop at the begining of the rains. The fruits were large, well formed and had good flavour. Most of the fruits harvested at the end of the dry and rainy seasons were smaller, malformed and diseased. This may be due to the effects of too little or two much water on the health of the plant.

Yields from crops interplanted among fruit trees and from one avocado tree that started bearing fruit in 1989/90, when added to those obtained from guava, sour sop, carambola and pawpaw provided over one ton of produce in 1990/91 and again in 1991/92. The 180 square meter backyard plot therefore yielded sufficient quantities of fruit to provide more than enough raw materials for processing.

At this stage, it can be stated that the traditional cropping system supplemented with organic methods of production, which were tested in Cameroon over an eight year period, provided sufficient data to show that high quantities of produce could be obtained on sustainable basis over some years after the fertility of the soil had been built up through regular application of compost.

Experiments with Harvested Fruits

Few domestic type equipment were acquired in addition to the basic laboratory ones. These included a pulper, grinder, steamer, food processor, plastic bag sealer, corking and caping machines, a blender and a mixer.

The first few batches of fruit harvested were used for experiments on juice extraction. Acidity and sugar contents of the juice extracted were determined. Experiments were also carried out on pectin extraction from fruits known to contain sufficient quantities of pectin. Using the chemical properties of the fruits, various jam formulations were made. The pH, sugar and pectin levels were adjusted in order to provide the desired balance for the jams to gel and to provide suficient acidity and sugar levels for the products to be preserved without added chemicals. Organoleptic assessment of the various formulations was organized and the most preferred flavours were selected for production for shelf-life studies. These included guava butter, pawpaw-ginger jam, guava and sour sop jellies. Carambola jam was later added.

To provide for further varieties, locally produced pineapples (without chemicals added) were purchased and used to produce pinapple and pineapple-ginger jams. Mango jam was added on during the mango season. Used jars were collected and used for the trials.

Unfortunatly by the time useful results were obtained, my sister, Mrs Edwards for whom the project was started, had been killed in an accident in Nigeria. I had no other choice than to continue with the project.

Assembling Needed Supplies

It became necessary that some appopriate equipment and other needed supplies be acquired to enable moderate quantities of jams and juices to be produced for marketing trials. Letters were sent to suppliers of various small-scale food manufacturing equipment and suppliers of glass jars for air-tight packaging of jams, with acid resistant twist-on caps for vacuum sealing of the products.

Most foreign firms responsible for producing packaging materials and labels were not interested in supplying small quantities of their products. One glass-jar producing company, however, offered to supply a minimum of 20,000 jars. With further negotiation, the company agreed to supply 5,000 jars plus acid resistant twist-on caps on pre-paid basis.

Labels were designed and printed with the help of my daughter who was then studying in the United States. 20,000 labels were printed. A local firm supplied cartons according to specifications given to it. By mid 1988, most of the needed equipment and supplies had been assembled for jam production for marketing trials to be started.

Production and Trial Marketing of Jams

The bulk of fruits harvested in 1987/88 had been juiced, pulped and the pulp frozen. These were available for the first trial batches of jams to be produced. The first 500 jars produced were labelled and packaged - 20 jars per carton. A few super-markets and exotic boutiques were offered free jam samples and a price list. Those interested placed orders and were promptly supplied. Apart from few incidents and problems, the trial marketing was encouraging.

Wine Experiments

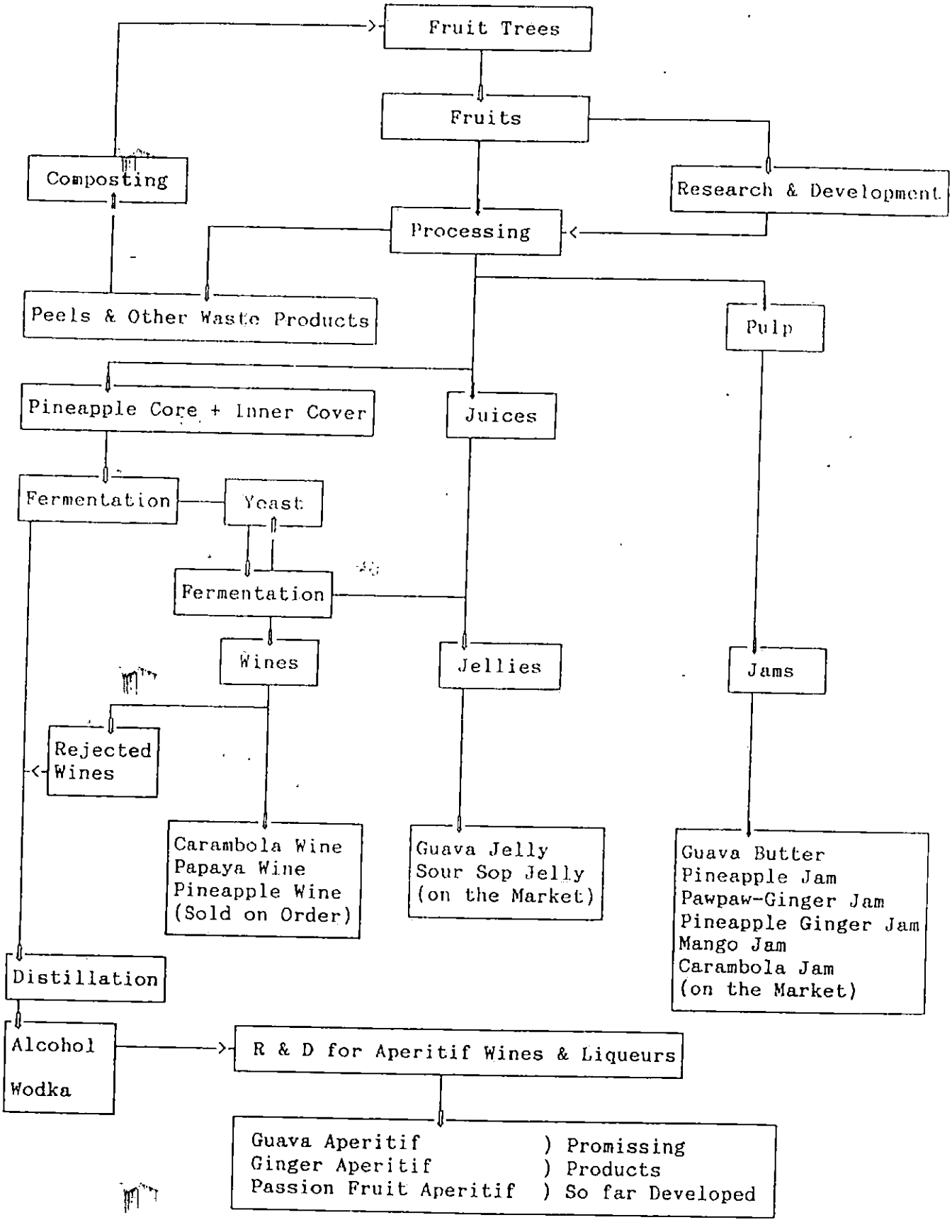
The jam production system set up caused a high level of juice extracts to accumulate. Pineapple, pawpaw and carambola juices were accumulated in quantities which needed either to be bottled as 100% fruit juices for marketing or to be used for preparing other products. A wine kit was acquired and wine experiments were carried out using the fruit extracts as basis. Acidity and tannin levels were adjusted and, where necessary, sugar was added to supplement the level in the juice in order to produce 10-12% alcohol in the finished wine. Wine yeasts were acquired and various yeast nutrient combinations were tried to determine the most effective.

By the end of 1988, the necessary parameters for production of acceptable stable wines without added chemicals had been determined. Few needed equipment and bottles were ordered and, by end of 1989, pineapple, pawpaw and carambola wine trials were started. Provisions were made to satisfy preferences for sweet, semi-dry and dry wines. Labels were designed and printed while the wines were in progress. Wines considered acceptable were bottled and kept to age further in the bottles.

Experimental wines that did not meet acceptable standards were distilled to produce alcohol. Additional alcohol was also produced from juice extracted from crushed pineapple core and the fleshy seeded pineapple waste. The alcohol obtained was used to carry out experiment on aperitif wines and tropical fruit liqueurs.

Schematic presentation of the integrated Research and Development (R & D) system evolved for production and processing of tropical fruits into jams, wines and alcohol is presented in figure 1 below.

FIG 1 SYSTEM EVOLVED FOR TROPICAL FRUIT PRODUCTION & PROCESSING



Difficulties and Problems Encountered

On the whole, the less difficult part of the project was the research and development part. My training, background and experience allowed that part to be carried out without much problem once the laboratory was set up and the necessary basic equipment acquired. Things bacame more difficult when equipment needed for production had to be selected within a limited budget. A lot of research had to be undertaken to gather information and to evaluate the information in relation to needs. Equipment was ordered only when it was considered vital for obtaining necessary scientific data or for enhancing productivity or for improving the marketing prospects of the product. Where available local substitutes could be found to provide the same result, this was preferred.

Marketing

No industrial set up would survive or grow without adequate markets for its products. Unfortunately, for small industries set up in Africa, the marketing outlets left at their disposal are either through large, local private distribution firms or government established ones, if they exist, or through established expatriate multi-national distribution firms. From experience, although local private firms readily accept locally produced goods for distribution, they do not readily pay for the goods received.

On the other hand, expatriate multi-national firms, which readily pay for goods ordered, are not very eager to promote locally produced goods especially if they offer keen competition to their own imported products with similar quality. The alternatives for the distribution of products which are considered "exotic", "natural" or "organic" are, therefore, through established local boutiques, if they exist, or through export to markets created by the demand for non-chemical added products. In addition, there is also a vast market created by Africans living abroad who are forced to patronize Indian and Asian products due to the lack of African manufactured products on foreign markets.

Commercialisation

In 1992, Arkloyd's Natural & Genral Products Ltd, a small agro-industrial company, was registered in Ghana. The project was transfered to Ghana in June 1993, after one of our children completed his studies in Food Science and technology in the United States. By 1995, a system had been put into place to start production of jams and wines for the Ghanaian market. It soon became clear that there is limited market in Ghana for jams and wines. Since December 1997, Arkloyd's has shifted emphasis onto fruit juice production which is more in accordance with demand.

The project has reached a critical stage where management and accounting procedures are being put into place to enable checks and balances and financial controls to be made. These procedures are needed now before the

project expands and grows further. My husband, an accountant (auditor) is helping the project to do this.

THE EXPERIENCE OF GRACEM: A SMALL SCALE ENTERPRISE IN THE USE OF SCIENCE AND TECHNOLOGY TO ENHANCE PRODUCTION

BY

MRS GRACE MARFO

INTRODUCTION

Businesses are generally grouped under two main categories:

A. Large or Big companies: These are companies with 250 or more employees.

B. Micro and Small size enterprises (MSEs)
The MSEs are distinguished by the number of employees as shown below

1. Micro – (0-9 employees)
2. Small - (10-99 employees)

In fact almost all MSEs start as micro and graduate to medium size enterprises. Most of the present large companies started as MSEs and progressed to become large companies. Indeed MSEs can be described as the seedbed of future industries.

GRACEM enterprise is one of the micro enterprises struggling to grow into a small-scale size enterprise. Many of the MSEs in Ghana are agro based and are often started by women.

The aims for going into agro-processing are many and varied but the general ones are:

- To help reduce food wastage during the peak season
- To reduce food preparation time of women
- To be part of the world's instant food drive
- To provide jobs to the unemployed.

IMPORTANCE OF MSES

As earlier stated, MSEs are vital seedbed for future industries and also serve as:

- a source of innovation and competition
- creation of jobs in the society
- means of creating a dynamic, healthy market economy and preserving a stable economic base.
- to reduce waste of raw materials and to create market for farm produce.

The above factors help to establish the vital importance of MSEs, yet there is generally a chronic lack of enough documented information available on this vital sector of many economies.

In Ghana and in many other countries despite some efforts by Governments and their agencies to inform MSEs of the economic benefits that can be obtained, many MSEs are:

- unaware of the relevant legislations in the country
- unconvinced of the potential cost savings and market opportunities available in the system.
- out of step with their customers requirements
- dissociated from their stakeholders concerns.

Generally, there are buoyant and healthy formation rate of new businesses but not a good growth rate. MSEs are effective at harnessing individuals' creative efforts and need to flourish in sufficient numbers to be the seedbed for future industries.

However, small enterprises need help to facilitate their survival and growth. They initially face more problems than medium and large companies.

SOME COMMON PROBLEMS FACING MSES IN GHANA E.G. GRACEM ENTERPRISE

The MSEs all over the world including Ghana have some basic and common problems. The main ones are:

1. Financial Problems

The initiators of micro projects have the creative minds but MSEs usually work with small working capital with no collateral for bank loans. At the initial stages of micro businesses, there is usually not much profit, because most of the production is done on trial and error or testing bases with no established market or outlet for the product.

Though the financial gain is the ultimate of every business, the micro enterpreneurs thrive on the hope and assumptions that the micro business may grow into an industry in future. There are periods of real losses but one consoles oneself with the idea that the problems are not permanent but will be eliminated in future. It will help greatly if friends or relatives or small-scale entrepreneurs can pool their resources together or the government can support such people.

2. Lack of Appropriate Skills and Ability

MSEs usually start with individual's dreams, wishes, creative efforts or hopes and assumptions. One realizes later that he/she lacks most of the necessary skills and abilities needed to get the business going. Therefore from the initial stages the lack of skills and abilities start emerging. Most of the needed skills

and abilities remain a weakness that affects the progress of the business. Two factors that are responsible for this sordid state are lack of funds and ignorance of where to obtain the needed training.

Ignorance, exorbitant consulting fees and high cost of training make it very difficult for MSEs to acquire any meaningful training. Though MSEs are sometimes aware of their training needs yet they cannot afford to pay the fee.

3. Lack of Apropriate Technology

The micro project may be started purely by one person with or without any basic training. The person often starts sometimes with local tools, mostly manual and often simple hand tools.

As the business progresses, the need for more powerful and appropriate tools starts emerging. The more the need becomes obvious, the more the reality of the unaffordability of the needed tools instruments and machines become obvious.

At this state quite a number of the micro enterprises collapse and never rise again. Others try to force their way by working harder with the inappropriate tools to see if they can survive. This retards the growth rate of the business. Some also try to make sacrifices in order to buy very essential equipment.

Lack of appropriate environment for work and inability to meet environmental standards also contribute to retardation of growth. Appropriate working gear is never used and this affects the health of staff. Right methods or techniques are never applied due to lack of training and absence of qualified personnel. Right personnel are also not employed due to high cost of labour.

4. Marketing

MSEs are supposed to market their products in the open market. They are to compete with the medium and large companies, which carry out advertisements and sales promotions. MSEs lack funds for advertisement and sales promotion. Even simple public education to introduce their products is not carried out. The products are never launched into the market due to lack of funds. The inappropriate and unattractive packaging materials also affect the product marketing. Printing of suitable packaging material is expensive and unaffordable. The MSEs are therefore forced to use poor inappropriate packaging materials. Thus the MSEs find it difficult to compete with the medium and large companies, which use appropriate packaging materials. Therefore most MSEs find it difficult to attract any meaningful markets for their products. And this increases the problem as the slow sales rate affects the already low financial state of MSEs. This situation affects the little profit I any at all and generally erodes the fragile business finance and sometimes helps to collapse the whole business quickly.

Lack of sales outlets and lack of funds to exploit more sales outlets make the above factors affect marketing of finished products of MSEs even though the

products may be of good quality. The end result is poor patronage and eventual collapse of the business.

5. Production Cost

MSEs generally work with small capital and are not able to take advantage of seasonal low prices of raw materials. Sometimes lack of storage facilities limits the quantity of raw materials to purchase at a time. If the person has the storage capacity he/she may not have appropriate technology and appropriate equipment to produce more during the peak season. Thus production is stretched over a long period that results in high labour, utility and time cost.

The use of inappropriate tools and equipment leads to high losses during production and this swells up the production cost considerably.

6. Training

The micro enterprises are unable to offer training to their staff either on the job or by sending the staff for training. The enterprise does not offer on the job training because the personnel initially employed to work there are generally not skilled. The staff are not sent for training because of the high cost involved. Only few small-scale enterprises are able to send staff for training. Apart from funds another factor which prevents small-scale entrepreneurs from sending staff for training is insincerity of the staff. The staff leaves soon after they have received the training.

7. Lack of testing facilities for raw materials and finished products.

SUGGESTIONS FOR CONSIDERATION

1. MSEs need to be supported and helped by the government so that they can survive and grow.

2. All supporting organizations and institutions need to develop strategies to deal with the internal weakness of MSEs.

3. The financial and human resource limitations of MSEs need to be understood and addressed by policy makers and regulators.

4. Researchers need to identify cost effective management and technical solutions to MSEs problems.

5. Food Research Institute and other research institutions should reduce their training charges to enable the MSEs in Ghana to avail themselves of the training they offer.

CONSTRAINTS FOR TRANSFER AND COMMERCIALIZATION OF AGRICULTURAL TECHNOLOGIES

BY

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INTRODUCTION

Several countries in Africa have organisations, which carry out research with the objective of using the research results to accelerate agricultural development. The utilization of research results has been minimal. The situation in Ghana is not different from what pertains in the sub-region. The transfer and commercialization of the research results will enhance agricultural production, reduce post harvest losses, add value to raw produce and increase farm incomes. These activities would create additional employment through expansion and creation of micro-enterprises to service the agricultural sector. Why then have we not achieved high growth in agriculture from the use of technological innovations available from within and outside the country?

Several factors contribute to the slow growth in agriculture. These factors include the following:

- Low technology
- Constraints to technology transfer and commercialization
- Constraints to access to input and output markets.
- High post-harvest processing of produce
- Absence of post-harvest processing of produce
- Unfavourable macro-economic environment (e.g., high interest rate policy and limited loanable funds to the agricultural sector).

The main thrusts of the paper are the consideration of constraints with respect to transfer and commercialization of technology identified by the providers of technology, farmers, and small-scale enterprises owners and suggestions to minimize the constraints. The two main constraints considered are technical and socio-economic. Other areas of concern include institutional aspect of transfer and commercialization of technology.

TECHNICAL AND SOCIO-ECONOMIC CONSTRAINTS FOR COMMERCIALZATION OF AGRICULTURAL TECHNOLOGIES

The technical and socio-economic constraints are presented as identified by the different stakeholders. These stakeholders are researchers, farmers, extension personnel, NGOs, processing and governments.

TECHNICAL CONSTRAINTS

Several technical constraints have been identified as responsible for slowing down the transfer and the commercialization of improved technologies and innovations.

- **Researchers**

Some of the research institutions identified high farmer to extension officer ratio, farmers' level of education, inadequate supply of improved planting materials by registered seed growers, (maize, rice, cowpea etc.) and producers of other planting materials (e.g. plantain suckers, citrus seedlings, yam sets etc.).

Absence of facilities at research institutes such as the Food Reseaech Institute (FRI) to try the improved technology on pilot basis in order to identify operational bottlenecks and financial viability poses a major constraint to transfer and commercialization of technology. The appropriateness of technology is also a problem since researchers may lack resources to fully evaluate technological innovations before they are introduced to users.

- **Farmers**

Farmers identified unavailability of improved inputs (specifically seeds and other planting materials), difficulty in obtaining extension assistance due to high farmers/extension officer ratio (2,100:1), technology not suitable to a farmer, level of technical skills, managerial skills and socio-economic circumstances. There have been several instances where technological innovations have been found not to be suitable. Examples often mentioned include ginger, black pepper and recently cashew.

- **Processors**

Processors have complained about the difficulty of getting replacement parts for locally produced machinery and equipment. The technological innovation itself may not be appropriate.

SOCIO-ECONOMIC CONSTRAINTS

- **Researchers**

Initial acceptability of products from improved technological innovations and processes have always been a problem. Scientists may come out with a variety that may be high yielding but not profitable or acceptable on the market.

Mechanisms for transferring the results to enterprises, whether owners of micro-enterprises or small and medium scale enterprises, are in most cases

rudimentary. There are no commercial or marketing managers to promote the transfer and commercialization of relevant research results. These research institutes, as stated earlier, do not also have setups to try their inventions on pilot basis to determine the commercial viability of such innovations. The inability to demonstrate technical and financial viability to entrepreneurs also impedes the rapid transfer and commercialization of agricultural technology.

- **Farmers**

The farmers considered high cost of inputs, and wide variation of prices of agricultural commodities as major problems that they face. The high cost of inputs that the farmers considered as a problem may partly be a reflection of the inadequate capital and lack of credit.

The wide seasonal variations of prices of agricultural commodities, which have been documented in several reports and studies, continue to be a bother to farmers. Farmers who are protected from the wide variation of prices of commodities are those who produce commodities that are tied to an organized marketing system, e.g., cotton, tobacco and cocoa. An inventory credit scheme, which allows traders to increase their volume of purchases at harvest time, may help reduce the wide seasonal variation. Increase in commodities processed may also achieve the same objective.

Farmers ranked lack of funds or credit as the major constraint to adoption of technology. The lack of credit had been compounded by the fact that the government's macro-economic policies under the structural adjustment programme have significantly increased the cost of agricultural inputs. Existing land tenure arrangements in some cases affect the adoption of innovations and improved technology.

- **Input Dealers**

The main constraints identified by the input dealers are lack of capital, credit and marketing skills. Most of the dealers, as a result, can purchase and store small quantities of input at a time. They thereby have high transaction costs because of the frequent trips to purchase stocks.

The input dealers who sell improved seeds and seedlings, fertilizer, agro-chemicals and other farm equipment operate on a very limited scale because of lack of capital. In addition to the low level of technical, marketing and managerial skills, most of these input dealers operate at the rudimentary level.

Processors

The processors interviewed attributed the high cost of transportation of raw materials to the processing facility to the assembling of raw material from widely scattered small-scale holdings. Almost all the processors complained of their inability to purchase required quantity of raw material with their inadequate capital during periods of raw material scarcity

The concentration of many small-scale agro-processing enterprises in a catchment area may also account for the inadequacy of raw materials. The proliferation of foreign agricultural products and products as a result of the governments trade liberalization policies has limited the access to markets for locally produced goods. The processors do not have marketing skills and may be saddled with unsold stocks.

OTHER PROBLEMS, EXISTING POLICIES AND MACRO ENVIRONMENT INHIBITING TRANSFER AND COMMERCIALIZATION OF TECHNOLOGY

Problems identified by other stakeholders and impact of existing policies on transfer and commercialization of technology are outlined below.

- **Marketing Intermediaries**

The major problems complained of by the marketing intermediaries are high cost of transportation, inadequate capital and lack of credit, which force the traders to operate on small-scale basis. Majority of the marketing intermediaries lack managerial skills.

- **Promoters of Transfer and Commercialization of Agriculture Technology**

The facilitators of technology transfer, the Directorate of Agricultural Extension Services (DAES), Women in Agricultural Development (WIAD), the research institutes and some NGOs stated that high illiteracy among the farmers, their low incomes and lack of credit limit their to effectively use improved technologies.

- **Existing Policies**

The financial sector reforms removed sectoral allocation of loans and also freed interest Rates. The resulting high interest rates and limited loanable funds to farmers and other agro-businesses impede the transfer and commercialization of technology.

The liberalized and structural adjustment policies have resulted in the establishment of micro-enterprises in input supply, marketing and processing. Some organisations both private sector and public, have facilitated the transfer of technology and creation of several micro-enterprises. However, most of these enterprises are not operating as they should be partly because of some of the constraints discussed earlier and other institutional constraints.

INSTITUTIONAL ASPECTS OF TRANSFER AND COMMERCIALIZATION OF TECHNOLOGY

- **Paths of Transfer of Technology**

Some of the research institutions have elaborate system of getting their technology improvements and innovations transferred to users. In several

instances, the users directly obtain the technology from the research institutions.

- **Research Extension Linkage Committees (RELCs)**

The Crop Research Institute (CRI) and Savannah Agricultural Research Institute (SARI) appear to have the best institutional linkage. The improved technology and innovations get to users through Research Extension Linkage Committee (RELCs). The CRI and SARI also work with intermediate organisations such as the Grains and Legumes Development Board (GLDB). Linkage between research institutes and other collaborating organisation enhance technology transfer and commercialization. One farm trials, field days and training courses are other means through which research results get to the users.

- **Group Formation**

Several NGOs including Sasakawa Global 2000, Adventist Development and Relief Agency (ADRA) and TechnoServe (TNS), in most cases with the assistance of the Department of Co-operatives (DOC), have brought farmers and other agricultural entrepreneurs together to jointly access technology for farming, or storage and marketing or processing.

- **Nuclei Farm/Outgrower Concept**

The nuclei farm concept (e.g. in the oil palm industry) with outgrowers has also facilitated the transfer of technology to small-scale farmers. When the industry is managed by one body as in the case of cocoa, where research, extension and marketing are all managed by the Ghana Cocoa Board the transfer of technology is enhanced.

- **Direct Access to Technology**

Some of the institutes, especially, Food Research Institute (FRI), Soil Research Institute (SRI), Animal Research Institute (ARI) and the Institute of Industrial Research (IIR) deal directly with clients who visit their premises to seek help. Some of the clients complain about the high cost of training organised for them by Food Research Institute.

The FRI which has several research findings that can be commercialized but without elaborate institutional linkages as exists in the case of CRI and SARI has not been effective in getting its numerous research output transferred to users. The experiences of the RELCs, WIAD and some NGOs confirm the importance of institutional linkages.

- **Patent**

The absence of patenting of CSIR innovations has inhibited the transfer and commercialization of technology to entrepreneurs and has also denied the council revenue from its innovations. The CSIR is now working on patenting

of innovations which will enhance technology transfer and commercialization. Where there are patents the users claim that the patents are expensive to obtain.

INSTITUTIONAL ORIENTATION, CAPACITY AND PREPAREDNESS FOR TRANSFER AND COMMERCIALIZATION OF TECHNOLOGY

• Institutional Orientation

The research institutes orientation has not been geared towards transferring innovations and/or improved technology to users. In most cases, the commercial viability of research findings or innovations have not been tested. The unavailability of facilities for the research output to be pilot-tested does not allow the researchers to identify operational problems, make the necessary modification and advise prospective users accordingly. Some of the key research institutes that were required to hire marketing managers to assist the organisations' transfer and commercialize the research findings are yet to do so.

• Technical Capacity

Notwithstanding, the successes that have been achieved through the work of state institutions and the NGOs, the stakeholders interviewed mentioned several technical problems that they face. The Extension Service, WIAD, the research institutes and some of the NGOs indicated that high illiteracy rates limit the farmers' ability to know and also use available technologies. The low levels of incomes of the farmers and their inability of access credit facilities do not allow them to effectively use technologies that have been developed by the research institutes. Some of the research institutes do not have access to the state of the art equipment. They may also not have the capacity to determine the commercial viability of their innovations.

• Partnership of Potential Stakeholders

The potential stakeholders identified in the study are researchers, investors other generators of improved technology farmers and processors. Other stakeholders include social scientists, economists or other personnel who can assess the technical and socio-economic viability of such innovations under different socio-economic and environmental conditions, promoters of use and commercialization of improved technology, users of improved technology and financiers of the adoption, use and commercialization of improved technology. The collaboration between these stakeholders will promote the transfer, adoption and commercialization of technology at the micro-enterprise level.

RECOMMENDATIONS FOR MINIMIZING CONSTRAINTS TO TRANSFER AND COMMERCIALIZATION OF AGRIC TECHNOLOGIES

The recommendations are based on the issues that have been raised and discussed in the paper with the object of promoting the transfer and commercialization of technology.

- **Production of Seeds and Improved Seedlings**

The production of seed and seedlings need to be promoted. The current output of improved seeds, especially maize and rice, are inadequate to meet the demand of maize and rice seeds that they have stored from previous seasons. The research institutions mainly the CRI and SARI and also the Grains and Legumes and Development Board (GLDB) should be supported to expand their activities on seed breeding and foundation seed production so that Registered Seed Growers will obtain enough growers seed for production of improved seeds (maize, cowpeas, groundnuts and rice) for farmers.

- **Evaluation of New Seeds and Planting Materials**

The CSIR in conjunction with Ministry of Food and Agriculture (MOFA) should evaluate the suitability of new planting materials (either seeds or vegetative) before they are introduced to farmers.

- **Transfer of Technology to Farmers**

The experiences of agricultural production in the country point to the fact that technology transfer is enhanced by the use of commodity systems approach. Cocoa, cotton, tobacco and oil palm industries use more improved technology than in the production of other commodities.

The Research Extension Linkage Committees (RELCs) which bridge the gap between research and extension should be strengthened so that they cover not only innovations for production but also processing and marketing.

- **Appointment of Commercial/Marketing Managers For Research Institutes**

The research personnel of the research institutes have not been commercially oriented. The need for key research Institutes of the CSIR to appoint marketing managers to market and commercialize research findings has been agreed. Steps should be taken for such officers to be appointed soonest so that the drive towards commercialization can be achieved.

- **Modification of Criteria for Promotion of Research Personnel**

The current career progression is based on the number of scientific publications a researcher publishes. To give substance to the objective of commercialization the rate or extent of which research results or innovations are transferred to users or commercialized should be given a significant weighting in the criteria for promotion.

- **Patent**

Consideration should be given to giving an agreed percentage of revenue from patents to researchers who worked on the innovations. If processors

and other users of CSIR patent cannot afford to pay the cost of the patent outright they should be allowed to pay by installments.

- **Support For Researchers who want to Commercialize their Innovations**

The CSIR may consider supporting researchers who want to establish and operate SMEs, based on innovations developed by them. The mechanisms for implementation should be studied later.

- **Capacity of Analyze Financial and Commercial Viability of Technological Innovations**

The research personnel should be given training to equip them to analyze the viability of technological innovations and research findings. The research Institutes may, on the other hand, employ commercial and marketing managers who have the capacity to analyze commercial viability of research findings. Prospective investors will be more convinced if it can be demonstrated to them that the innovation is financially and commercially viable.

- **Establishment of Research Parks of Key Research Institutes**

The establishment of research parks for key research institutes of CSIR or even the universities will afford the researcher and users of new processing facilities and also assess the product suitability for the local Ghanaian market. The researchers will also observe operational bottlenecks at the research parks and would be in a better position to make necessary adjustment before the process is introduced for commercialization.

- **Multi-Disciplinary Approach to Research**

The CSIR should consider a multi-disciplinary approach to research based on commodity basis. A system approach to research may minimize the problems associated with the introduction of new technology and products. The agronomist/marketing specialist should work together in order to reduce problem of acceptability, commercial and financial viability and market access. It is believed that technology transfer and commercialization will increase if this approach is used.

- **Demand Driven Research**

To ensure that micro-enterprise processors do not have problems marketing their products, technology being promoted for adoption should be demand driven. This also requires that research projects embarked on by researchers are also demand driven.

- **Promotion of Nuclei Farm/Outgrower Schemes**

The nuclei farm/outgrower concept that is being promoted by the Ministry of Food and Agriculture (MOFA) might be an alternative means of ensuring that technological improvement developed by the research institutes are transferred to farmers.

The high cost of inputs and lack of credit have contributed to farmers' inability to adopt new technology and innovations. Promotion of nuclei farm/outgrower schemes may be a solution to the nagging problem of high cost of inputs unavailability of inputs, high farmer/extension ratio, lack of credit and access to market.

- **Assistance to Producers of Planting materials**

It has been stated in the paper that production of planting materials namely grain seeds, citrus seedlings and yam sets and others are not adequate to meet the needs of farmers. There is, therefore, the opportunity for the establishment of micro-enterprises in the production of planting materials. The existing producers operate on a very small scale. These operators may need both technical and financial assistance to expand their scale of operations. New entrants may also be encouraged to establish micro-enterprises in these areas.

- **Financing of Marketing Intermediaries and Processors**

The scale of operation of most marketing intermediaries (both input and output marketers) is quite small. Innovative financing such as arrangement of suppliers' credit from distributors with bank guarantee may help the input dealers to expand their operation and hopefully achieve economies of scale. The collateral management system promoted by TechnoServe and the Natural Research Institute (NRI) of UK for farmers and traders should be evaluated and promoted.

The support for GRATIS and NBSSI should be increased so that these institutions could give financial assistance to budding processors.

- **Training of Marketing Intermediaries**

A training programme to upgrade the technical, marketing, accounting, warehousing and managerial skills for the operators of micro-enterprises especially, marketing to lack some basic skills is proposed.

- **Identification and Selection of Projects**

A major problem facing most small-scale agro-processors is the low capacity utilization that affects profitability. Prospective small scale agro-processors should be assisted on proper identification and selection of projects to help avoid situations where facilities are sited in areas with inadequate raw materials base.

- **Support to NGOs and Other State Organisations**

NGOs and some state organisations have been on the forefront of organising groups to operate micro-enterprises. There are some micro-enterprises that may be beyond the reach of the average small-scale operator, e.g. oil mills, cleaning, drying and grading facilities for grains and warehousing. For such facilities group ownership may be to option to follow. For group owned facilities proper formation of groups and training given to the leadership will be essential. The NGOs and other state organizations may be assisted to organise the groups and provide the necessary training to the leadership of the group.

DISCUSSION

Mr. Odzeyem: The marketing aspect should be looked at with technology transfer. The main constraint is marketing. I was expecting Dr. Asante to talk about the marketing problem. The inventory system is not working. Prices are almost stable. Waiting for higher prices in future is not possible. Credit inventory scheme will not solve the marketing problem. We should merge technology transfer with marketing.

A lot of certified seed was produced last year which have still not been bought. I am a seed grower and I have 500 mini (25,000 kg) bags of seed in my store without market. If we have any seed inadequacy, it is in the vegetables.

Mrs Andah: Research is now interdisciplinary and inter-institutional. This has been the case for seven years through the National Agricultural Research Project (NARP). We should go into processing before marketing. We should also approach these activities as business enterprises. You have to know the customer, both internally and externally. We go by experiences. Farming should be seen as a business enterprise. Technology should be seen as an important component.

Dr. Hemeng: Mrs. Marfo has seen the need for training but she is not financially strong. In terms of cashew production, the institutes working here have limited linkages. Any new planting material should be evaluated. If pests and diseases emerge, the investment will be a waste. Cashew is not suitable for high rainfall areas. Pests and diseases will attack it.

Mrs Kordylas: What happens to our formal education system. What prevents us from injecting these schemes, that is, processing into the systems. We should readjust our formal educational system. Benin has been growing cashew for a long time. We should not go to Brazil but look in the region.

Dr. Osei: The relationship between researcher and commercialization should be well-balanced, else we will lose the best scientists.

Mr. Nketiah: Since one of the practitioners in food processing complained so much about cost of training and technology transfer, is it not time to emphasize the option of joint ventureships between technology generators and entrepreneurs. In this way revenue to the technology

generators could be delayed till the technology transfer is fully effected. What can be done to encourage this partnership?

Mrs. Marfo: We want to come together. Finance is a problem.

Mr. Boateng: Small businesses do not have a business plan. If they have business plans such problems will not arise. It is very important to have a business plan. NBSSI has a Business Advisory Centre which can help, but you have to pay.

ENHANCING THE TRANSFER AND COMMERCIALIZATION OF TECHNOLOGIES THROUGH THE TTG PROGRAMME: THE EXPERIENCE OF SARI SINCE JULY 1998

BY

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SUMMARY

Groundnut and soybean, among other food legumes, not only serve as major and cheaper sources of dietary protein; but are also important in the cropping systems of northern Ghana. This is because of the substantial quantities of nitrogen these crops fix for succeeding crops, especially cereals. Additionally the crop residues can be fed to the livestock as fodder or incorporated into the soil to help increase he soil organic matter content. The production of groundnut and soybean in the northern sector of the country is on the increase. However, there is still room for improvement in their productivity. These low yields may be partly attributed to the use of unimproved traditional varieties by farmers as a result of unavailability or inaccessibility to newly improved varieties. Additionally there exist a lot of recommended agronomic practices that can help improve the yields per hectare of these crops, when adopted and used by farmers. This project seeks to enhance accessibility of farmers to improve vegetable oil crops whilst ensuring that they have access to ready markets for the grains they produce.

INTRODUCTION

Soybean production is on the increase in northern Ghana. However, there is no guaranteed market for the farmers. Production figures for Northern Ghana was about 33000 tons in 1998. The varieties in use were all released by SARI and they have an average oil content of 22% and a potential yield ranging from 2000 to 2500 kg/ha with a maturity period of 90-120 days. Despite this potential, the average yield from farmers' fields is 1000 kg/ha. One problem identified as a contributing factor to such low yields is the inadequate supply of improved soybean seed on the market. Most farmers are compelled to use grains bought from the food stalls as seed that comes with the attendant problem of poor crop stand. Another problem identified is the late harvesting that leads to yield loss through shattering.

As a result of the anticipated increase in production of groundnut and soybean in the coming years, the existing vegetable oil mills have been rehabilitated with plans to build new ones. Thus it is imperative that these oil mills are sustained with supply of adequate raw materials, i.e. groundnut and soybean from the small-scale farmers, who are the major suppliers.

The Savanna Agricultural Research Institute (SARI) in collaboration with the National Seed Service have been trying to ensure adequate supply of improved varieties of these crops by organizing rural farming communities to produce their own seed every planting season since 1995. In 1998, the Community Seed project expanded its activities within six of the eight districts in the Northern Region that have so far participated in the project. These districts increased the number of community group seed growers with a corresponding area cropped to cowpea and soybean which were the crops much emphasis were laid on in that season. The seed-grower groups were assisted to acquire foundation seeds of the various crops and were guided technically to produce certified seeds from them.

The concept of involving rural farmers in the project was laudable because it fits into the decentralization policy of the Government of Ghana at the district level where most rural farmers do not have the opportunity to use genetically improved and good quality seed. This situation has been hampering improvement in food production and family income.

To maintain a steady increase in groundnut and soybean production in our mandate area, SARI in collaboration with the Ministry of Food and Agriculture (MoFA) and Bosbel Vegetable Oil Mills, Tamale undertook the TTG project titled ***"Increasing vegetable oilseed production and processing in Northern Ghana"*** with some financial support from OAU/STRC-SAFGRAD. This project is an after thought to add value to the community seed project mentioned above and it is aimed at enhancing improved seed utilization of crops among the rural farming communities.

The project is to:

i) supply farmers with seeds of high oil content varieties of groundnuts and soybean;
ii) transfer the technology of growing these varieties to obtain yields close to the potential yields to the farmers;
iii) guarantee farmers of a market for their produce by linking them to vegetable oil mills and
iv) guarantee the oil mills high quality raw materials in required quantities.

The project took off in the 1998-cropping season and despite the very enthusiastic response from farmers who collaborated, it was plagued by bad weather that expressed, itself in the form of a prolonged dry spell. This led to late planting, poor plant stand and/or poor pod filling consequently production level fell far below the target.

PROJECT IMPLEMENTATION AND OUTCOME

Seed Production

The 1998 programme of the Community Certified Seed Project expanded by the addition of thirty-one group seed growers in six districts who cropped 23.6 hectares of cowpea, soybean and groundnuts. This brought the total number

of group seed growers in the eight districts to 66 who were to crop a total land area of 51.6 hectares under the crops mentioned above. The crops on this land area were projected to produce a total of about 64 tonnes of cowpea, soybean and groundnut seeds that could have been used on about 2000 hectares in the 1999-cropping season.

As shown in table 1,only an area of 41.6 ha was planted to the three crops. This produced only 9.9 tonnes of seed – more than 80% short of the target. This amount of seed can be used on a total of 280 ha of land under cowpea, groundnuts and soybean taking into consideration waste at all levels of storage to the planting date.

Table 1: Seed produced by community group growers in districts of Northern Region, 1998

DISTRICT	CROP PLANTED/AREA PLANTED/AMOUNT OF SEED PRODUCED					
	Cowpea		Soybean		Groundnut	
	Area, ha.	Seed, kg.	Area, ha.	Seed, kg.	Area, ha.	Seed, kg.
West Gonja	3.2	1020	0.8	-	0.2	120
East Gonja	3.2	450	2.4	350	1.8	80
Nanumba	1.6	250	2.8	500	-	-
Yendi	2.4	650	4.0	286	-	-
West Mamprusi	0.8	50	3.6	2300	-	-
Tolon/Kumbungu	4.0	1177	2.0	663	0.4	-
Tamale	-	-	2.8	700	1.2	240
Savelugu/Nanton	-	-	2.4	600	2.0	400
	15.2	**3597**	**20.8**	**5399**	**5.6**	**840**

This drastic shortfall in production is mainly attributed to the prolonged drought experienced in the middle of the 1998-cropping season coupled with abrupt cessation of rains towards the end of the season in these areas. Whilst some communities could not plant at all, others had a total crop failure with the majority obtaining poor yields. This bad weather condition adversely affected most agricultural activities of the season in the region.

Grain Production

122 farmers were assisted to acquire soybean seed and money for land preparation in July and August to grow 54 hectares of soybean in six administrative districts. They were to produce grains for sale to the Bosbel vegetable oil mill in Tamale. In Gushiegu-Karaga district, a group of 100 farmers involved in a nucleus farm scheme revolving around one farmer, who joined our project later on produced 40 hectares of soybean. These 100 farmers did not enjoy any financial and material support from the project but were given some technical advise during monitoring tours.

Table 2: Soybean grain production performance by farmers in northern region, 1998

Districts	No. of Farmers	Area Cropped, ha.	Expected Yield, kg.	Actual Production kg.
Tamale	62	30	24000	-
Yendi	21	8.4	8400	150
East Gonja	12	4.8	4800	1350
Nanumba	6	2.4	2400	1250
West Gonja	12	4.8	4800	150
Tolon/Kumbungu	9	3.6	3600	-
Gushiegu/Karaga	100	40	40000	22000
Total	**222**	**94**	**88000**	**24900**

CONCLUSION

Though the project took off late in some of the districts, response to the exercise was good and encouraging, as farmers were ready to collaborate and actively showed concern by meeting the target land areas they proposed to crop.

The performance of some farmers in this exercise for a start fell below expectation. This situation was attributed mainly, as indicated earlier, to the adverse weather conditions that occurred during the season. However, during monitoring, we came across soybean fields that were over grown with weeds because the farmers lost hope of reaping any meaningful yields as a result of the poor rainfall distribution. Many were the farmers who harvested late allowing the pods that were already not well filled to shatter thereby losing a substantial part of the anticipated poor yield. In the Yendi, East and West Gonja districts, we came across complaints of poor plant stands attributed to picking of emerging soybean seedlings by birds. Some few farmers are also not declaring their yield figures to the extension agents.

All these reasons cumulatively contributed to the poor production levels shown in table 2 that f ell below 10% of the expected targets in the districts that the project supported.

The nucleus farmer concept was encountered during our visits to the communities in two districts – Gushsiegu/Karaga and Nanumba. Participation of farmers in this kind of our grower scheme was encouraging as we witnessed greater seriousness on the part of these farmers. The performance of one such group in Gushiegu/Karaga district is shown in table 2 where despite the adverse weather conditions. 55% of the production target was achieved.

Nevertheless, from all indications, the initiative of this project is catching up well with the rural farmers and this must be vigorously continued in the areas with comparative advantage like Gushiegu/Karaga and the Nanumba districts for soybean, whilst groundnut kernel production is concentrated in the Upper-East region. We will suggest that the project should work with farmers who

are in the nucleus farmer groups, than those standing on their own. This will make invested inputs accrue quantifiable benefits.

The Bosbel Vegetable Oil Mill is offering an amount of 72800 cedis per 100 kilogram of soybean. We are trying to work out with the farmers and the oil mill percentages of the investments made that will be deducted from their sales. It will not be possible to retrieve all the investments made in this first year from farmers. However in the subsequent years, counting on favourable growing conditions these farmers are expected not to be indebted to the project.

RECOMMENDATION

Other uses for soybean should be enhanced in the communities, targeting women groups that are already in place. Processing soybean into dawadawa (a local ingredient used as flavour for soup), extracting milk from soybean and adding soybean flour to wheat flour for baking are a few tested uses of the crop that can be transferred to the communities. These initiatives will definitely increase the demand for the crop, which will eventually promote its market, hence improvement in both the living standards and nutrition of farm households. We hope to actively involve some identified NGOs and the Women in Agricultural Development (WIAD) department of MoFA in future to enhance alternative ways of utilizing soybean in the farming communities.

ENHANCING THE TRANSFER AND COMMERCIALIZATION OF TECHNOLOGIES THROUGH THE TTG PROJECTS: THE EXPERIENCE OF THE FRI SINCE JULY 1998

BY

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INTRODUCTION

Given the known agronomic and nutritional advantages of soybean, a multidisciplinary team of researchers from three institutions in Ghana has been promoting the production and utilization of soybean in selected farming communities in the country, with external financial support. The success of the community based project and its visible impact has led to the need to extend the activities to other rural communities. A project funded as one of the Technology Transfer Grants (TTG) projects under the Semi-Arid Food Grain Research and Development Agency (SAFGRAD) was conceived to extend the experiences obtained in earlier projects by the team to a wider cross-section of the Ghanaian population, taking into account production and utilization of soybean, through the development of appropriate processing techniques, widespread dissemination and influencing policy. The SAFGRAD project was initiated to encourage the use of soybean at household and small-scale enterprise levels in two farming villages: *Samsam-Odumase* and *Mimpemihoasem* in the Greater Accra Region of Ghana.

The general objective of the project is to develop and encourage the adoption of soybean utilization technologies appropriate for household and small-scale enterprises in order to stimulate soybean production, encourage small enterprise development, make available more utilization technologies, improve economic and social benefits to primary producers, processors and, rural communities in Ghana. The collaborative institutions in the team include the Food Research Institute of the Council for Scientific and Industrial Research as the lead institution, the Home Science Department of the University of Ghana, and the Ga District Agricultural Development Unit of the Ministry of Food and Agriculture (MoFA).

Since July 1998 when the project was initiated, activities undertaken in the two project villages towards enhancing the transfer and commercialization of soybean technologies include:

1. Baseline studies on soybean production and utilization, food consumption patterns and the nutritional status of the people at the two project villages.

2. Product and recipe development and quality evaluation, and field training and demonstration activities on household utilization of soybeans.

This report provides information on these activities undertaken and captured as the experience of the FRI since July 1998.

BASELINE STUDIES ON SOYBEAN PRODUCTION AND UTILIZATION, FOOD CONSUMPTION PATTERNS AND THE NUTRITIONAL STATUS OF THE PEOPLE AT THE TWO PROJECT VILLAGES

GENERAL METHODOLOGY

Selection of Project Sites

The inhabitants of two villages - *Samsam-Odumase* and *Mimpemihoasem*, in the Greater Accra Region of Ghana, constituted the target population in the study. The Project Team established rapport and paid several visits to the villages to identify key informants, contact persons and farming groups. In all cases, the Head Office of the Extension Department of the Ministry of Food and Agriculture (MoFA) in Accra was first contacted for the team to be introduced to District Extension Officers who would assist the team in the selection of villages and respondents.

Survey Methodology

The Participatory Rural Appraisal (PRA) technique and the conventional survey methods were used to collect both qualitative and quantitative data in the study area. These were supported with a secondary data from government institutions and data banks. For the PRA, both formal and informal interviews were conducted with key informants selected from the survey areas using a checklist. A semi-structured questionnaire was also developed and used to collect data on foods available, sources of food for the household, food consumption patterns, economic activities, gender issues and decision making processes as well as other factors that influence the general household food behaviour.

Determination of Food Consumption Pattern and Food Quality at Household Level

To assess the food consumption patterns, quality of food consumed at the household level and the effect on the nutritional status of the household a repeated 24-h dietary recall and food frequency methods were used to collect information on food and nutrient intake of selected subjects in the project areas. This information was converted into the quantitative data of nutrients using Food Composition Tables. In addition, actual samples were obtained and analyzed at the Food Research Institute laboratories to determine the dietary quality using standard methods of analysis.

Determination of Nutritional Status

Nutritional anthropometry was used to assess the nutritional status of the different age groups in the households. Additionally data on the household food consumption patterns and the food quality analysis were used to determine whether individual recommended daily allowances are being satisfied. Some nutritional indicators used include weight-for-age and weight-for-height to

classify the nutritional status of pre-school children. Weight-for-age was based on the WHO (1983) manual for measuring nutritional status. Children falling below 80% of the standard were considered as being malnourished or 'at risk'. Weight-for-height was based on the Harvard standard. Using the Waterlow (1977) classification, children falling below 80% of the standard were considered as malnourished. Body mass index (BMI) was used to determine adult nutritional status.

CHARACTERISTICS OF THE PROJECT AREA

Project Villages: Location and Historical Background

Samsam-Odumase and Mimpemihoasem are two farming villages north-east of Accra off the main Accra-Nsawam road. Samsam-Odumase is about 7km while Mimpemihoasem is 8km east of the main road. The people are a mixture of Ga and Akan (Akwapim) ethnic groups with a few Ewes, and are basically Christians. As a small farming community, the population of each village is only about 500. At Samsam-Odumase for example, there are about forty-six households with an average of ten people in each household.

The village of Samsam-Odumase was established several decades ago by a hunter from Accra by name Kwame Pebi who first settled there and took to farming. The land originally belong to the Akwapim tribe of the Akan ethnic group. The grandson of Kwame Pebi, Aboa Fianko became the second chief of the area. The people of Mimpemihoasem were also originally at Samsam. According to their historical background, one wealthy female farmer, by name Madam Anyaman, had relatively large farms at the present settlement. She was losing most of her children while at Samsam. She attributed this to the evil work of her friends and relatives who were making demands and asking for favours she did not provide. She finally decided to leave the Samsam village to settle on her farmland. She named her new home *Mimpemihoasem* which in the Akan dialect literally means: "I do not want trouble for myself".

Regional Characteristics

The Greater Accra Region, where the Project villages are located, is in the South Eastern part of Ghana along the coastal belt of the Atlantic Ocean about 6km north of the equator on the Greenwich Meridian. It is the smallest region with a significantly high population because of the city of Accra which is the Nation's capital. A striking characteristic of the region is the low rainfall which rarely exceeds 14 cm . The result is that while the interior plains where the farming villages are situated have thicker cover of bush and richer soils, the coastal section is characterized by a more open grassy scrub. Outside the urban centre, the main human activities are agriculture, livestock raising and fishing. The usual crops are cassava which is the most widespread, maize, peppers, tomatoes, okros and garden eggs with pineapples as a recent addition mainly for export. The crops are grown primarily for local consumption and for sale in the larger and coastal settlements. Apart from the commercial pineapple farms, most of the farms are usually not larger than one or two acres and are grouped

round small villages dotting the plains or strung along motor roads for ease of communication with buying centres within the locality.

SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

Age Distribution

Age distribution of respondents ranged between 25 - 60 with mean age of 35 years. Most of the respondents (72%) were within the active age group of 25 - 40 and only 4% were between 50 - 60 years of age (Fig 3.1).

Educational Background

Majority of the respondents had formal education with about 50% and 33% having Primary and Secondary level education respectively (Fig. 3.2). This is quite encouraging in terms of technology adoption as they are likely to be receptive to new improved technologies.

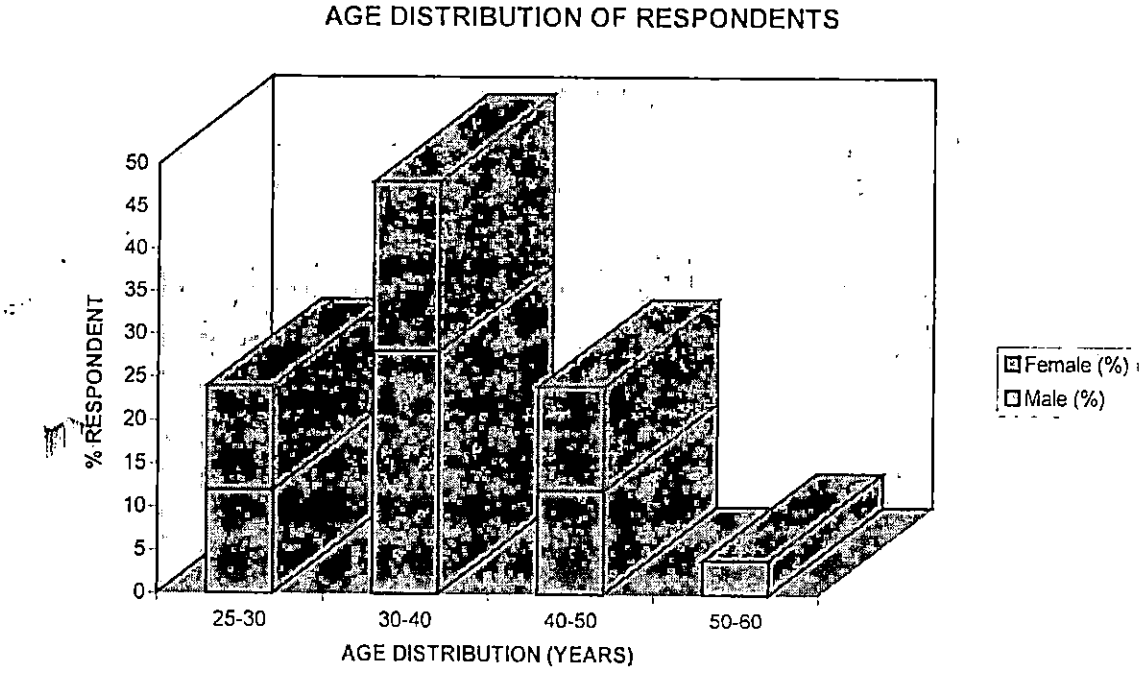

Fig. 3.1. Age distribution of respondents.

Beliefs, Attitudes and Gender Roles

A large proportion of the respondents were Gas while few were Ewes and Akans. About 80% were Christians, 12% Traditionalists and 8% Moslems. Friday is the day for the gods in the area and no farming activity nor working around riverside is allowed on Fridays. Considering social obligations in the household, provision of income to support the family is the onerous responsibility of husbands. However, due to the general economic situation women who used to be homemakers also shoulder some of the financial responsibilities in the family. In some households women are sole breadwinners of the family. Domestic tasks like food preparation, serving of meals, washing, sweeping, etc. are done by women.

EDUCATIONAL BACKGROUND OF RESPONDENTS

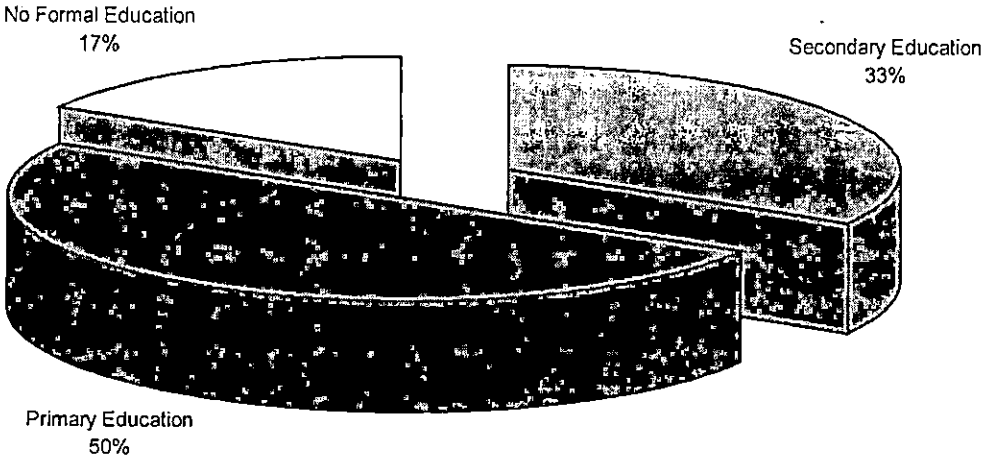

Fig. 3.2. Educational background of respondents.

Generally, household heads who are mostly men take decisions on the following based on the availability of funds: type of crop/livestock to produce/rear, including acreage cultivated or number of animals to rear, level of inputs used and proportion of output sold, consumed or given out as gifts.

Gender roles commonly observed in agriculture production in the study area are summarised as follows: Land preparation (males), Slashing and burning (males), Planting (males & females), Undergrowth weeding (males), Application of agro-chemicals (males), Harvesting (males & females), and Marketing of output (females).

Marital Status and Number of Children

In terms of marital status, most of the respondents (80%) were married with more than four children. About 12% were single while only 4% each were divorced and widowed (Fig 3.3).

Sources of Income and Concept of Wealth

The primary economic activity in the study area is farming. Crops cultivated include staples like cassava, maize, yam and plantain for both home consumption and sale. Others are fruits and vegetables like pineapples, palms, oranges, tomatoes, pepper and garden eggs which are purposely produced for sale. Livestock reared include pigs, sheep, fowls and goats. Subsidiary economic activities undertaken are petty trading, tailoring/sewing, food preparation for sale and traditional birth assistance. It was observed that only 16.67% of the sample mainly thrive on petty trading. Farming activity contributed about 75% of household income while secondary activities contributed 25% only.

Concept of wealth in the community is based on ownership of pineapple farms and transport. It is believed that pineapple farming is capital-intensive and therefore the larger the size of pineapple farm the richer the owner. However, it was observed that most of the medium to large-scale pineapple farms in the area were owned by individuals outside the locality. In relation to household income expenditure, about 40% of household income is reinvested into farming activities, 35% is spent on education of their wards and only 5% is spent on food since most of the household food is supplied from their farms (Fig. 3.4). Other expenditure include medical bills, clothing, maintenance, etc. which take up the rest of the family income.

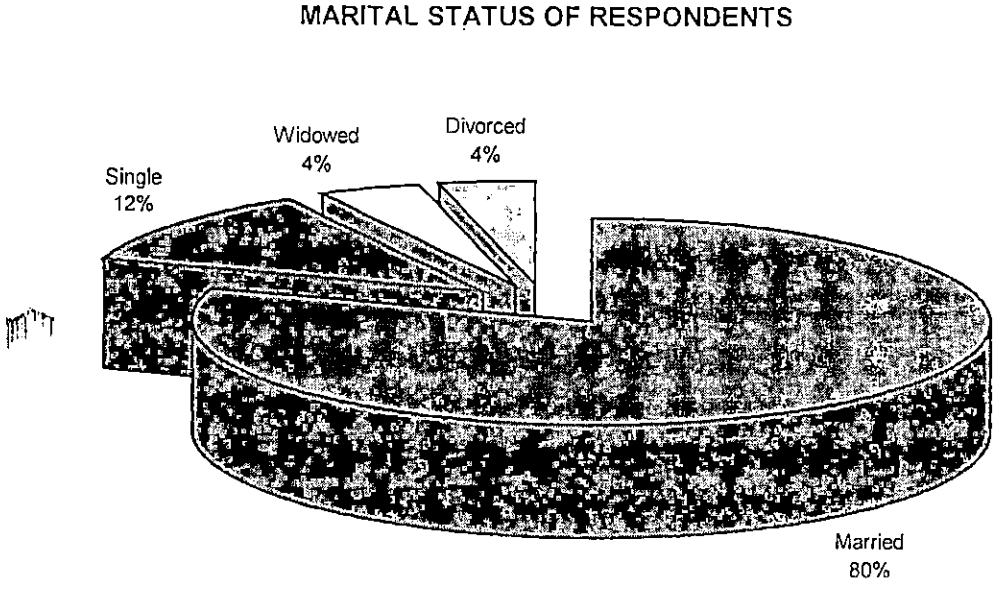

Fig. 3.3. Marital status of respondents.

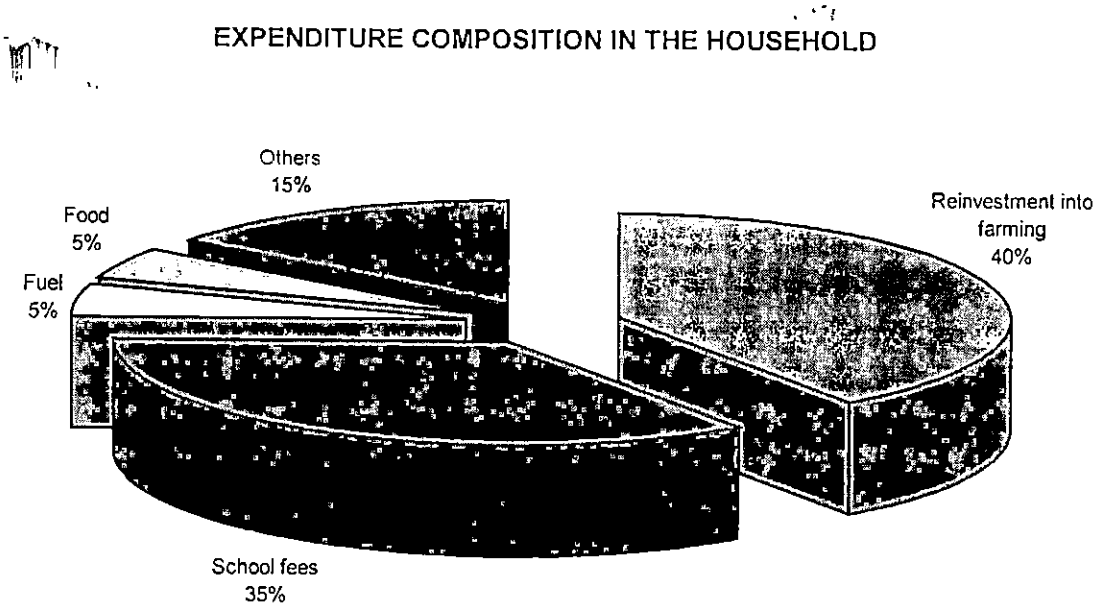

Fig. 3.4. Expenditure composition of respondents.

STATUS OF SOYBEAN PRODUCTION AND UTILIZATION AT PROJECT VILLAGES

From both the PRA and the conventional survey there have been no indications of the cultivation of soybeans by the farmers at any time in the two project villages, *Samsam-Odumase* and *Mimpemihoasem*. In terms of utilization, the MoFA extension staff in separate nutritional programmes mentioned and demonstrated the use of soybean in traditional diets to some of the people in the two villages. Some of the people therefore have some slight knowledge on the use of soybeans in soups and stews. About 4% of the respondents buy soy flour or soybeans (for preparation of paste) occasionally from nearby town (Nsawam) for use in soups and stews. In general however, knowledge of soybean utilization and its nutritional benefits is lacking in the area.

In terms of cultivation in the future, 95% of the respondents expressed their readiness to cultivate the crop if given the proper training and assisted with inputs. All the respondents were however willing to use it in their traditional diets, including weaning foods provided. they have adequate knowledge of the household utilization methods. Their main reason for not cultivating the crop earlier on was the limited knowledge, anticipated difficulties involved in soybean cultivation as well as lack of inputs such as seed.

FOOD CONSUMPTION PATTERNS AND FOOD QUALITY IN PROJECT VILLAGES

A questionnaire was developed and used to collect data on the food consumption patterns in selected households at the two project sites, using the

24-h dietary recall and food frequency. Major staple foods in the area and food preparation methods for the major staple diets were recorded. For each village, nutritional anthropometry was used to assess the nutritional status of the different age groups in the households. Some nutritional indicators used included weight-for-age, weight-for-height and Body Mass Index to classify the nutritional status of the vulnerable groups of the population in the study area. The Participatory Rural Appraisal (RRA) technique was first used to get a general qualitative data on the food consumption pattern in each village. The results of the study helped achieve the following in line with the set objectives of the project: (a) establish the nutritional status of the people and to justify the need for the promotion of soybean production and utilization in these areas; (b) obtain data on food consumption patterns, food preparation methods and food quality at household level, based on which acceptable soy recipes were to be developed and promoted.

Major Food Crops Produced and main Staple Dishes

As mentioned earlier, the major food crops produced include maize, cassava, yam, plantain, cocoyam, pineapple, pepper, tomatoes, garden eggs as well as some leafy vegetables. Most of these crops form the basis for the traditional food consumption pattern in the area. The main staple dishes are based on cereals, especially maize, and starchy root and tuber crops such as cassava and yam. The staple dishes include Kenkey, Banku, Ampesi (boiled cassava, plantain or cocoyam) and fufu (pounded boiled cassava, yam, plantain or a mixture of cassava and plantain). These are consumed with soups (light soup, okro soup or palm soup), stews and leafy vegetable sauces which may contain some marine fish brought from the coastal areas for sale.

One striking observation was the absence of legumes in the diets of the people in these areas. In Ghana, legumes such as cowpea and peanut constitute a second major source of protein for the people, after fish. In areas where fish consumption is low due to unavailability and cost, consumption of legumes and bushmeat (game) usually make up for the deficiency. In the project villages, consumption of other sources of animal protein such as sheep, bushmeat, cat and snails was considered a taboo with certain people. The problem of lack of adequate sources of protein is compounded further by the fact that no fishing activity is undertaken in the only stream in the area (the *Abotre* stream). It is a taboo to fetch fish from the stream at all times.

Quality of Traditional Weaning Foods

Children in the project villages are weaned with cereal porridges prepared from fermented maize meal or roasted maize flour. In a number of cases, the weaning period starts as early as three months. Mothers are incapable of affording high protein imported baby foods which are available mainly in the large towns and cities. Reports of earlier studies have indicated the nutritional inadequacy of such cereal-based traditional weaning foods in supporting proper growth and development of babies in Ghana, and stressed the need for fortification with high plant protein sources to improve the quantity and quality of the protein (Plahar *et al.* 1983; Plahar and Leung, 1985; Plahar and Eyeson,

1988; Annan and Plahar, 1995; Nti and Plahar, 1995; Plahar *et al.* 1997a; 1997b).

Table 5.1. Average daily nutrient intake of respondents at Project villages

Nutrient/Engergy	Project Village		
	Samsam-Odumase	Mimpemihoasem	Overall
Calories Respondents	2100	2140	2120
% RDA[2]	105	107	106
Protein (g) Respondents	26.4	28.6	27.5
% RDA	60	65	62.5
Vitamin B_1 (mg) Respondents	0.750	0.800	0.775
%RDA	75.0	80.0	77.5
Vitamin B_2 (mg) Respondents	0.960	0.912	0.936
%RDA	80.0	76.0	78.0
Calcium (mg) Respondents	400	480	440
%RDA	50	60	55
Iron (mg) Respondents	7.2	8.1	7.7
%RDA	40	45	42.5

NUTRITIONAL STATUS OF POPULATION IN PROJECT VILLAGES

Nutrition and Growth Pattern of Children at Project Sites

Nutrition is a combination of processes by which the body receives and uses food nutrients. It involves obtaining and eating the right type of food and in their right quantities. The nutritional status of a community or a community's level of nourishment is therefore an essential element in the total concept of health of that community. It reflects the status of the various body parts of its members and function that relate in some manner to nutrition. In this study, the nutritional status of young children, up to five years, was used as an indicator of the general nutritional situation of the project target communities. This is because nutritional deficiencies in a household usually manifest themselves in young children, who are the most vulnerable to nutritional changes.

The data obtained in the study is to help identify specific problems or situation with the target communities which makes it necessary for the promotion of soybean processing and utilization in the area. It is supposed to not only justify the need for the project but also serve as baseline data on the nutritional status of the people to be used later in impact assessment studies.

Three measurements were combined to form three indicators of the nutritional status. These were the weight-for-age, height-for-age and weight-for-height.

[2] Recommended Daily Allowance

Weight-for-age serves as a general measure of malnutrition in children. Figures 6.1a and 6.1b give the weight-for-age curves for girls and boys, respectively, under two years. For the first three months, the mean weight-for-age curves were only slightly lower than the WHO (1983) standard reference, and the difference could not place the children within this age group below the required 80% of the standard to be declared malnourished. During the first three months, mothers in most villages in Ghana actively breast feed their infants without any supplementation. Hence the relatively high nutritional status of infants less than three months. The weight-for-age curves however, showed a great drop in mean weight of infants (both boys and girls) at the age of four months. This is due to the fact that most mothers in Ghana introduce weaning foods to their infants at about four months. As mentioned earlier, these weaning foods are thin cereal gruels which are low in food nutrients. The initial "nutritional shock from the relatively poor quality foods is responsible for the decrease in weight observed. There was overcoming the initial shock. The combination of breast feeding and traditional weaning food usually administered within this period was adequate to maintain the infants slightly below the WHO standard.

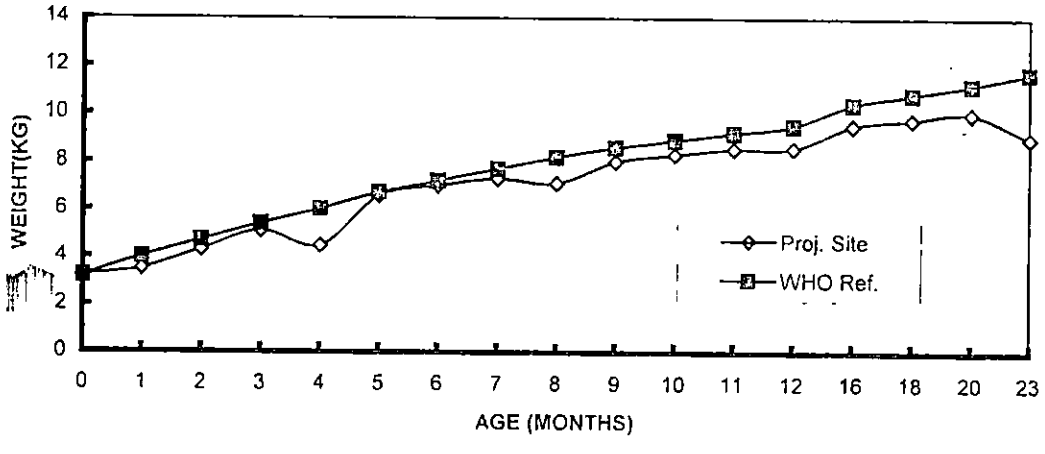

Fig 6.1a. Mean weight-for-age curves for girls <2 years (Project sites vs W.H.O. Reference).

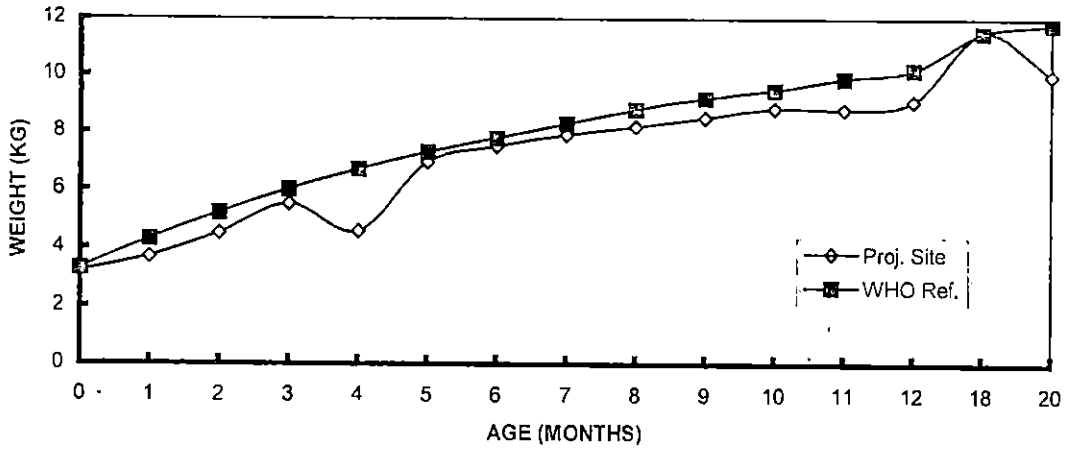

Fig 6.1b. Mean weight-for-age curves for boys <2 years (Project sites vs W.H.O. Reference).

The situation became worse after two years when the mean weight-for-age curves of children of both sexes at the project sites were found to deviate drastically from the WHO standard (Figs 6.2a and 6.2b). The curves indicated gross malnutrition and underweight. This is normally the period when most young children are completely weaned off the breast and are depending solely on family meals for their nourishment. An analysis of a 24-hour dietary recall and food frequency questionnaire data collected at the project villages revealed that family meals were low in almost all the major nutrients except for energy. Protein intakes were highly inadequate in both quantity and quality (Table 5.1).

A plot of height-for-age of children at the project sites compared to the WHO reference also showed that the children in the study group have low height-for-age, meaning that they are stunted (Figs 6.3a and 6.3b). Stunting is usually due to chronic malnutrition or extended period of inadequate food intake leading to malnutrition.

Based on the above observations, it was concluded that pre-school children at Samsam-Odumase and Mimpemihoasem are "at risk" nutritionally and therefore need a nutritional intervention.

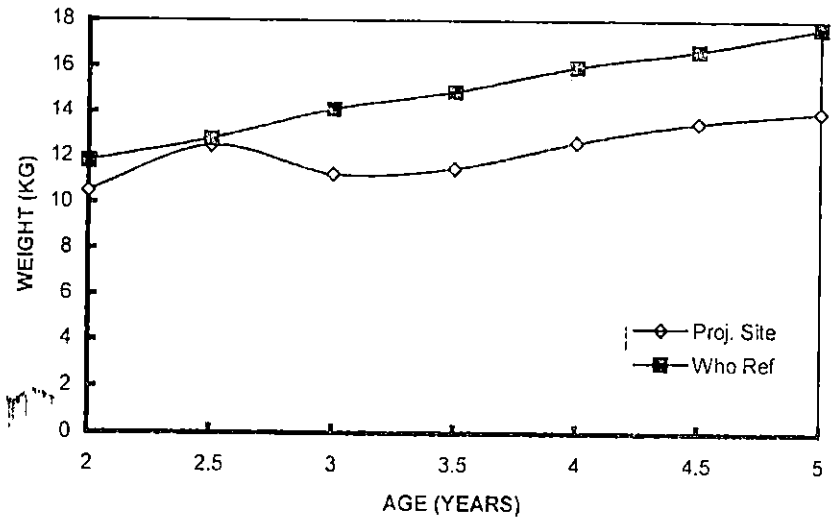

Fig 6.2a. Mean weight-for-age curves for girls 2-5 years (Project sites vs W.H.O Reference).

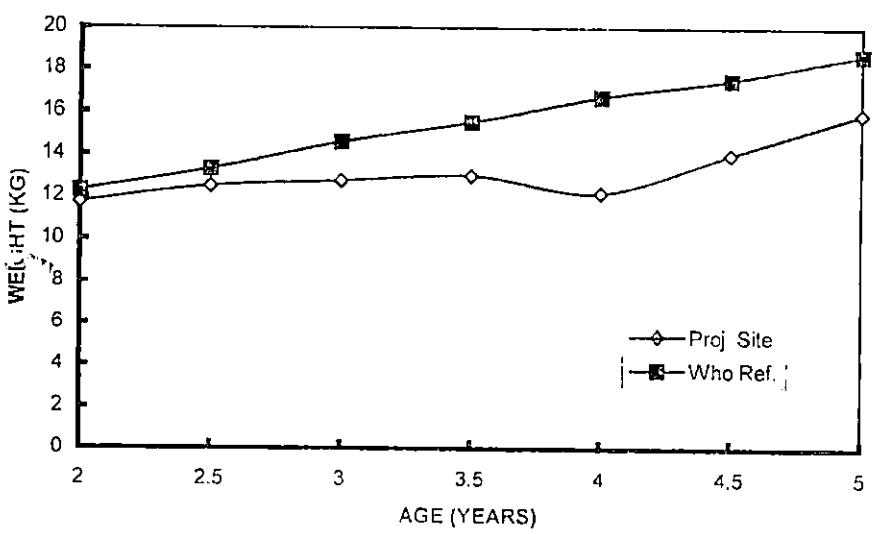

Fig 6.2b. Mean weight-for-age curves for boys 2-5 years (Project sites vs W.H.O. Reference).

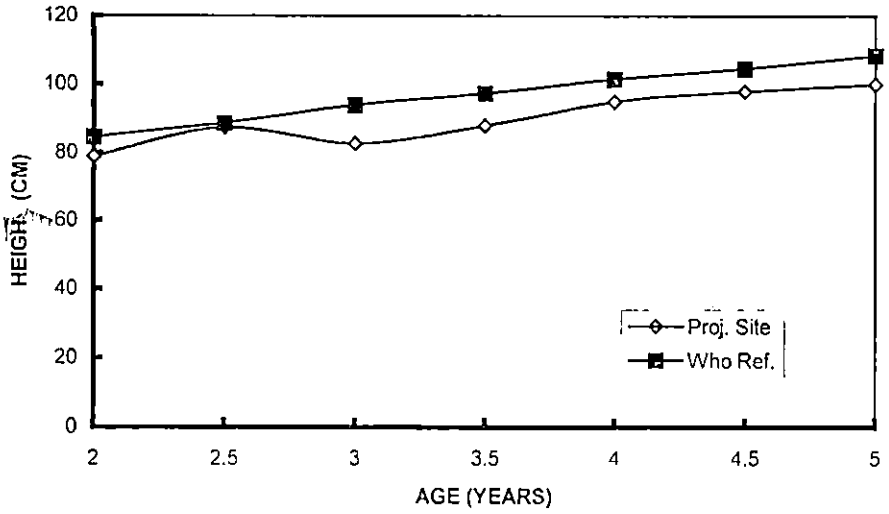

Fig 6.3a. Mean Height-for-age curves for girls 2-5 years (Project sites vs W.H.O. Reference).

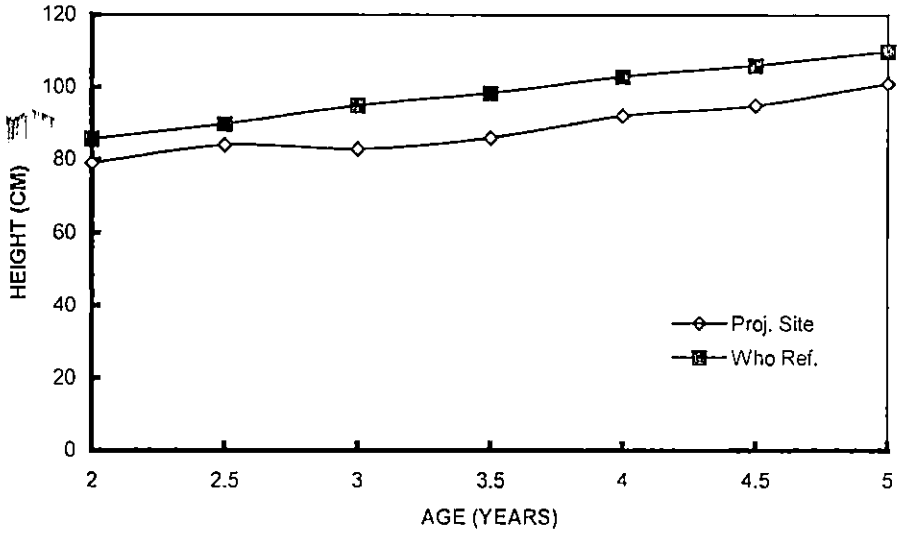

Fig 6.3b. Mean height-for-age curves for boys 2-5 years (Project sites vs W.H.O. Reference).

PRODUCT DEVELOPMENT AND QUALITY EVALUATION, TRAINING AND DEMONSTRATION ON HOUSEHOLD UTILIZATION OF SOYBEANS

Products and Recipe Development and Quality Evaluation

In the baseline studies on soybean production and utilization, food consumption patterns and the nutritional status of the people at the two project villages, the major staple foods of the people have been identified to be mainly based on cereals and root crops. These foods were found to be very low in protein and the need for protein supplementation was established in the survey. The recipe development activities during the first year of the Project were therefore aimed at targeting these foods for fortification with soybeans and soy products to help improve the nutritional status of the people. In addition, techniques appropriate for the prevailing conditions in the study area were developed for the production of intermediate soy products for use in fortification of traditional foods at household level. In all the product development and recipe formulation activities, the normal phases involving idea generation, technical development processes for optimization and prototype refining by sensory techniques were applied to arrive at the final formulations and preparation methods. The recipes were evaluated for consumer acceptability.

So far, products and recipes developed using techniques appropriate and specific for the study area include (a) whole soy products such as full-fat soy flour and soybean paste; (b) soybeans in the local traditional stews, soups and sauces; and (c) soybeans in the local staple foods.

The technique for the production of full-fat soy flour involves dry-cleaning soybeans by removing stones, chaff, dirt and other foreign matter, washing and soaking for one hour before boiling in water for 20 minutes. The boiled beans were drained and spread to dry in the sun. The dried beans were then broken in a mill (local corn mill - a commercial disc attrition mill used in the villages for milling corn as service) and winnowed to remove hulls. The dehulled beans were then milled to fine flour in the corn mill. The resulting full-fat soy flour is the intermediate soy product for fortification of traditional foods as described later. The nutritional composition of the product was found to be as follows: 423 kCals/100g energy, 34.66% Protein, 0.79 mg/100g Vitamin B1, 0.30 mg/100g Vitamin B2, 284 mg/100g Calcium and 8.7 mg/100g Iron.

For the preparation of the soybean paste, the same procedure as above was followed up to the boiling stage. The boiled beans were drained and washed with cold water while rubbing in a kitchen strainer (commonly used in the villages in the preparation of palm nut soup or porridge) to dehull. The hulls were removed by floatation which was achieved by immersing the strainer and contents in a bowl of water. The dehulled wet beans were then ground in an earthenware mortar until a smooth paste was achieved. The nutritional composition of the paste was determined to be as follows: Energy - 280 kCals/100g, Protein - 24.57%, Vitamin B1 - 0.60 mg/100g, Vitamin B2 - 0.25 mg/100g, Calcium - 194.86 mg/100g and Iron - 5.0 mg/100g.

Recipes formulated and tested based on the traditional food habits of the people include soybeans in the local staple foods such as banku (a cooked paste of fermented maize dough or a mixture of fermented maize dough and cassava dough), aprapransa (a dish made from roasted corn flour, fish, shrimps and palm oil), plain cooked rice, jollof rice, maize dough porridge and roasted maize flour porridge. In addition formulations were developed for soybeans in several types of traditional stews, soups and sauces eaten in the two villages. In consumer affective tests, all the recipes had high acceptability scores.

Training and Demonstration on Household Utilization of Soybeans

The training and demonstration activities within the period of this report formed part of a major objective of the project. Planned training activities under the project include: (a) project staff training, (b) training of farmers and housewives on household level utilization of soybean based on recipes developed, (c) training of village entrepreneurs and individuals on small-scale processing for commercial production of soy-based high protein foods, and (d) training of farmers in project villages on soybean cultivation. Training of research assistants was achieved during the product and recipe development. The major field training activity within the period was the training of farmers and housewives in the project villages on small scale production of soy flour and soybean paste, as well as on household utilization of soybeans based on the recipes developed.

A total of six minor and two major training sessions were held in the two project sites on house-hold utilization of soybeans where some of the recipes developed under the project were extended. The minor training sessions involved a group of mothers at a time. In the minor training sessions a total of twenty-five women were involved throughout the whole period. The major training sessions on the other hand involved the whole village including mothers, fathers and children. At Samsam Odumasi, participation in the training sessions include 33 women, 21 men and 24 children. In the other project village, Mimpemihoasem, 39 women, 8 men and 23 children participated in the training and demonstration.

Areas covered in the training and demonstration include:

a. Lectures and discussions on protein-energy malnutrition and the inadequacy of traditional weaning foods used in the villages to support proper child growth and development.

b. Village level techniques for the preparation of full-fat soy flour.

c. Techniques for the preparation and uses of soybean paste in traditional foods.

d. Household preparation of soybased soups, stews, sauces and staple foods.

e. Field evaluation of soymilk.

In all the training and demonstrations, the participatory approach was adopted, and the participants actively took part in the preparation of the dishes, the way they normally did at home, with instructions from the resource people only on the aspects concerning the incorporation of soy product. The field sessions were highly successful and generated a great deal of interest for soybeans among the villagers.

CONCLUSIONS

In conclusion, the inception of the SAFGRAD TTG Project in July 1998 has made it possible for the Food Research Institute, the Home Science Department of the University of Ghana and the other collaborators at the Ministry of Food and Agriculture to establish the socio-economic characteristics of Samsam-Odumase and Mimpemihoasem - the two project villages, and determine the traditional food habits of the people based on which recipes for the promotion of soybean utilization at household level is being developed and promoted. Nutritional data obtained from the study indicate that pre-school children in the project area are "at risk" nutritionally and are malnourished. The need for a nutritional intervention has been established. This is being achieved through the development and promotion of soy recipes - an activity which has so far been highly successful.

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PART TWO

BUILDING AND STRENGTHENING LINKAGES:

THE CRUCIAL NEEDS OF TECHNOLOGY TRANSFER AND COMMERCIALIZATION

THE TRANSFER, ADOPTION AND COMMERCIALIZATION OF CHORKOR SMOKER: THE SUCCESS STORY OF EFFECTIVE LINKAGE PRACTICES BY THE FOOD RESEARCH INSTITUTE

BY

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INTRODUCTION

In Ghana and many other African countries, fish constitutes over 70 per cent of the total animal protein intake (FAO/World Bank Report, 1979-81). The fisheries sub-sector is one of the most important divisions of the Ministry of Food and Agriculture playing an important role in contributing to the country's food security. Another important contribution of the fishing industry is that of employment. It is estimated that 500,000 fishermen, traders, processors, boat builders and mechanics are employed by the fisheries industry. It also supports twice as many dependants, (Asafo, 1995). Ghana's total fish production figures for the period 1993 to 1996 as given by the Fisheries Department are 383,650; 327,904; 374,798 and 484,889 metric tonnes respectively.

In general fish is made up of 70-84 per cent water; 15-24 per cent protein; 0.1-22 per cent fat and 1-2 per cent minerals. The high moisture content of fish renders it highly perishable. It is estimated that in the high ambient temperatures of the tropics, fish spoils within 12-20 hours depending on the species and the method of catch (Clauses et al, 1981, 1996).

Various traditional methods are employed in processing fish for consumption and also to prolong its shelf life for storage. These methods include smoking, drying, salting, frying and fermentation (Okraku-Offei, 1970; Nerquaye-Tetteh, 1979; Kordylas et al, 1982). Among these, smoking is the most widely applied method in Ghana. About 70-80 per cent of the total fish landed is smoked ((Resource Development Consultants, 1987; Fisheries Department, 1998). Various studies undertaken on fish consumption patterns in Ghana indicate that, to a large extent, fish is consumed more in the smoked form since the traditional flavour, taste and colour obtained by smoking are preferred (Orraca-Tetteh et al, 1971; Plahar et al, 1995, 1996, 1997).

FISH SMOKING

The art of smoking is said to be as old as civilization. It is done by combining three main effects.

a. Preservative value of smoke – the smoke is produced by burning wood, which contains a number of compounds some of which will kill bacteria.

b. Drying – the fire which produces the smoke also generates heat to dry the fish.

c. Cooking – since the smoking is done at high temperatures, usually above 80°C, the flesh of the fish is cooked and the heat also destroys or kills bacteria on and in the fish (Clucas, 1981).

Depending on the type of fish to be smoked, what it would be used for, and the length of time it may have to be stored, the smoking process can take the form of "wet" hot smoking of "dry" hot smoking. Both processes are carried out at temperatures high enough to cook the fish. The smoke drying method is the most widely used.

The reasons for smoking fish are varied, but the notable ones as far as Ghana is concerned, are:

a. To prolong shelf life.
b. To enhance flavour and increase utilization in soups and sauces.
c. To reduce waste at times of bumper catches and store for the lean season.
d. To increase protein availability to all people throughout the year and
e. To make fish easier to pack, transport and market.

Before the introduction of the Chokor Smoker to the fish smoking industry in Ghana, four main types of traditional smoking ovens were used. These were:

a. Cylindrical (round) mud-sometimes referred to as the "Fanti oven".
b. Cylindrical metal or Oil drum oven
c. Rectangular mud
d. Rectangular/square metal oven.

CYLINDRICAL MUD OVEN

This oven, as the name implies, is round and constructed from mud. It is widely used in the Central and Western Regions of the country hence the name "Fanti" oven. The oven exists in various sizes, but typically, it has an external diameter of about 132cm: internal diameter of about 105cm and a height of about 80cm. A ledge is made in the wall at about 50cm up the full height of the oven, on which sticks can rest to support the layers of fish to be smoked. The layers of fish are then separated by sticks.

A stoke hole of about 42-48cm is cut at the bottom of the wall of feeding firewood into the oven. Pieces of wire mesh can also be used to hold the fish for smoking instead of the sticks.

CYLINDRICAL METAL OVEN

The cylindrical metal oven is usually constructed by joining two opened steel, 44-gallon oil drums together and cutting a stock hole at the base. Pieces of iron rods are fitted about two-thirds above the base of the drum to serve as a

support for the layers of fish. The average diameter of the metal oven is about 114cm with a height of about 88cm and a stock hole of approximately 41cm. This type of oven is used throughout the country.

RECTANGULAR MUD OVEN

This oven is rectangular in shape and constructed from mud. Pieces of thick iron bars are placed across the top of the wall to support the layers of fish to be smoked. A stoke hole is cut along one of the longer sides of the oven. The fish is arranged on pieces of wire mesh and placed on the supporting iron rods. Where more than one layer of fish is smoked, the layers are separated by sticks. Pieces of jute bag are used to cover the fish whilst the fish is being smoked. This oven was widely used in the Greater Accra and Volta Region.

RECTANGULAR/SQUARE METAL OVEN

This oven is normally constructed from 44-gallon steel oil drums, which are opened and joined to give the rectangular/square shape. Sometimes, battens of wood are used for re-enforcement. Thick pieces of iron rod are placed on top of the base to support the fish arranged on pieces of wire mesh. A large stoke hole is cut at the base of the sidewall.

DISADVANTAGES ASSOCIATED WITH THE USE OF TRADITIONAL OVENS

Many disadvantages have been reported (Kagan 1969; Nerquaye-Tetteh 1979); Clucas 1982; Bostock et al, 1987):

a. Constant attention is required to control the fire and turn the fish. This may involve smoking through the night.

b. The operation is both health and fire hazard.

c. They are inefficient in their use of fuel and ventilation system.

d. There is little or no control over the temperature of the fire and the density of the smoke produced.

e. In some cases, the construction materials used limit the durability of the ovens.

f. The open construction of the ovens leaves the fish susceptible to climatic conditions and animal attack.

g. The smoked product is usually of poor quality due to non-uniform smoking, burning and charring on the outside.

Since the early 1950s, the awareness of the shortcomings of the traditional fish smoking ovens boosted work on the development of new and improved smoking oven models in Ghana and other African countries. Examples are:

"Adjetey" oven (1962); Altona oven Anon (1971); Ivory Coast oven (Maembe 1982); and Nyegesi Fish Smoking Kiln (Wood et al 1990).

The "Adjetey" oven was not accepted because of its high cost and the inconvenience in its operation. It was also observed that the smoked fish produced using the "Adjetey" oven, could not come out as that from the traditional ovens.

When loading fish for smoking on the Altona oven, the fish is skewed through the eyes using metal rods and hung in the enclosed chamber. The skewing process resulted in removing the eyes of the smoked fish and this was unacceptable to the consumers. Hanging of the fish for smoking was also a complete departure from the smoking techniques to which the smokers were used. In addition, the high cost of the Altona oven made it unaffordable to the processors.

The Ivory Coast oven was also expensive and cumbersome to use. The poor colour of the smoked product and the high variability of the oven temperature also mitigated against its use.

The Nyegesi Kiln which was designed by Natural Resources Institute of the United Kingdom as a fuel-efficient oven which could smoke fish that could keep for several weeks did not offer any great advantages over the Chorkor Smoker when tested at the Food Research Institute.

THE CHORKOR SMOKER

With the constraints and disadvantages associated with the traditional ovens and the bad experiences associated with the new ovens which were introduced earlier, in mind, the Chorkor Smoker was developed as an improvement on the traditional rectangular mud oven used in some fishing communities.

Before the development of the Chorkor Smoker, a thorough study was carried out throughout the country to assess the methods and equipment used in fish processing, types of smoked products, the people involved in the smoking business, as well as the marketing of the product. The fish processors were then involved in the development process of the Chorkor Smoker. This was necessary because from their experience they had a better understanding of which modifications will work better.

The technology was based on the already existing system which was familiar to the users. In addition it was simple, easily adaptable and easy to construct and use.

At the Chorkor community in particular, round and rectangular mud ovens were in use. The rectangular ovens were used for the initial smoking process of cooking the fish. Then the cooked fish was transferred manually into the round mud oven for further smoking till the fish was very dry. When the Chorkor Smoker was being designed, these two processes were taken into

consideration, so as to enable the entire smoking process to be done on one oven which is the Chorkor Smoker.

The Chorkor Smoker, an improved traditional fish smoking oven consists of a combustion chamber and a smoking unit of a set of trays. The combustion chamber is originally rectangular, twice as long as wide with two stoke holes in front. There is a middle wall dividing the combustion chamber. The recommended average standard measurements of the combustion chamber is: length – 225cm; width – 112.5cm; height – 60cm; thickness of wall – 12.5cm; 7.5cm width and height of stoke hole – 15 37.5cm and depth of fire pit – 15cm.

The combustion chamber forms the base of the Smoker. It is generally constructed from mud, but burnt bricks and cement blocks may be used. The latter two are more expensive than mud. The use of cement blocks is not recommended since I cannot withstand the high smoking temperatures. The top of the wall is flat so that the trays fit flush to avoid loss of heat and smoke. The oven is designed so that the wooden frame of the tray which rests along the mid-line of the base wall is firmly supported and not easily burnt.

The smoking unit consists of a set of 5-15 smoking trays depending on the size and quantity of fish smoked. On average, however, 10 trays are used per oven for small to medium-sized fish species such as Anchovies, Mackerels and Sardines. For large species such as Tunas, Grouper and Snapper, five trays are used. Wawa (Sterculiaceae triplochiton) has proved over the years to be ideal for the construction of the trays. The average depth of the smoking tray is 6.25cm. Wire net of half an inch to one inch mesh and 18 to 20 gauge is recommended.

The following list highlights some key features of the design.

a. The top of the oven wall is level and flat so that the trays rest flush upon the wall leaving a 5cm space from the frame wall to the inner space of the base.

b. The stock holes are in the middle of the width of each of the half sections of the base and are arched to provide a greater structural strength. It is large enough for easy stoking and removal of firewood, but not so large as to permit heats and smoke escape.

c. The height of the smoking chamber is low for ease of stacking up to 10 or more trays, but the fire is at least 50 cm from the lowest tray. 10 to 15cm fire pit is dug for each stoke hole.

d. The trays fit flush together in order to form a "chimney".

e. The wire mesh is stretched in both directions across the bottom of the frames, in order to support about 20kg of fresh fish per tray without the tray sagging.

f. The wooden frames of the tray can last three or more years and the wire mesh one to two or more years if properly constructed and maintained.

g. Deeper trays of about 15cm height have been developed in some fishing communities and used for storage of smoked fish.

h. Each oven has a sheet of plywood used as a cover and also for regulating smoke and heat in the smoking unit.

EFFECTIVE LINKAGE PRACTICES IN THE TRANSFER, ADOPTION AND COMMERCIALIZATION

In 1969, the first set of the Chorkor Smoker designed in collaboration with fish smokers at Chorkor, a suburb of Accra West, was presented to two fish smokers who were operating their smoking business together and also indicated their willingness to accept and use the Smoker and give their findings and comments to the Food Research Institute.

The Smoker was located in a place where other fish smokers were operating. This was done so that as the two fish smokers used the introduced technology their colleagues around them would observe how it operated. The intention was to get them interested in the new idea. Six months later, the following general views were given by the fish smokers themselves:

a. The smoking process became less tedious with the use of the trays.

b. More fish could be smoked. This was because by framing the pieces of wire mesh, the fish could be arranged up to the corners and up to 10 trays could be placed on one oven.

c. The trays formed a chimney to trap the smoke and heat resulting in a more efficient fuel wood used due to improved heat and smoke circulation. Thus more fish could be smoked over a shorter period.

d. With the use of the sheet of plywood as a cover, the heat and smoke required during the smoking process could be regulated to some extent. Therefore a uniformly smoked product of a better quality in terms of colour, shape and taste was produced.

e. Handling of the fish during the smoking process was greatly reduced.

f. Charring of the fish was reduced considerably.

g. And above all, the product had a higher market value.

From 1969 to 1971, with a small grant from Freedom Form Hunger Campaign (FFHC), more Chorkor Smokers were constructed and sold at subsidized prices to interested smokers at Chorkor.

Gradually, the use of the technology spread within the Chorkor Community as more smokers realizing its obvious advantages were prepared to adopt it. The smokers started making their own arrangements for the construction of the "Smoker".

Following the ready acceptance of the technology by the Chorkor community, various means were used to extend it to other fishing communities using effective linkage practices. Examples are the following:

From 1982 to 1986, UNICEF (Ghana), ILO, UNDP, UNESCO and FAO financed various collaborative projects aimed at promoting the transfer and adoption of the Chorkor Smoker in the Greater Accra, Volta, Central and Western Regions of Ghana.

The strategy used in the transfer of the smoker in most cases was the participatory technique. The construction was carried out in the communities with the participation of the users. Local masons and carpenters were taught the skills of construction of the "Smoker".

The "Smoker" was owned by individual fish smokers who contributed to the cost of its construction by providing mud, water and labour.

A manual on the Chorkor Smoker entitled, "A Practical guide To Improved Fish Smoking in West Africa" was published in English and French as part of the extension activities funded by UNICEF (Ghana) in 1982/83.

A video cassette on "Improved Fish Smoking in the Tropics", an educational programme for fish smokers, extension officers as well as students was also produced in Ghana in 1986 by FAO in collaboration with the Food Research Institute and the National Council for Women and Development.

An FAO Technical Co-operation Programme (TCP) project carried out at the Food Research Institute in 1986 assessed the technical performance of different types of traditional and improved smoking ovens including the Chorkor Smoker. The study showed that some variations in temperature distribution occurred within all the oven types. It also showed that control of the smoking and drying rates could only be achieved by re-arranging the layers of fish or taking fuel wood away from the fire. However, the oven that performed well in terms of cost, capacity, ease of operation, product quality and fuel efficiency was the Chorkor type (Stroud, 1986).

From 1988 to 1998, as part of the activities of the Ghana/Netherlands regional training and Applied Research Project for Artisanal Fish Processing in Africa, a six week regional training course was organized each year on artisanal fish processing and extension methods for middle level extension officers by the Food Research Institute, University of Ghana, National Council on Women and Development and the Ministry of Food and Agriculture for Extension Officers. The main objective of the project was to contribute to the reduction of post harvest losses of fish and to enhance the availability of quality of fish and fish products for the rural population. During these courses the Chorkor

Smoker featured prominently. A grand total of 204 key extension personnel from 12 African countries have participated in the 11 training course. Participants from Ghana, Nigeria, Sierra Leone, The Gambia, Cameroun, Kenya, Tanzania, Uganda, Zambia, Ethiopia, Eritrea and Lesotho were taught how to construct and use the technology. In the fourteen fishing communities used for the field demonstrations, 202 fish smokers have received a total of 202 Chorkor Smokers with 1010 trays.

Information received from some of the participants who came from other African countries show that the Chorkor Smoker has been successfully transferred and adopted in their various countries. From Zambia the construction of 143 ovens was reported by ex-course participants.

A study undertaken in Ghana by Nti et al, 1999, in some selected project pilot fishing communities established that the adoption rate of the Chorkor Smoker was 100 per cent. Majority (72.5 per cent) of them were among those who were introduced to the technology under the Ghana/Netherlands fish project. The rest obtained the information on the improved technology through observation (13.7 per cent), friends and relatives (11.8 per cent). Assessment of the scale of adoption showed 88 per cent full adoption.

The Food Research Institute was established in 1963 to carry out a co-ordinated programme of applied research in storage, processing, preservation and marketing of foods with the aim of contributing towards the development of the food industries in the country.

The Chorkor Smoker was developed in 1969 with the above mandate in mind. Also most of the programmes undertaken for the development, transfer and adoption of the Chorkor Smoker were funded by external organizations with specific objectives and terms of reference, which did not include commercialization. So not much has been done by the Food Research Institute on the commercialization of the Chorkor Smoker.

In line with the change in the policy of CSIR, in recent times, making commercialization one of the key objectives in the operation of the Institutes, commercialization of the Chorkor Smoker may now be undertaken.

LESSONS LEARNT

The Chorkor Smoker has completely replaced the old smoking ovens in many fishing communities in Ghana. Its adoption has enhanced by the better quality of smoked fish, which attracts premium price on the market.

The Chorkor Smoker which was developed for use in Ghana has received acceptance in Western, Central and Eastern African countries. Since the fish processors were involved from the beginning of the development of the oven, its acceptance and adoption rate was high from the initial stage.

Construction materials for the Chorkor Smoker are locally available.

The possibility of constructing the oven in the community in the presence of the users also facilitated its acceptance. The construction is easy.

The Chorkor Smoker has a capacity of 200-250 kg per batch compared to 30-50kg per batch for the traditional oven. There is 60 per cent saving in fuel consumption, 50 per cent reduction in labour force and 60 per cent saving in smoking time.

Impact studies undertaken by the Ghana/Netherlands Fish Project in 1990 and 1994 showed that, the adoption of the Chorkor Smoker resulted in the following:

a. More fish was smoked resulting in the reduction of fish wastage.

b. Higher income was earned due to the smoking and selling of greater amounts of fish. Along the east coast of lake Tanganyika small herring-like fish "daga" is smoked during the bumper season and sold across the lake in Zaire where it is scarce.

c. There is reduction in expenses due to reduced use of fuel wood.

d. More money is available for feeding the family, pay school fees, support economic activities of their husbands, to invest in additional economic activities such as animal husbandry and also contribute to the construction of better houses.

The "Smoker" is easy to operate and time saving so that it alleviates drudgery and is user-friendly. This has contributed positively in encouraging younger women to take up fish smoking as a profession.

Before the introduction of the Chorkor Smoker, the bulk of Anchovies landed was sundried on the ground, producing a product of poor quality and unsafe for consumption. With the availability of the Chorkor Smoker, smoking of Anchovies is widely practiced producing a product of better quality of safer for both human consumption and animal feed production. It also has a higher market value. The Smoker has proved a useful innovation in both the marine and freshwater fisheries because it is easily adjusted by the processors themselves to suit their local needs and conditions. For example, the clay base has been replaced by refractive bricks in Tema U Compound where the bricks are available. The height of the oven base and the trays are used for storage of the smoked fish. Half and even quarter sizes of the normal Chorkor Smoker are used where smaller quantities of fish are smoked.

Nti et al, 1999, reported of improvement in economic activities which has resulted in positive impact on house hold income and food consumption patterns of the processors.

Group formation is another important factor to be considered in technology transfer. The adopters are assisted to form groups, which are introduced to

banking at the rural level. This has helped some of them in acquisition of loans from the banks.

The key factors limiting effective adoption of the Chorkor Smoker are high cost of inputs and lack of credit.

In recognition of the important contribution of the Chorkor Smoker to the reduction of post-harvest losses in the fish processing industry, postage stamps depicting various activities on the Chorkor Smoker have been issued in Ghana. This further helped in the transfer of the technology.

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INSTITUTIONALIZING LINKAGES TO ENHANCE THE TRANSFER AND COMMERCIALIZATION OF TECHNOLOGIES: THE EXAMPLE OF THE RESEARCH EXTENSION LIASON COMMITTEES

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INTRODUCTION

There are four major stakeholders involved in agricultural activities in Ghana; The farmer, staff of the Ministry of Food and Agriculture, researchers, and others (NGOs, Financial Institutions, and Agribusinesses). These four key players have for a long time been operating relatively independent of each other. This situation has resulted in a slow growth of the Agricultural Sector over the years. Under the Medium Term Agricultural Development Programme (MTADP), a number of committees and institutions were set up to help accelerate the rate of growth of the agricultural sector. One of such committees which was set up jointly under the National Agricultural Research Project (NARP) and the National Agricultural Extension Project (NAEP) was the Research Extension Liaison Committees (RELCs).

THE RELC

The country was divided into five agricultural (RELC) Zones as follows:

ZONE	LOCATION	COORDINATING INSTITUTION
Zone 1	Upper East and Upper West Regions	Manga Agriculture Research Station (SARI)
Zone 2	Northern Region	Savanna Agricultural Research Institute (SARI)
Zone 3	Ashanti and B. Ahafo Regions	Crops Research Institute
Zone 4	Central and Western Regions	School of Agriculture, UCC
Zone 5	Eastern, Volta, and Greater Accra Regions	Animal Research Institute

Membership of the RELC included

- Researchers
- Staff of MOFA
- Farmer representatives
- NGO Representatives
- Zonal RELC Coordinator

TERMS OF REFERENCE (TOR) OF THE RELC

1. To review extension programmes and training programmes each year.

2. Review performance of extension during the previous season

3. Assess the relevance of extension recommendations given to farmers and farmers' responses to them

4. Select resource persons for SMS training sessions, workshops, and evaluating their performance, including contribution to the planning of zone.

5. Review the implementation of adaptive trials initiated by research under the NARP, and make recommendations to increase their relevance.

6. Organise Bimonthly Technical Review Meetings (BMTRMs) and Monthly Technical Review Meetings (MTRMs) to train MOFA staff.

Out of the seven TOR listed above, the Zonal RELCs have managed to implement TORs 1,2,3,4 and 7 quite effectively. TOR 6 was partially implemented, while TOR 5 was not implemented. To achieve the above mentioned tasks, a number of activities are undertaken by the RELC.

PLANNING SESSION

The RELC activities each year begin with a planning session. Objectives of the planning sessions are to:

a. Make researchers aware of the problems identified in the field by (MOFA) staff and farmers during the year.

b. Make extension staff aware of new technologies generated by research that are ready for transfer to farmers.

c. Outline technologies that need further adaptive trials and demonstrations before they become available for transfer to farmers.

d. Draw up zonal programmes for BMTRMs, MTRMs, workshops, and RELC meetings for the year.

The above mentioned objectives are aimed at ensuring that, MOFA staff are given regular training on relevant technologies that need to be transferred to farmers. Secondly, to ensure that research conducted in the zone are relevant to farmers' needs.

Planning sessions were held at three levels: District, SMS Centre and Zonal.

Participants at the District and SMS Centre level were predominantly farmers and MOFA staff, with only a few researchers.

Participants at the Zonal Planning Sessions were made up of researchers, farmers, input suppliers/NGO representatives, and MOFA staff. The researchers may come from the Universities, Food Research Institute, Animal Research Institute, Soil Research Institute, Crops Research Institute, Savanna Agricultural Research Institute, Plant Genetic Resource Centre at Bunso, and Oil Palm Research Institute.

SMS Centre representatives from the centres in the Zone present reports on problems identified during their Centre planning sessions. The Zonal Research Programme Co-ordinators also present reports on on-station and on-farm research activities in their respective programmes. These reports form the basis for discussions and planning of activities for the year.

The problems identified are grouped into three under the headings:

1. Research problems (To be addressed by researchers, either On-station or On-farm). Unfortunately, not all the identified problems receive attention due to logistic problems.

2. Technologies available and ready for transfer to farmers (To be addressed at BMTRMs and MTRMs).

3. Opportunities: These are enterprises which farmers have not thought about but which participants felt that they should be introduced to farmers (To be addressed by both researchers and MOFA).

A list of researchable problems identified at the session are communicated to researchers in the Zone.

After the decentralization of extension services, the planning sessions have been held at the District and SMS centre levels only. Secondly, researchers' participation in the planning sessions has reduced drastically to only the RELC coordinator. This is due largely to problems of logistics.

ADAPTIVE TRIALS

As part of its TOR, the Zonal RELC is expected to review the implementation of adaptive trials initiated by NARP, and to make recommendations to increase their relevance.
Technology generated on-station needs to be tested on-farm under farmer managed conditions before they can be recommended for adoption. In Zones 1,2, and 3, there are scientists (Farming Systems Research Team) at the Coordinating Institutions who are specifically assigned to carry out on-farm research, but this is not so in Zones 4,and 5. Consequently On-Farm Adaptive Trials suffer in the latter two Zones. Each researcher is expected to undertake on-station research as well as conduct on-farm adaptive trials.

Researchers generally are not enthusiastic about on-farm adaptive trials hence that component suffers.

On-farm trials carried out in the zones are done in collaboration with MOFA staff and farmers in the Districts. The researcher usually provides the protocol, inputs, and sometimes, some amount of money per location for labour and other incidental expenses.

Some problems encountered in the conduct of On-farm adaptive trials in Zone 4 where I am familiar with, include the following:

a. Difficulties in convincing researchers to send their research findings on-farm.

b. Absence of On-Farm research team at the University, responsible for the conduct of such trials.

c. Poor handling of research materials by farmers and MOFA staff in the field.

d. Sometimes, unreliable data collected from the field.

e. Poor recovery rate of data from the field

f. Inadequate logistic support to effectively monitor trials in the field

g. Sometimes, protocols received from researchers outside the Zone are not backed by any funds to be used by the local researcher for monitoring and other incidentals expenses.

h. Some trials may take place without the knowledge of the RELC coordinator.

TECHNOLOGY TRANSFER

The Zonal RELC is also responsible for the conduct of workshops, and Bi-monthly Technical Review Meetings (BMTRMs) during which MOFA staff are exposed to new technologies while at the same time, researchers are made aware of problems encountered by MOFA stafff during visits to farmers' fields. Prior to the decentralization of extension services, the BMTRM were held at the Zonal level, but now it is at the SMS Centre level.

TRAINING GUIDES AND FOLDERS

After each BMTRM, or workshop, folders and training guides were produced. A training guide is an 8-16 page booklet which provides concise information on the topic treated. It is intended to serve as handbook or reference material for extension agents. A folder on the other hand is a single-leaf six-page document containing the key points highlighted on the topic under

consideration. Folders serve as quick reference materials for farmers and extension staff.

Draft copies of the folders and training guides are usually completed by the end of the BMTRM or workshop, yet still it sometimes takes a long time before the final copies of the documents are completed.

Sometimes also, not enough copies of these documents are made. Consequently, not all extension agents are able to get copies, much more farmers. The few times some of these training guides were exhibited during Farmers' Days, there was great demand for them. There may therefore be the need to multiply these materials to make them more available for farmers.

FIELD VISITS

It is important that field visits are undertaken by members of the RELC for the following objectives:

a. Observe mini-demonstrations set up by Agriculture Extension Agents (AEA)

b. Observe technologies transferred by AEA and the extent of adoption by farmers.

c. Monitor the activities of AEA, and their supervisors in their operational areas/districts. (Route maps, frequency of field visits, contact group formation, use of field notebooks. etc.)

d. Identify problems mitigating against effective transfer of technology.

OBSERVATIONS MADE DURING THE FIELD VISITS

Transfer of improved technology is going on at a faster rate than the adoption rate. Farmers are aware of most of the improved technologies and the benefits to be derived from their adoption, but are reluctant to adopt them because of the extra expenses that go with their adoption. Because of uncertainties in the weather, and unreliable or unattractive prices for farm produce, farmers are not willing to take the risk of investing in extra inputs required for the adoption of new technologies. Again, technologies that have long gestation periods were not readily adopted.

There are again technologies which have not been adequately demonstrated to convince farmers about their effectiveness. For instance, most farmers who have heard about the improved method of treating plantain suckers before planting are still not convinced that the method will work. There is need to intensify the use of mini-demonstration as a tool for technology transfer. Most farmers are not familiar with the use of sighting poles for planting in rows. Meanwhile they complain that the use of garden line is too cumbersome. Other simple operations such as seed bed preparation,

application of fertilizer, and manures etc, need to be adequately demonstrated to farmers.

The narrow crib was found not to be very effective for storage of maize in some parts of the Western Region where rainfall is high. The maize goes bad in the cribs, even when cribs are constructed according to specifications. There is need to take a second look at the design.

Access to spraying machines is a problem to most farmers. This is especially true for farmers who need to spray chemicals only once a while and therefore do not find it necessary to purchase a spraying machine.

There is a growing interest in snail and mushroom production. There is the need to organize a workshop to train the extension staff on the above subjects.

Access to improved oil palm seedlings unsuspecting farmers.

PROCEDURE FOR CONDUCT OF VISITS

- Districts were given prior information about the visits.
- The first point of call each district was the District Extension Office.
- Operational areas to be visited were selected at random, but with consideration to areas of easy accessibility.
- The visit schedules of the AEAs in the selected operational areas were consulted to know the exact locations where the AEAS could be found, and also the contact persons to be consulted in case of difficulties in tracing the AEAS.

In the operational areas the team did the following:

- Interviewed farmers about technologies imparted to them by AEAS, mini-demonstrations set up on their farms, problems they encounter in their farm operations, the major enterprises they were involved in, and the frequency of visit to the operational area by the AEAS.
- Inspected mini-demonstrations set up by AEAS.
- Looked for signs of adoption of technologies by farmers.
- Inspected field notebooks and MIS daily logs of AEAS.
- Checked on effectiveness of contact group formation.
- Team members took turns to interview AEAS on problems/constraints to technology transfer in their various disciplines.
- Farmers fields were visited to observe extent of technology adoption in the area.

RELC MEETING

- Approve of programme agreed upon at the planning session
- Reports on activities in zone.

DISCUSSION

Mrs. Andah: My contribution is on Dr. Tetteh's paper in which he indicated that some technologies which have been extended to farmers had been totally rejected or partially rejected in some parts of the country. May I suggest that specialists in these subject areas i.e alley cropping, yam minisett, narrow maize cribs and slatted floor for animal housing think seriously about conducting studies to identify reasons why these technologies have not been adopted as expected. Such information will be useful in ensuring that we have more success stories to tell in our efforts to upgrade technologies that are used in the agricultural sector.

Mrs. Kordylas: We need to find out what people's needs are. Once we have satisfied the need of farmers then they would adopt it. We therefore need to ask questions as to whether alley cropping is better than multi-cropping. We need to conduct research to convince farmers that it is better to do what we are recommending.

Mr. Odzeyem: Is the Crops Research Institute involved in the current campaign to organize farmers by a private group to produce sunflower in the country and where is the guarantee that farmers will not be cheated because a kg of sunflower is ¢30,000.00?

Dr. Hemeng: Different varieties of sunflower have been introduced into the country and being distributed to farmers to grow. Any introduced crop should first be evaluated before those which prove to be resistant to pests and diseases and high yielding are released to farmers. My observation on the seeds of some of the varieties imported was that they were moldy.

Mrs. Marfo: What is the body or organization that is pushing/propagating the sunflower cultivation? The practice of concerned bodies sitting back or looking on unconcerned needs to be stopped. I suggest that the Crops Research Institute takes this up and try to protect the farmers.

Dr. Azu: It is the Sunflower Association. They are very sharp guys. They came to us (Amex International) for assistance and we asked for their business plan. They did not have it and said they would provide it later but we never saw them again.

Prof. Norman: It seems MOFA and GEPC are pushing it. I am glad that the matter is being expressed. I thought the Ghana National Association of Farmers and Fishermen (GNAFF) could express their concern to the MOFA. We will take the matter up from the research side. One of the groups in the discussion group should take it up.

Rev. Dr. Marfo: It is very appalling with the sunflower issue. Nobody has tested it. Research has not been involved. The crop has a future, but should be well-developed.

Dr. Osei: It is going to follow the ginger case. I believe since it is an export crop it depends on the export market. There is no processing plant in Ghana. This is not the first time. No control mechanism in the country. We do not know the kind of pests and diseases. CSIR should step in and question the rationale behind it before bigger problems crop up.

Dr. K. O. Marfo: The way we are going about the sunflower issue nationally is appalling. We may have to go about it by conducting systematic genetic evaluations before trying to propagate its large scale cultivation.

Mrs. Maldini: Why are farmers not adopting new technologies? Are they properly educated on new methods and why the old methods have to be changed?

On sunflower cultivation why are the farmers no more interested in its cultivation? Do they know what kind of soil and climate are suitable for sunflower cultivation. Are they educated on risks? As far I know, sunflower oil has a high market value and it is export oriented but have the buyers been identified? Before farmers are encouraged and introduced to new technologies, intensive education has to be made.

Mad. Addy: Research and extension should educate farmers well on any new technology that is being introduced to them because experience has shown that farmers are always left half-way when any new technology is given to them.

Research should come to the aid of farmers when new technologies are being put on them. Like the sunflower issue, research should intervene by sitting down with the organizers to know that it will be beneficial to farmers.

Mr Udofia: I would like to know whether soybean brings about impotence and cancer.

Mrs Andah: No, the effect of soybean extrogene reduces natural extrogene. It rather talks about the beneficial effects. It rather prevents cancer in women. Let us look at the advantages and disadvantages. I have publications which indicate it rather prevents cancer. It is like saying cyanide in cassava. Every food commodity has certain things that you regard as not useful for the body. First you need the facility to test the phytoextrogene.

Dr. Osei: There is so much soybean in the north which cannot be sold.

Prof Norman: It is the problem of information not circulating round. No consensus on prices. It is cheaper to import soybean than to buy from Tono.

LINKAGE PRACTICES WITH RESEARCH INSTITUTIONS AND FARMERS BY THE ADVENTIST DEVELOPMENT AND RELIEF AGENCY (ADRA)

BY

STEPHEN AMOAKO

WHAT IS ADRA?

The Adventist Development and Relief Agency (ADRA) is a non-governmental, non-sectarian, not-for-profit development-oriented organization established by the Seventh-day Adventist Cchurch for the specific purpose of community development, disaster relief and rehabilitation. ADRA operates in 146 countries worldwide as a network and has its central office at Silver Spring, Maryland in the United States of America.

ADRA-Ghana evolved from a successful emergency relief programme organised by its predecessor institution, the Seventh-day Adventist World Service (SAWS) in direct response to a situation of acute food shortage caused by drought, bush fires and the repatriation of more than one million Ghanaians from Nigeria in 1983.

In 1985, the disaster situation had abated so SAWS was re-organised and re-designated as ADRA with a significant shift from relief orientation to on demand-driven community development programmes with a concomitant expansion in its portfolio of activities.

CORE PORTFOLIOS

Food security (agriculture and health)
Environment
Economic development
Relief

DEVELOPMENT OBJECTIVES OF ADRA/GHANA

1. To develop an effective result-oriented and innovative community based development programmes that lead to an improved quality of life for depressed people.

2. To assist clientele communities to effectively and efficiently utilize, protect and maintain the environment.

3. To respond to the needs of victims of disasters.

4. To address the specific needs of women and children through development interventions.

A BRIEF DESCRIPTION OF THE RELEVANT PROGRAM ACTIVITIES

Under a Development Activity Proposal (DAP)-1996-2001, which is of relevance to the topic under consideration, ADRA is supporting a 15,500 farmer-households(101,250 beneficiaries) to adopt the agroforestry system of farming to produce enough food to meet their food and other needs.

In 1996, ADRA commenced the implementation of a five year food security enhancement programme through the window of agroforestry. The primary goal is to enhance food availability, access and utilization for approximately 101,250 beneficiaries (15,500 households) in the **Coastal plains, the Eastern, Brong Ahafo, Northern, Upper East and West regions**. The purpose of the programme is to;

(a) increase the percentage of households providing adequate food for their families,

(b) the real incomes of households,

(c) increase the adoption of appropriate storage techniques and

d) improve household nutrition.

The program objectives directly related to these issues focus on;

(i) consumption of a balanced diet,

(ii) adoption of agro-forestry techniques and

(iii) increased access to safe water.

The intervention ADRA provides vary from project to project. In the Eastern and Brong Ahafo regions, citrus and cashew trees respectively are planted. The fields are intercropped with maize, yams, cassava and other food crops. In the other regions, farmers are encouraged to grow trees of their chioce in association with food crops. The project communities are first animated, after which farmers who show interest and meet a set of selection criteria are selected. This is done in collaboration with the Ministry of Food and Agriculture's Extension Service and the Department of Cooperatives. The program provides technical advice and farm inputs to clients as a means to increasing food production.

With support from the post-harvest Unit of the Ministry of Food and Agriculture, farmers are assisted to construct improved farm level storage cribs and silos to minimise storage losses. Client farmers are encouraged to operate an inventory credit scheme as a means of maximising the benefits from their farm produce. Clients are linked to marketing institutions and are also encouraged to develop marketing cooperatives. Communities are assisted to rehabilitate existing insfrastructure such as roads, markets, dugouts, latrines and the afforestation of riverbanks using food-for-work.

ADRA in collaboration with the Ministry of Health (MOH) has trained 700 community-selected Nutrition and Sanitation Motivators (NSMs). The NSMs present health messages to project clients aimed at improving the poor utilization of food and improper water and sanitation practices. The content of their messages have been adapted to suit the culture of each project area for the ease of adoption by the communities. An internal evaluation of this component of the project has revealed that there has been a change or an improvement in the nutrition, water and sanitation practices in over 90% of the project communities.

LINKAGE PRACTICES WITH RESEARCH INSTITUTIONS AND FARMERS (PROJECT CLIENTS)

In this paper, the term linkage practices is taken to mean the catalytic intermediary activities that ADRA undertakes by facilitating the transfer of agricultural technologies from the reseacher to the farmer and by a similar token, making the problems and concerns of the farmer known to the reseacher.

ADRA's interest in linkages stems from its belief in partnership, which is one of the core operating principles of the organization.

ADRA's role in linking research institutions to users of research dates back to 1991, when the organization entered into an agreement with the University of Science and Technology, now Kwame Nkrumah University of Science and Technology, for the supply and installation of hand pumps to ADRA supported hand-dug well projects in all the ten regions in the country. Since that time ADRA has had others experiences. Two of these would be discussed in this paper because of their significance to the theme of this workshop.

CITRUS PROJECT - EASTERN REGION

In 1994, Dr.J.K Osei of the University of Ghana Agricultural Research Station, Kade, approached ADRA and introduced to the organisation a variety of citrus, the Late Valentia Sweet Orange, which the research station had worked on. He requested for a collaboration between his institution and ADRA to enable as many farmers as possible to grow the tree in the Eastern region. ADRA welcomed the idea and a process involving exchange of visits,studies, discussions and negotions ensued. The discussions and studies which followed culminated in a Memorandum of Understanding (MOU) between ADRA and the Faculty of Agriculture of the University of Ghana.

Among other things, the MOU provided that:

- ARS will make available to project farmers, staff and collaborators research findings and recommendations on citrus considered essential to maximise benefits.

- specifically, ARS will advice on the choice of planting material or variety of citrus to be cultivated by farmers, as well as the type of food crops to be integrated on their farms.

- ARS will organise on-farm and on-station training for clients, ADRA staff and Front Line Staff(FLS) of the Ministry of Food and Agriculture now known Agriculture Extension Agents (AEA).

- ARS will visit farmers' fields, provide advice on cultural practices and identify problems relating to citrus production and where necessary and in consultation with ADRA undertake research studies to find solutions to the problem.

- assist to monitor and evaluate the project from the second to the fifth year after planting the citrus in the recipient farmers' farms.

- supply within two years 200,000 seedlings of Late Valentia sweet orange on rough lemon rootstock for planting by clients.

ADRA's responsibilities under the MOU included:

- the payment for the citrus seedlings that were to be produced by ARS.

- carting of seedlings to farmers.

- payment for the cost of training and where necessary the cost of operational research.

The project is currently in its third year and being implemented in eight districts in the Eastern region of Ghana. These are the East and West Akim, Suhum-Kraboa-Coaltar, Kwahu South and New Juaben. The rest are Kwaebibirem, Birim North and South. The client population of 2,018 registered farmers have cultivated a total of 2,264 acres.

The support which has been given to the farmers is in the form of loan which they are to repay with interest.

TABLE I CITRUS PROJECT

year	# farmers registered m[3] f[4] total	# seedlings supplied	# communities	# mofa collaborators	# farmers & AEA's trained by ARS	# farmers trained by MOFA
1996	459 109 568	56,611	73	42	117	509
1997	762 260 1022	102,200	59	21	155	827
1998	nil 428	60,000	23	3	38	650
1999	nil ,nil nil	-	-	-	-	-
total	1221 797 2018	218,811	155	66	310	1986

YAM MINISETT TECHNOLOGY

Under ADRA's DAP, the implementation of which started in 1996,the agency is supporting 1,500 farmers in the Techiman, Nkoranza and Kintampo Districts of the Brong Ahafo region to cultivate approximately 4,500 acres each of cashew. Clients are supported with basic farm inputs (fertilizers, improved seeds, hoes, cutlasses etc) on credit. Additionally, farmers are provided with extension services by the staff of MOFA. In 1997 (after the first year of support), the farmers showed that the input cost for producing an acre of maize was by far higher than that for an acre of yams. As a result of this realisation, project farmers requested ADRA to extend direct support to include yams as was being done for maize farmers. In response to this request, ADRA conducted a rapid assessment involving 200 clients from 30 communities to seek information. The study revealed that;

(a) seed yams were expensive, difficult to obtain and often of poor quality,

(b) market was unreliable and

(c) Farmers lacked capital to procure seeds.

Based on this information, ADRA contacted some institutions to enable her address the problems facing clients. The institutions were the Ghana Yam

[3] males
[4] females

Producers and Exporters Association, which was to help address the marketing problem; the Roots and Tubers Unit of the Crop Research Institute (CRI) in Kumasi and MOFA, to recommend the most appropriate and affordable technologies that will enable clients to produce export quality yams and improve upon their access to seed yams.

In the light of the above, ADRA in collaboration with CRI and MOFA have been involved in the promotion of technologies aimed at (i) producing yams specifically to satisfy the export market and (ii) train farmers to adopt the yam minisett technology to produce seed yams.

The minisett technology has been studied and adapted to the Ghanaian condition by scientists. However, it is not widely extended to farmers. In consultation with the exporters it became evident that fresh yams for export should among others have the following specifications;

(a) a weight of 2.5 to 3.5kg
(b) the peel should be smooth and free of bruises
(c) should not have holes either from pest damage or penetration by stones.
(d) should be of the white yam variety (dioscorea rodundata) bearing local names such as puna, asana, araba and morinyua.

In order to meet the above stated requirements, ADRA approached the CRI for technical advice on how yams of specific sizes could be produced by farmers. The minisett technique was suggested as a possible alternative along side other cultural practices such as spacing and mound size. In brief, the manipulation of three factors a) sett size, b) mound size and c) spacing between the mounds were considered.

A pilot project involving 150 farmers in the three districts started in 1997 and it is on-going. Fifty (50) of the farmers are to produce seed yams using the minisett technique and 100 others to produce yams specifically for export using a combination of the minisett, mound size and spacing. Several training programmes have been organised for the beneficiary farmers. Cash credit ranging between 120,000 to 180,000 cedis was provided to each client to procure seed yams from self arranged sources.

THE USE OF MINISETT IN CONJUNCTION WITH SPACING TO PRODUCE EXPORTABLE YAM

One hundred and fifty (150) farmers have been supported to produce a total of 61,000 tubers (approx. 123 tons) from a total of 70 acres in the first year. After sorting, it was noted that 59% of the yams met export specifications as indicated by exporters. Farmers and exporters were satisfied with the outcome. Unfortunately, the marketing aspect could not proceed as was anticipated as a result of disagreements over price between farmers and exporters. Consequently, not a tuber was marketed under this export arrangement in the Brong Ahafo region.

The farmers showed that, new yams from the Brong Ahafo region are the first to appear on the market each year. At such times of the year (Mid-July to September) prices of yams ranged between 300,000 and 500,000 cedis depending on size for 100 tubers. These are mostly of the 'puna' variety. During the negotiations the farmers bargained for the prices offered for early yams. They therefore wanted an offer not less than that on the local market at that time. However after September, yams from other regions of the country appear on the market and this situation reduces prices of yams generally.

THE NORTHERN GHANA EXPERIENCE

Based on the experience in the Brong Ahafo region, the idea has been introduced at Mpaha, Salaga, Bimbila, Wulensi and Kpandai in the northern region in 1998. A total of 250 farmers are involved. Unlike the experience in the Brong Ahafo region, within one year,a modest quantity of 41,000 tubers (export quality) were exported through CAN & KAA, a private yam and assorted food exporting company based in Accra.

THE USE OF MINISETT TECHNOLOGY FOR SEED YAM PRODUCTION

Farmers in all the communites that the technique was promoted were unanimous on the strengths of the minisett technique. Some observations of farmers were that;

- the minisett technique is suitable for the rapid multiplication of the seed.
- it requires inputs(land, labour, stakes).
- a better seed quality is produced through this method of seed production.
- it reduces the pressure on farmers to prick yams especially at work peak, since it provides an alternative method to the production of seed yam.

After one year of promoting the technique, a study involving 101 clients was conducted to find out their opinions. The study, which was funded ADRA was carried out by social-scientists from the CRI. The results of the study showed that 20% of the farmers in the Brong Ahafo region used the technnology the following year (1998). Despite the low adoption, farmers admitted that the minisett technology has the potential to fill a technology gap, namely the rapid production of good quality seed yam with minimum resources. According to the study, the promotion of the technique has met with some success. This is because it cannot be expected that a large proportion of the farmers would adopt the technology at the first instance. Farmers vary in their disposition to adopting new technology. Most will normally adopt a "wait and see" approach. More over, one year is too short a time for many farmers to adopt a new technnology. This is particularly so for the minisett technique which

requires the learning of technical details. The report stated the following as concerns expressed by farmers.

- late planting
- Inability to market yams
- lack of encouragement from promoters i.e. field visits
- uncertainty about timing/date for starting the nursery.
- ignorance of the fact that the technology is applicable to local varieties of yam.

RECOMMENDATIONS OF THE STUDY

- The information gap on time of planting the nursery, transplanting and the method of transplanting has to be filled.

- Future programmes should include several follow-up visits to farmers to provide technical support.

- Farmers should be made aware that the technology is for their own use and benefits.

LESSONS LEARNED FROM LINKAGE PRACTICES

- Linkage practices amongst farmers, reseachers and ADRA provides the opportunity for the parties involved to identify challenges on the ground together. It provides a common platform for understanding, sharing and jointly helping to find solutions to problems.

- It provides a multifaceted front /interdisciplenary approach that allows for quick answers to field problems to be provided.

- It is cost effective in that reseachers, MOFA and ADRA staff often travelled to the farmer together.
- Material and technological inputs are specific and accurately delivered. e.g. citrus seedlings from ARS were delivered to the liking of both farmers and ADRA.

- It enhances institutional capacity building in that information (formal and informal) are shared directly or indirectly.

- Farmers are prepared to pay for services rendered to them provided the services are relevant and the cost is affordable.

CONCLUSION

The importance of linkage practices especially with small-farmer operations cannot be overemphasised. This is because it provides rural farmers with the opportunity to have access to improved technological information and other forms of support which on their own may not be in a position to access. It

provides the farmer a first hand privilege to discuss farm problems in the presence of both the program implementing agency and the researcher.

We are convinced that the catalytic intermediary role that we are playing, particularly as it relates to funding, is critical to the fortunes of both the research institution and the farmer. However, the question we have been asking is what happens between the many research institutions and the numerous farmers who need each other's support? And it is to this crucial question of linkage between research and the end-user of technology (the farmer in this context), on a sustainable basis that we crave the indulgence of this august body to help address in this forum.

LINKAGE PRACTICES OF DAPIT WITH RESEARCH INSTITUTIONS AND RURAL COMMUNITIES

BY

S. K. DOTSE
AG. EXECUTIVE SECRETARY, DAPIT

DAPIT, which stands for Development and Application of Intermediate Technology, is one of the first government organisations to be set up for the development and dissemination of appropriate technologies. In fact it was started around 1980 with the support of the US Agency for International Development (USAID) after Ghanaian development planners have become increasingly disillusioned with development strategies calling for large scale industrial and agricultural modernisation and requiring large input of non-renewable resources and contributing to environmental deterioration. It was therefore time to turn back to the small-scale farmer and entrepreneurs to try to improve the situation. The sectoral goal of DAPIT was therefore to increase agricultural production on small-scale farms and provide local craftsmen and small enterprises in rural areas with the means to provide or create the required resources that will lead to higher levels of income and welfare for small farmers and the rural population.

The main purpose of DAPIT is therefore to establish a national mechanism to identify, develop, test, produce, demonstrate and deliver to the rural sector appropriate technologies that will contribute to increasing production and incomes.

DAPIT carries through its mandate in the area of identification, development and testing in conjunction with a number of Research and Development (R and D) institutions called the Participating Agencies (PAs). The production, demonstration and transfer is carried out with the support of beneficiary communities, opinion leaders and extension agencies and services capable of introducing innovations.

DAPIT can therefore be seen as the link between R and D on the one hand and the end-users on the other hand. Briefly the strategies adopted by DAPIT consist of:

- Providing information on identified technological problems of the small scale sector to R & D institutions and serves the backward linkage of disseminating demand driven technologies to the users.

- Disseminating appropriate technologies to the rural communities through demonstration workshops and publications

- Linking tested technologies with existing agencies and services capable of introducing innovation to target groups.

DAPIT AND R & D INSTITUTIONS

At the time of conception of DAPIT, the planners had already thought of the important inputs that R & D could make in improving the standard of life of the target group. Consequently a number of institutions were brought into the picture and assigned specific roles to play with matched inputs. The strategy here is funding urban research institutions and encouraging them to create technologies for transfer to the poor. It is utopian to insist that illiterate, uneducated persons be given the function of increasing societal rate of technical innovation.

These institutions are the Food Research Institute, the Institute of Industrial Research and the Information and Documentation Institute now called Institute for Scientific and Technological Information, all of the Council for Scientific and Industrial Research (CSIR) and the Technology Consultancy Centre of the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi. These institutions serve on the Management Committee so as to assist in formulating policies to enhance DAPIT mandate.

Later DAPIT added two other participating agencies (PAs). These are Forestry Research Institute of Ghana, CSIR, and Department of Agricultural Engineering of the School of Engineering, KNUST. DAPIT also has good working relationships with GRATIS.

The first groups of participating agencies were given equipment and training to prepare them for the task ahead in the Phase I of DAPIT activities. Thereafter, where a problem is identified these research institutes prepare proposals for DAPIT for the development activities DAPIT appraises these:

- if they involve technologies specifically designed for the target group
- if these technologies have been demanded or have the potential to be demanded by the poor majority i.e. high benefit incidence and spread effect.
- if these technologies are affordable compatible and easy to operate
- if the proposal emphasises local group participation and local raw material use.

The result was that at the start of the second phase of work, they were above to assist DAPIT to develop and test some technologies. Some funding was made available. Some of the outputs are detailed below:

Institute of Industrial Research	Rice planter, Hydraulic Ram Pump
Food Research Institute	Maize shellers (hand-held) and Improved Narrow Maize Crib.
Information & Documentation	A collection of AT Unit now INSTI

Technology Consultancy Centre: Brick Press and Pugmill development.

For the second group of PAs, funds were made available after their proposals were scrutinised and accepted by Management Committee. Activities carried out by the group were:

Department of Agricultural Engineering	Wooden Grain Storage Silos
Forestry Research Institute of Ghana	Snail Farming Technology
GRATIS	Rice thresher

Currently DAPIT is working with these participating agencies to develop new areas of project ideas for implementation. It is noteworthy to observe that the various PAs turn to collaborate better where specific activities with all the necessary support facilities are in place.

Some of the major problems involved are that insufficient funding to enter into more collaborative activities and also funds to monitor the progress of work by DAPIT personnel. It also becomes a little difficult when some of these PAs on the Management Committee are not delivering to expectation.

EXTENSION AND DISSEMINATION

After developing and testing the technologies it must be made available for those it was destined. This group constitutes out target group and is found mostly in the typical rural settlements.

The major method by which DAPIT introduces its technologies to these people is by demonstration workshops, training sessions and publications.

The Secretariat as a policy identifies stakeholders in a particular technology that has been developed and being demonstrated. As the agricultural sector is predominant in the target group the Extension Services Department of Ministry of Food and Agriculture/District Assemblies are the first point of contact. These people are briefed on the technologies available for adoption and they in turn talk to the farmers and opinion leaders. A series of meetings are held within the community until finally a consensus is reached. DAPIT then proceeds to have demonstration units set up for farmers to copy. Scheduled follow-up visits are then paid to keep encouraging the communities. For instance, in areas where maize crib was introduced, farmers were visited just before harvest time (when they are preparing their barns) and after harvest when they are about to store. Additional visits made during thereafter to guide the farmers on any other measures to be taken to ensure wholesome storage practices. The craftsmen are equally involved, as they are the ones who would finally replicate (physically) the technologies.

At times the technologies are introduced to other outreach agencies that are capable of introducing those technologies to others to take up the transfer process. A noteworthy achievement was when DAPIT/FRI introduced the Improved Narrow Maize Crib to the Sasakawa Global 2000 Foundation in Ghana in the early 1990. The result was that Global 2000 with the financial means introduced the crib countrywide.

Currently DAPIT is working with organisation such as Friends of the Earth, Volta Organic Farmers Association at Agbozume VR, and other Government agencies such as Rural Enterprises Project, National Youth Council, etc to disseminate technologies.
Publications are also distributed to libraries individuals and organisations involved in technology transfer.

FUTURE PROSPECTS AND CONCLUSION

The future is as uncertain as rain clouds. However DAPIT intends to meet future challenges and deal with them expeditiously in order to achieve its mandate. Changes that are being brought in the system such as commercialisation would be studied and appropriate steps taken to ensure the availability of appropriate technologies to our target group.

More collaborative work with other relevant agencies would be persued and implemented religiously. Other funding sources would be brought to play major roles in increasing accessibility of the majority beneficiaries to credit finally we wish to emphasise that DAPIT's work involves changing behavioural patterns of people, a slow and ardours task. However, we believe that with visible results, DAPIT would be able to gain the respect and confidence of its stakeholders.

THE ROLE OF A TECHNOLOGY CONSULTANCY CENTRE IN THE TRANSFER AND COMMERCIALIZATION OF AGRICULTURAL TECHNOLOGIES

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INTRODUCTION

Until lately, very few conscious efforts have been made by institutions of higher learning and research in sub-Saharan African to apply the results of their work and to use their expertise and facilities for promotion of real industrial development.

That one of the first successful attempts in this direction should originate in Ghana, and specifically at the University of Science and Technology, Kumasi is the outcome of a combination of several factors. These include Ghana's position as the first black African nation to be independent, a situation which gave it a head start in experimenting with various development theories; the presence of a technological university which is situated in the heart of one of Ghana's richest regions with a long tradition of enterprise and a vibrant formal and informal industrial community; the availability of a relatively large reservoir of professional and technical manpower; the blossoming of an inter national movement in the nineteen sixties which prescribed grassroots industrialization as a strategy for more durable industrial development for developing countries and more importantly, Ghana's post independence economic history.

Whereas countries like India, at independence found it necessary to lay sound foundations in the form of infrastructure and resource development for the country's future industrialization, Ghana in the immediate post independence years tackled the problem of industrialization from the top by establishing many ambitious manufacturing industries without due consideration of the resources on which these industries were to thrive. Many of these industries had to close down as a result of chronic capacity underutilisation occasioned by shortages of raw materials and foreign exchange to import spare parts and other inputs. As the situation got worse, policy makers for the first time started to look out for alternative development strategies other than the "big push" approach. It was around this time that the Technology Consultancy Centre (TCC) was established. Since its establishment in 1972, the TCC has been playing a unique role in the development, transfer and promotion of technologies which have forward and backward linkages with agriculture, food production and processing as well as agro-machinery production. In the process numerous secondary industries have been generated and employment opportunities created.

[5] Presented the paper

This paper intends to share the actual experiences of the TCC mainly in the role playing of transfer and commercialization of rural non-farm and on-farm food and agricultural production technologies which have served the needs of Ghanaians.

BACKGROUND AND ORIGIN OF THE TECHNOLOGY CONSULTANCY CENTRE

The history of the Technology Consultancy Centre -TCC, dates more than a quarter of a century. Like so many institutions everywhere, it had its origin in the politics of the day, both national and within the University of Science and Technology.

The origin of the centre can be traced to the Suame Product Development Group (SPDG) formed in 1969 by a group of lecturers from the UST, Kumasi. The group aimed to help the small entrepreneurs of the large informal industrial area of Suame to improve their skills and resources through the introduction of the manufacture of new products and improved processes. As the activities of the group built up, and the positive effect on the small-scale informal sector became apparent, the university authorities began to search for a means by which this might be permitted and controlled within the university system. The university turned to the Intermediate Technology Development Group (ITDG) of UK for advice.

The ITDG had been founded in London in 1965 by the late Dr. E.F. Schumacher, the author of the well known book "Small is Beautiful". Dr. Schumacher advocated a search for intermediate or appropriate technologies that were specially adapted to the needs of developing countries, making effective use of local human skills, raw materials and energy resources. Such technologies could be applied on a small scale, unlike many advanced technologies and could provide the basis for new enterprises that could be started with small capital investment. The ITDG recommended that the university should take an interest in adapting and developing intermediate or appropriate technologies for local small-scale industries and that this could form the basis of the work programme of a new institution with the status of a faculty within the university to be called the Technology Consultancy Centre. This was in 1971.

The university however, was not having much success in gaining financial support for the TCC. So 1971 passed away without anything happening. In 1972, the then vice-chancellor, Dr. Evans Anfom took the brave decision to go ahead with whatever resources the university could allocate in the hope that, once operations were underway, support would be attracted. In January 1972, Dr. John Powell was summoned to the vice-chancellor's office and offered the challenge of starting the TCC as Acting Director with a budget of 5000 cedis for the remaining 9 months of the academic year. The challenge was accepted and the TCC opened for business on 11 January 1972.

The Centre was to serve as an interface between the Research and Development (R&D) activities of the university and the Ghanaian public to

facilitate national development. Initially, it functioned as a purely consultancy unit, directing clients need to the appropriate university department for solutions to their problems. This passive role soon came to an end with realization that desk-bound consultancy alone, from the comfort of the campus can be no substitute for first hand practical involvement with the new technologies which were being transferred. Consequently, the centre took steps to become more practically involved in the technologies, and this has been the basis of the operation of the centre in the past two decades.
In playing the above roles, the TCC promotes the development of small-scale industries by:

+ obtaining details of technologies being developed in the university faculties and other similar institution elsewhere

+ adapting them to suit local conditions by running pilot projects/production units to complete product and process development under real commercial conditions,

+ transferring such proven technologies by providing technical and material support to entrepreneurs based on the experience of the pilot projects.

Through the operations of these pilot units productions, the TCC gained considerable knowledge and experience necessary for technology transfer and the promotion of small-scale industries which now constitute about 80% of its work.

FIELDS OF ACTIVITY

The technologies developed by the TCC are those that rely primarily on local sources of raw materials and labour and use locally produced plant and equipment, thus making them easily affordable and suited mainly to small-scale operations. In addition, they are technologies that seek to provide employment that is socially acceptable to the people. In the language of the development scientist or economist, the TCC transfers appropriate technologies.

Since it was set up in 1972, the TCC has developed a number of technologies in response to prevailing needs, from glue manufacture to glass bead production, from broadloom weaving to iron casting, and from sustainable on-farm agricultural production methods to the development of equipment for agro-processing.

The TCC's current development projects fall into several areas. These are- Food processing and vegetable oil extraction, Micro-concrete roofing tiles, Industrial ceramics, Intermediate Brick Production, Beekeeping, Weaving, Agriculture (Agro-forestry promotion) and Fish Farming.

SUAME INTERMEDIATE TECHNOLOGY TRANSFER UNIT (ITTU) AND LOCAL MANUFACTURE OF PLANT AND EQUIPEMENT

Supporting the TCCs work in these areas is its ITTU which was established in August 1980 at Suame magazine, Ghana's largest informal light industrial area.

The aim was for the TCC to establish an effective operational presence among the artisans so that new technologies could be perfected and transferred at the grassroots level to those who may need them most. The ultimate goal is to promote a steadily rising level of technology leading to greater productivity and increased employment opportunities within the surrounding workshops.

Since it was established, the Suame ITTU has helped over a dozen entrepreneurs to establish their own basic light engineering industries. These primary industries produce a variety of items including agricultural and food processing machinery and parts needed by farmers and food processing industries as follows:

1. For Agriculture: Hoe blades and cutlasses, seed planters, bullock carts and ploughs, seed bed moulding boxes, small farm vehicles (SFV)

2. For vegetable and palm oil extraction: Presses, boiling tanks, palm fruit pounding machines and palm kernel crackers, rice threshers with pedal drive.

3. For Agro-processing: Corn-milling machines, Gari processing plants and presses, animal feed mixer/milling machines.

4. Beekeeping: Beehives and Smokers

The unit itself consists of a group of small manufacturing workshops engaged in metal machining, plant construction ferrous and non-ferrous metal founding and woodworking. The aim is to transfer technology by demonstration of continuous manufacturing activities under commercial conditions. As a technology is transferred to the surrounding workshop, the unit shifts to other technologies and products developed at the university or other similar institutions. The ultimate objective is to gradually raise the level of technology within the industrial area eventually leading to improved productivity and greater employment opportunities in the surrounding workshops. In the process of transferring and commercializing technologies developed by the TCC, the ITTU provides the following services to its clients according to their particular needs,

i. Demonstration and application of new technologies and manufacturing techniques.

ii. On-the-job training of artisans and entrepreneurs at the ITTU workshops

iii. Assessment of the viability of projects and the recommendation of entrepreneurs with viable projects to financial institutions for loans to purchase machine tools and other equipment.

iv. Importation and sale of machine tools to suitable entrepreneurs through the TCC Machine Tools Sale Programme. Under this programme grants provided by agencies like EU, CIDA, USAID and DFID are used to purchase mostly reconditioned machine tools from the developed countries for re-sale to local entrepreneurs.

v. Secondment of TCC technicians to commission and supervise new manufacturing operations at clients workshops.

vi. Hire of machine tools time at the ITTU workshops to clients for the Performance of certain operations at clients workshops.

vii. Subcontracting jobs to new entrepreneurs who have not yet realised the full market potential open to them.

THE BASIC WORKSHOP PROGRAMME AND SUPPORT FOR SECONDARY AND TERTIARY INDUSTRIES

One of the important contributions of the TCC to the promotion of small-scale industries is its assistance in the establishment of light engineering workshops under its basic workshop programme. As mentioned already, over a dozen workshops have been established in Kumasi alone. The benefits of these workshops can be seen not only in the number of workplaces that have been directly created, but also in the benefits from the secondary and tertiary industries thereby generated.

Through these workshops it has been possible to establish very effective productive capabilities for a wide range of industrial process plants and engineering products for the agricultural and agro-processing industry. The combined effect products is the proliferation of small-scale and family medium scale industries based on them. The actual number of workplaces generated by these workshops may not be impressive, but, the employment opportunities offered by the secondary and tertiary industrial and retail activities based on their products go into thousands. Like the ripples created by pebble thrown into a pool of water, the initial humble investment of the TCC in few machine tools and few dedicated entrepreneurs have multiplied several times, creating more and more employment opportunities at various levels of industrial activity and trading generated by them.

CLIENT SELECTION AND DEVELOPMENT

A few words must be said about the selection of clients by the TCC. With all the services that the TCC offers through the ITTU in the transfer and commercialization of technologies, it might be thought that, the centre is in the business of free hand-outs. It is not. Clients are expected to do most of the work themselves. When a client first approaches the TCC, his project is

discussed and he is advised on what initial step to take. This might involve undertaking a simple market survey for a new product, undergoing training at the ITTU or elsewhere acquiring land or building for the project or any other necessary preliminary task. Most clients given such advice are never seen again. They are the ones standing in line for a handout. The few who take the initial advice and keep coming back are the real entrepreneurs. The centre will normally work with a client for about two years before the new process or product is finally established in his own workshop. Over this period a degree of mutual confidence is established which has benefits in several ways. The client sees the market potential of the new activity and the cash flow that can accrue to a private entrepreneur free from all the constraints of institutional management. He is a vital ingredient in the development process as he is the agent of technology transfer. For this reason, the work of the TCC is still people-centred, but more specifically it is entrepreneur centred. What attracts the entrepreneur is one word-PROFIT. Thus the emphasis must be placed on those manufacturing and agricultural activities which generate attractive profit levels. This is a dimension which is of paramount importance in Ghana.

ON-FARM AGRICULTURAL TECHNOLOGY DEVELOPMENT AND TRANSFER

It is quite obvious that the developments that have taken place on the engineering front of the Centre's work have been very crucial for its industrial promotion efforts. The successes which have been registered could not have come without a parallel programme for the development of specific technologies such as the Agroforestry Demonstration and Extension programmed.

The agroforestry programme operates as a pilot project on a 14 acre farmland near Fumesua. Established in 1982, the Centre has been using this facility primarily to demonstrate the advantages of various agroforestry practices like alley cropping to surrounding farmers and agricultural development workers who are exposed to the improved results such as soil fertility maintenance and sustained crop yields under continuous cultivation, as a means of guaranteeing small farm incomes.

Following the successes demonstrated, the Centre in 1990 embarked on an extension drive aimed at introducing the technology to farmers on a large scale. The Extension Department of the then Ministry of Agriculture responded positively to a request by seconding as extension officer to be attached to the project. Subsequently farmers were organised and 1-2 day on-farm workshops were organised for them. Through this modest effort, farmer-managed trial plots were established for various farming communities and some Junior Secondary Schools. Farmers who eventually introduced the system on their farms testified of improved and sustained yields and higher farm incomes. The long term objective is encourage the widescale adoption of agroforestry practices for improved small farm productivity and to ultimately develop the farm into a focal point for the development and transfer of various

conservative farming practices such as beekeeping, snail farming, and fish farming as a means of raising farm income.

In the area of fish farming, the Fish Seed and Feed Project has in the past promoted fish farming technologies aimed at overcoming overpopulation in fish ponds through the production of all male fingerlings to accelerate the growth of fish to table size. This technology has been adopted by a number of fish farmers in the country.

The Apicultural Promotion Unit has done a lot to popularise scientific bee-keeping in Ghana through research, seminars and workshops. Even though thousands of enthusiasts have taken up beekeeping, we cannot claim that our efforts have helped achieved the ultimate aim of making beekeeping a viable industry in Ghana. Having recognised the shortcoming, steps are being taken to remedy the situation. It has generally been agreed that the most effective means of doing this is to establish an all-embracing and intensive beekeeping pilot project in an area of proven potential which will serve as a test case of the Centre's claim that beekeeping can be a lucrative business in Ghana, and for the dissemination of the benefits which might accrue thereof.

FUTURE TRENDS AND NEW REALITIES

Looking back on more than 25 years of activities in the transfer of technologies for national development, what are the lessons to be learnt for the future transfer activities? The first would seem to be that scientists and technologists must take their message to the people and not wait for the people to come to them. Having said that however they should not seek to preach their cause but to answer the questions that the people ask. We should remember that it is profit that transfers technology. We should not waste time trying to promote ideas of doubtful economic benefit.

Another fundamental point is that any industrial development effort must be sustained by a basic light engineering capability. It is essential to be abie to manufacture, repair and improve the plant and equipment used by rural industry and agriculture. Without this capability all attempts at technology transfer become superficial and piecemeal. One effective means of promoting the development of the light engineering industry in Ghana is the ITTU. As a result of the seminal role of the Suame Intermediate Technology Transfer Unit, the Government of Ghana in 1987 found it necessary to establish the GRATIS project to spread the ITTU concept and the TCC experience in technology transfer to all the remaining regions of Ghana. To date, there are fully operational ITTU's in all the regional capitals.

The direction and the mechanism adopted for technology transfer in Ghana during the past 25 years came about as a curative prescription for a deteriorated economy which had suffered from total neglect and a post independence period of rigid central planning which was characterised by ill conceived grandiose projects.

The newly emerging entrepreneurial class have embraced the profit motive as their guiding principle. However since the introduced free market started to take root and the economy began to pick up, new realities which will have profound effects on the industrial climate of the country have started to emerge, thus making it necessary to give fresh thoughts to the transfer and commercialization of technologies.

With the influx of a host of cheaply priced consumer products (mostly from South East Asian countries) into the Ghanaian market, it is increasingly becoming difficult for small scale manufacturers of such items as soap, grinding plates, bolts and nuts to sustain their production. This is on account of the relatively inefficient manufacturing processes which the local entrepreneurs have adopted leading to a situation where some of them have to fold up in the face of stiff competition.

Obviously there is no one way out of this problem. However the TCC and a few collaborating institutions have recognised that, in present day Ghana where competitiveness is crucial for the survival of productive enterprises, the improvement in the quality of the products and production processes of companies which have benefited from the centres technology transfer model is the next big step. Already something has started in this area.

In addition the following measures need to be considered as a means of making small and medium scale enterprises more competitive through more effective co-ordination of the respective roles played by R&D institutions, the government and the private sector in technology transfer.

- more judicious use of credit for technology identification, acquisition of the right equipment and well tailored technical assistance to ensure that products and services provided beneficiaries are competitive

- Selective assistance as a strategy for improved performance to ensure that we end up with the best and dedicated entrepreneurs

- The promotion of healthy joint ventureships
- The promotion of fruitful linkages between workshops with varying capabilities

CONCLUSION

The long history of the TCC spanning more than 25 years has been a constantly expanding programme of technology transfer for grassroots development. It shows how a university can seek a new role and develop a new concept in technology transfer to serve the whole of the community that supports it. Even though a lot has happened during this relatively short period of time in improving the performance of the Ghanaian entrepreneur through the transfer of technologies for small scale industrial and agricultural development, lessons learnt during the period have shown that the Ghanaian industrial environment is passing through many crucial phases of change, and that any effective transfer mechanism which may be introduced needs to take

serious account of the changing situation in its design to ensure that maximum financial benefits can be reaped by entrepreneurs.

IMPROVING TECHNOLOGY TRANSFER THROUGH DECENTRALISATION OF EXTENSION SERVICES

BY

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INTRODUCTION

At independence, the government of Ghana placed emphasis on 'modernising' the small-holder agriculture to achieve food and agricultural products to service industry. Efforts were made to develop and disseminate 'improved' technologies on research subsidised rates. Development agencies were then responsible for the development of the people where development objectives, plans and resources are controlled at the national level.

However, the "stasis" models of development has neither helped (a) farmers adopt the recommended practices as envisaged nor (b) improve the lives of farmers and the rural economy. This has brought to the fore the need to make the grassroots responsible for their own planning and implementation. This represents a change from 'trying to develop the whole nation from the centre' to providing an enabling policy environment within which the people can participate effectively in their own development. This has to do with supporting self-help, local responsibility and ownership of development programmes while allowing market mechanism to distribute goods and services.

In agriculture, a decentralised system, which devolves power to the districts to formulate and implement development activities is seen as providing the necessary conditions for stimulating agricultural development on a sustainable basis. This policy can also be interpreted as seeking a more responsive agricultural and rural institutional structure within which the public, private sectors and NGO's could complement each other to provide agricultural goods and services to meet the needs of the local communities.

Under this management system, the focus is shifting from 'selling the best technology developed from research stations' to that of establishing an interactive learning or negotiating relationship among the various actors in the social system (farmers, farmer groups, research, NGOs, credit providers, input and agricultural commodity sellers) as a means of achieving agricultural production that meets the food and income needs of the farming communities.

DECENTRALISATION AS A DEVELOPMENT MODEL

Government's decentralisation policy is meant to reform the social services sector of the economy from a 'centre-led' to a district focussed administration. The aim is to transfer public sector planning and control from the national, regional, regional, and ministerial levels to the districts assemblies. This policy reform is given legal backing by Chapter 20 of the 1992 Constitution

which is now superseded by the Local Government Act of 1993: Act 462 (MLGRD, 1998). The essential features of the decentralised system as enshrined in the 1992 Constitution are as follows:

Box 1 Features of the Decentralisation Policy

- Functions and, powers, responsibilities and resources should be transferred from the central government to local government units,
- Measures should be taken to enhance the capacity of local government authorities to plan, initiate, co-ordinate, manage and execute policies in respect of mattes affecting the people
- Local government units should have sound financial basis with adequate and reliable sources of revenue,
- Local government staff must be controlled by local authorities,
- There should be popular local participation in local decision making

Korang-Amoako et al. (1998)

Decentralisation can be seen as government's policy decision to ensure the *'participation of the people in the institutions and systems that govern their lives'* (FAO, 1998). The policy decision calls for (a) the re-orientation of the bureaucracy of governance and (b) the reinforcement of a new set of values and management practices. The main features of this change include:

- Local participation in decision making
- Self reliance and community responsibility for development

This also implies that agricultural planning and control of resources to achieve agricultural development become vested in the district administrative structure.

IMPROVING EXTENSION SERVICE DELIVERY THROUGH DECENTRALISATION

Decentratisation has the potential of facilitating agricultural extension delivery by helping improve (a) agricultural planning, (b) training of field staff and farmers, (c) coverage (number farmers, agricultural commodities and related issures), (d) supervision, (e) appropriateness of technology, (f) farmer participation, (g) relationship with other rural services providers, and (h) building the capacity of the local communities for self-development.

PLANNING

In a centre-led development planning, specific issues affecting respective districts and communities are often lost in the 'aggregate planning regime' adopted. Decentralisation ensures that the content of programmes fit the needs and interest of the district (Axinn, 1998). It also enables the district to

reconcile their targets with their resources. Further, the district owns this programme and would work to achieve set targets since they are held responsible for the execution and success of the execution and success of their own programs.

TRAINING

Under a decentralised system what is learnt and when is decided at the district and operational areas. This makes training topics more relevant to the production needs and regimes of farmers.

COVERAGE

In a central planning system, programmes are based on 'national priority commodities' to the neglect of other commodities that are of importance to specific locations. The District Directorate of Agriculture now has authority to plan to cover commodities and issues that are relevant to various communities

SUPERVISION

The responsibility of agricultural development now rests with the District Assemblies. The closeness of the administration to site of program implementation and responsibility and responsibility and ownership of the programmes make the supervision, monitoring and evaluation of programmes more effective.

APPROPRIATE TECHNOLOGY

Despite the various technological options available, adoption by farmers to increase agricultural production has not materialised. It was postulated that this situation has arisen because the lack of understanding of the context of application of these technologies by centre-led development agencies (Chamber, 1986). Carney (1998) has argued that in the centralised management system,

- Research and extension are isolated from farmers
- Technologies transferred by extension do not fit the context of application
- Research/extension not very responsive to the needs of farmers.

Decentralisation has provided the opportunity for development agencies to;

- become more sensitive to the real needs of the local communities
- ensure understanding of the relationship between inherent technological values of researcher-recommended practice and the socio-economic issues that impact on production.

Further, centralised extension management system, with emphasis on passing on technology to farmers, does not encourage the souring and use of farmers indigenous technologies. By refining and making use of location

specific knowledge of all stakeholders, relevant production practices could be adopted by farmers.

FARMER PARTICIPATION

Decntralisation is a policy decision aimed at creating the necessary environment for the grassroots to make input into the their own development. This makes it imperative to involve farmers and other stakeholders in (a) needs assessment and (b) setting the research agenda and (c) review the performance of the development process.

Farmers participation also facilitates the use of farmers' indigenous knowledge (IK) in technology generation, improves feed back from farmers and learning about contextual issues that affect their production and livelihood. Effective participation of farmers in therefore seen as ensuring that the needs, concerns and expectations of small holder farmers are taken into account in the generation of technologies and planning of agricultural development in general.

LINKAGE AND SYNERGY AMONG RURAL SERVING AGENCIES

Extension work depends on inputs from various other organsations such as research, credit houses, input sellers and traders. However, in a centralised management system the important role interrelationship among the various rural serving agencies should play to help communities achieve development is sacrificed for targets set by the central authorities. A case in question is the abortive on-farm trials of 1994 (see box 2 for details).

Box 2. The Case of the 'Abortive' Adaptive Trial of 1994

In 1994, the Crop Research Institute (CRI) of CSIR designed farmer-managed on-farm trials, on maize and cassava, to be tested on farmers' fields in the Volta Region. The implementation of these trials was to be done by Department of Crop Services (DCS) of MOFA. CSD saw itself as implementing the trials for CRI and requested logistic support from CRI. CRI expected DCS to lay the trials as part of their adaptive research work. CRI therefore provided no resources for the trials and DCS too could not lay the trails for 'want' of logistics. So who is responsible?

Souci: D.L. Tetteh, Regional Adaptive Research Officer for Volta Region (pers.comm.)

DECENTRALISATION CAN BE SEEN AS

- the establishment of an important forum for the main stakeholders to meet constantly to plan and co-ordinate the implementation of district assembly agricultural development programs.

- Forging and strengthening a mutually supportive relationship among various development agencies (farmers, farmer groups, input sellers, marker women, NGOs) to work to complement each other to achieve.

A decentralised administrative system provides an environment within which the people in the local area can develop and nurture their own capacity for planning, resource allocation, implementation, monitoring and evaluation of development programs. This also calls for a shift in our agricultural development efforts (a) from 'solving farmers problems for farmers' to supporting farmers to develop their own capacities (b) from farmer dependency on development agencies to self help initiatives, (c) from 'forcing' farmers adopt technologies 'as given' to supporting them to take informed decisions and (d) to strengthening farmers ability to negotiate market relationships in the global economy.

THE RESPONSIBILITY OF EXTENSION UNDER A MARKET-LED DECENTRALISED SYSTEM

Government's decentralisation and market economy policies imply the reversal of:

- the public sector control over supply of inputs, credit, research and marketing of agricultural products

- Central control of planning, resource control and supervision to make districts more responsible for the planning, implementation of programmes.

The role of extension in this situation is seen as ensuring that agricultural programs are responsive to local needs and interests, as well as helping farmers to learn to undertake self-improvement in a competitive market. I.e. the focus of agricultural extension has shifted to support farmers with available knowledge to be able to take economic decisions as they produce and sell agricultural products. This implies that extension must focus on facilitating the competitiveness of farmers in a globalised and open economy.

This means that the agricultural department of the district assemblies must go beyond technology salesmanship to providing the necessary conditions for all stakeholders to 'learn about and take actions' to address both the technological and the contextual constraints within which farmers must produce and market their wares. Specifically the agricultural development unit of the District Assemblies must work to;

- Support partnership with private sector (networking among input distributors, credit, market women), research, NGOs and other rural service providers to further the cause of agricultural production.

- Leverage collaboration between research and farmers to explore he production needs of farmers and to generate relevant technology and information to help the production process.

- Support farmers in modifying available technologies to meet their special needs

- Strengthen farmers understanding of the market system and how that impact on farm production and sustainability of production and income of the rural economy

- Formation of farmer groups to facilitate their learning and to strengthen their negotiating power in the market.

CHALLENGES

The challenge to the decentralisation process is how to develop and maintain appropriate personal attitudes to support institutional management frameworks implied in the decentralisation. In a centralised planned economy, the development agents see themselves as experts who must bring development to farmers and the district levels rely on instructions from the top. A dependency relationship is therefore established and reinforced through the TOT model. In a decentralised system, development agents must develop a participatory approach to doing things while farmers take more responsibility for their own development. The agriculturist also needs to make conscious efforts to relate to their peers, subordinates and other stakeholders as co-partners in development (Amezah, 1998).

CONCLUSION

Decentralisation is aimed at reorienting governance from a centre led model to improving the capacity of local government institutions to become more effective in identifying contextual issues, opportunities and solutions.

This policy decision brought into being an organisational structure that makes it easier for extension to respond to the real needs of farmers as program planning, resource allocation, programme focus and coverage by taking local conditions and interests into consideration.

Decentralised Extension could be seen as enabling agricultural extension to
(a) better serve the needs of farmers
(b) react faster in response to problems at the operational areas
(c) improve collaboration with other sector
(d) reduce administrative overload

It is the expectation that by decentralising and focusing on the real issues at the grass roots, technologies developed can respond to the contextual issues being faced by farmers. However, the success of this policy would depend on the cognitive orientation of the administrators and the ability of the field staff to work with farmers and other stakeholders as colleagues. The answer to our development might therefore not rest solely on decentralisation but on how we work with your stakeholders within the decentralised system.

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DISCUSSION

Dr. Hemeng: The impression created by the presenter that CRI refused to provide funding for on-farm activities jointly implemented with extension services is unfortunate. During the period of the Ghana Grains Development Project, there was budget covering all activities of on-farm work. After the project, CRI has not enough funds to cover completely the work jointly undertaken with extension services. As extension services is mandated to work directly with the farmers these activities should be included in the budget of the Directorate of Agricultural Extension Services.

Mrs Kordylas: This question is directed to ADRA. How old are the mango and citrus trees. What are you planning for marketing?

Mr. Stephen Amoako: The current programme is for five years. We hope that by the end of the five years the trees would have started fruiting. The marketing department is working on that. We are looking at the processing as well as sources of raw fruits. We are happy that the Food Research Institute has the technology for processing cashew fruit. This is the kind of opportunities we are looking for. We will follow up on this.

Mr. Nyamekye-Boamah: Talking about linkages. The real motivation is it is market driven and people are rational and take profit. They will adopt. Is the technology transferred is it cost-effective? If bumper harvest what do you do with buffer stock? Make storage facilities and do processing. Once it makes sense economically, it will be sustained when donor funding ceases.

Mr. Stephen Amoako: ADRA is looking at who is between the researcher and the farmer.

Dr. Prakah-Asante: If technology to be adopted is profitable, it will be sustainable.

Mrs. Andah: We have sustainability of agricultural production. We have researchers working with farmers. Who is the market? Is it the industrialist? Until we are able to link the user to the farmer for industrial/export purposes we will continue to have problems. The Food Research Institute is finding

out what crops are best suited for getting industrialist as stakeholders to be interested in the crop from the very beginning.

Dr. Hemeng: Available local varieties should be considered. In 1995, the World Bank recommended that socio-economist should be involved in technology development up to impact assessment. Involve DAES in planning together with farmer. And consider indigenous technologies when they are available.

Prof. Norman: In view of the commercialization which CSIR is expected to do and from the discussions, it appears it will be a good thing if CSIR adopts DAPIT, GRATIS. What is your view about that?

Dr. Prakah-Asante: This issue was discussed in 1988 to make GRATIS as one of the CSIR institutes. The conclusion was that the focus and funding were different. The funding agency for GRATIS insisted that it should stay like that. Besides, there were too many institutes in the CSIR. GRATIS should therefore be on its own. Both CSIR and GRATIS are however under the same Ministry.

Rev Dr. Marfo: I agree with the DAES that decentralization should make the researcher limit research. I expect the District Councils to give part of poverty alleviation fund for that. The District Councils are more interested in KVIPs for people to see instead of funding research. I doubt how the District Assemblies are going to react to that.

Mr. Nyamekye-Boamah: Innovation developers should show how the technology works and how it makes economic sense. Once the innovators win, farmers and District Assemblies win, all win.

Dr K .O. Marfo: One can foresee the problem of sourcing for funds from District Assemblies to solve problems pertinent to a particular district. Is there a way out.

Dr. Tetteh: It is difficult to source for funds from the District Assemblies. There have been instances where district specific problems that required research intervention were identified. Efforts were made to solicit funds from the respective District Assemblies to support student research projects to

address these problems. Unfortunately, responses have been negative.

Dr. Amezah: It is difficult with the District Assemblies. Their budget for agriculture is limited.

Mrs. Kordylas: I want to know if TTC works for GRATIS to produce stainless steel. Do you have a brochure that a manufacturer can look at and know what is in the system? Do you have a catalogue or directory?

Mr. Evans Dawoe: We have the expertise to produce stainless steel at the University, Food Research Institute and Institute of Industrial Research.

Dr. Prakah-Asante: GSB, GRATIS, and University have for the first time established manufacturing standards where they are going to operationalize. Use of scrap metal for food processors. Recommended that it should be from stainless steel. Consumer should ensure that food is produced from stainless steel. Food processors from the ITTUs are from stainless steel.

Mr. S. K. Dotse: DAPIT has compiled a directory of manufacturers of equipment. It is available at the Presbyterian and Legon Bookshops. We intend to update that.

Mrs. Andah: On stainless steel, I know that specific processors ask for stainless steel equipment. Cassava juice and fruit juice manufacturers make specific requests for stainless steel equipment. DAPIT has a list of that. Visit the manufacturers and if they are not making stainless steel equipment, you can request them to make it for you.

Dr. Prakah-Asante: What is the present extension system?

Dr. Amezah: It is moving towards decentralization and farmer-led.

PART THREE

ENHANCING TECHNOLOGY TRANSFER AND COMMERCIALIZATION USING ADVANCES IN INFORMATION TECHNOLOGIES

RECENT ADVANCES IN THE CSIR AND ITS LIBRARY SYSTEM FOR ACCESSING INFORMATION ON TECHNOLOGIES FOR ENTREPRENEURIAL DEVELOPMENT

BY

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INTRODUCTION

I would like to start this presentation with sincere thanks to the organizers for inviting me to take part in the proceedings of the workshop and also to present a paper My presentation will focus on the various initiatives undertaken by CSIR libraries aimed at bringing current and up to date information to the door steps of the research community which will ultimately be transferred to the wider Ghanaian society. The first part of the presentation will be a general overview of the library and information systems in Ghana, to be followed by an overview of the library and information system in the CSIR and finally the various initiatives within the CSIR in terms of information provision.

Our present era has been described as the INFORMATION AGE. This has given rise to such expressions as 'information business', 'information explosion', 'global village', 'information transfer', 'information repackaging'. Libraries with their collections have existed for many thousands of years. The value of information, however, can be realized only when the right information gets to the right user for whatever purposes he/she requires the information for. Getting the relevant information from its source to the right user in a timely manner and in whatever format is what is involved in information transfer. Collecting, organizing and making information available to individuals and institutions have been going on for a long time, however in the last 25 to 30 years information has come to be looked on as an economic resource much like land, labour, and capital. Coupled with the shift in attitude towards information is the variety of technological developments that affect generation, storage and retrieval of information for use.

For a nation to be well developed it needs to harness all the available information resources both within and outside its borders. The main source of published information readily accessible to the manager, researcher or student is that held within libraries. Libraries are not simply storehouses of books, but provide proactive services to their users both from within the library's stock and from a wide range of external sources. Rapid advances in technology and telecommunications over the last decade or so have enabled librarians to provide access to, and advice on information which is well beyond the bounds of the library's own bookstock[1].

LIBRARY AND INFORMATION SYSTEMS IN GHANA

Information systems, like other social structures, are intended to contribute to the socio-economic and cultural development of individuals in society[2]. In the well developed societies, libraries no matter their type cooperate and coordinate their information resources for the benefit of the entire country. In Ghana, unfortunately, the promotion and development of library and information systems has not been accorded the priority it deserves. This may be due to the fact that the potential contribution of information to economic, social and cultural development has never been seriously acknowledged or appreciated, probably because of its intangible nature.

A careful study of library resources and facilities in the country reveal a picture that is not too impressive. Except for public libraries which are established in all the ten regions of the country, most of the special libraries are concentrated in Accra and Kumasi[3]. Conscious effort to establish libraries and information services in Ghana backed by Law was initiated in the 1950s and 1960s. This was a period of comparative prosperity for many developing countries development and progress meant striving to reach in two or three decades, the stages reached at the time by the western industrialized countries[4].

Library and information services in Ghana may be classified into four broad categories, namely: Academic libraries, Public library services, school libraries, and special libraries.

ACADEMIC LIBRARIES

Academic libraries are usually fully subsidized by the government and aim at the development of science, technology, education and research in the interest of society. The information resources collected are openly accessible and few restrictions are placed on dissemination, lending and photocopying services.

In Ghana, they comprise the libraries of the country's tertiary institutions. Among them, they hold the largest collection of materials used to support teaching, learning and research.

PUBLIC LIBRARY SERVICES

Public library services in Ghana are provided by the Ghana Library Board which is characterized by a central direction in respect of policy formulation and administration, central support and economic services and a planned hierarchy to provide library services over a wide geographic area to meet local needs. The Ghana Library Board has ten administrative units in the ten regions as well as forty three service points for adults and forty nine for children throughout the country[5]. The first attempt to start public library services in Ghana was made in 1928 when the Anglican Bishop of Accra made accessible to the public his personal library.

SCHOOL LIBRARIES

The School Library Service scheme was initially proposed as part of Ghana's second Development Plan beginning from 1959. Hitherto some schools, particularly in remote areas, were already subscribers to the book box service provided by the Ghana Library Board from which they obtained children's books. The school libraries are located in second cycle schools, and support the teaching, learning and recreational programmes of these schools. The size of their collections depends, to some extent, on how well-endowed the school may be.

SPECIAL LIBRARIES

The main aim of special libraries is to give information support to decision making and research in governmental and private enterprises and organisations. They are characterized by the following features:

1. Organized under the sponsorship of a parent enterprise or organisation which provides the funds for its support and continuance;

2. Assigned the mission of acquiring, organizing and providing access to information and knowledge so as to further the goals of its parent enterprise or organisation;

3. Assembling a physical collection of information, knowledge and/or opinion limited to a single subject or group of subjects or to a single format or group of formats;

4. Administered by a librarian or specialist in the subject(s) covered as format(s) included[6].

   This group in Ghana, comprises the libraries of research, financial, industrial, and commercial institutions as well as those of government ministries and departments and para-statal organisations. They are mostly mission or discipline-oriented and tend to serve a well-defined clientele. Their collections centre mainly in their areas of special interest.

Library growth in Ghana to some extent has been fragmentary and uncoordinated. In the case of special libraries, they have grown to meet the exigencies of isolated situations. Library and information resources are unevenly distributed. There are vast areas and regions virtually deprived of even the most basic provision. As a result, the existing libraries serve only a small percentage of the national population, a situation that does not augur well for the total development of the country.

While there are difficulties in establishing a nation wide library and information facilities of all types, one is disturbed by the rationale behind the provision of library services. The approach is still uncoordinated in spite of the constant use of the term network. The basic fault with the approach is that instead of a concerted effort to determine areas of information needs by looking at users,

we are taking pre-established areas of information and applying them to people[7].

It is in the light of this that the various institutes of the CSIR through their libraries have taken various initiatives aimed at addressing some of these problems and to bring information to the door steps of the research community which will eventually be translated into the development of the country.

LIBRARY AND INFORMATION SYSTEM WITHIN THE CSIR

The CSIR as an organisation is made up of thirteen research institutes and centres whose services are coordinated at the national level. The institutes and centres have different areas of specialization and so are the libraries that service them, that is, providing current information for research purposes.

The information services within the structure are however not coordinated though there used to be a Central Reference and Research Library (CRRL) which for all practical purposes was the library for the CSIR Secretariat.

The Animal Research Institute has a library collection rich in animal science and related subjects. It provides current awareness service to its staff and compiles bibliographies in specific fields.

The Building and Road Research Institute library has a book stock of over 12,000 and a periodical holding of 120 titles. In scope, the library reflects the subject interest of the institute – civil engineering, building technology, architecture and allied subjects. The essential services provided by the library include: reader advisory and loan services, issuance of a quarterly accessions bulletin and contents list of periodicals.

The library of the Crops Research Institute supports the programmes of the institute by way of fulfilling the information needs of the scientists. This is done through the acquisition of needed books and journals, literature search, provision of reader services.

The Soil Research Institute has a library complex which houses a total of 11,483 books and 133 periodical titles. The library provides information to help fulfil the institutes' mandate and objectives which are to take inventory of the soil resources of the country and to carry out research and provide advice on maintaining soil fertility for food security and sustainability of the environment. The library provides current awareness services, reader services, photocopying services, printing and binding services.

The Savanna Agricultural Research Institute library was established in 1981 to collect, process, package, provide and develop a strong information service to support the institutes' programme of activities and to meet the needs of the scientific community for the realization of its mandate. The library holds 139 periodical titles and over 4000 books. The book stock focuses on the main areas of research of the institute. The following services are provided:

lending, electronic database search service, periodical service and photocopying service.

The Water Research Institute library was set up to support the various divisions, technical and auxiliary members of staff by providing them with adequate information needs to carry out their duties effectively. The objective is to maintain a library and documentation system capable of supporting water resources development in Ghana. This is done through the provision of current awareness services, inter-library loan services, provision of E-Mail and internet services.

The Oil Palm Research Institute library functions to support the institutes' research activities with the selection, acquisition, processing, storage and dissemination of relevant literature resources that may be needed to support on-going and other scientific research endeavour at the institute. Literature search and CD-ROM search services are some of the services that the library performs.

The Food Research Institute library is one of the most important libraries in the field of food science and technology, nutrition, agricultural economics and food engineering in Ghana. It has a book stock of about 3574 and subscribes to over 20 titles scientific journals and holds 271 research reports. The library provides reading facilities, reference and loan facilities, photocopying, literature search and selective dissemination of information (SDI) services.

These libraries, as indicated earlier on, were established to serve the interest of their parent institutions and in isolation of one another though they all fall under the CSIR. Certain responsibilities however were placed on the CSIR for the establishment of an efficient information system in Ghana in respect of science and technology. It was this responsibility that prompted the CSIR to re-organize its own internal information system in order to build the national system on a sound footing. This then, marked the beginning of the idea of collaborating and sharing information among CSIR libraries and other libraries in the country.

INITIATIVES TAKEN BY CSIR INSTITUTES

Various initiatives have been taken by CSIR institutes aimed at providing coordinated information services in a timely manner to the user community. Some of the initiatives are: The Ghastinet Project, the GAINS Project, the FIN Project, the Technology for Livelihood Programme, INTIB and the ILL/DD Programme.

◦ GHASTINET PROJECT

The Ghana National Scientific and Technological Information Network System (Ghastinet) project traces its history to the National UNISIST[6] Committee which was later re-designated as the National Committee for Information and

[6] World Science Information System

Documentation which prepared a five-year (1975-80) plan for a national science and technology information system. The draft plan could however not be implemented immediately. After a brief period of inactivity, a series of initiatives were undertaken by individuals and organisations which culminated in the preparation of a project document which was submitted to the donor community for support.

The International Development Research Centre (IDRC) accepted to fund the project so a Memoramdum of Grant Conditions was signed in 1989 which approved an amount $200,000 CAD for the project to start. The purpose of the Grant was to enable the National Focal Point (NFP) provide the necessary outreach for participating agencies in the network.

RATIONALE FOR GHASTINET

It was recognized that the main constraints that had impeded the sustained development and growth of science and technology information was inadequate financing, the absence of a cadre of highly trained manpower, the inaccessibility of foreign literature, as well as lack of equipment. Another constraint was the absence of a capability of repackaging science and technology (S&T) information to cater for the needs of farmers. There was also the problem of lack of coordination and pooling of information resources in science and technology; coordination is particularly important when funding is limited, to avoid unnecessary duplication.

To remedy these constraints, the Ghastinet project was designed to fit in with the Economic Recovery Programme (ERP), and with the nine key sectors of the nation's economy, namely; agriculture, industry and technology, water resources, health and environment, transport and communication, housing and public construction, geology and mining and socio-economics.

Components of Ghastinet

The Ghastinet project was made up of the NFP of the erstwhile Central Reference and Research Library of the CSIR and nine libraries as nodes representing key sectors of the economy already mentioned. There were special resource centres and agencies like the Ghana Standards Board, the Ghana Library Board and the Department for Library and Archival Studies. The project was managed by a Project Coordinator who was stationed at the NFP assisted by an 11-member Advisory Committee. The relation between the focal point and the nodes was purely collaborative.

Each sectoral nodal point consisted of a core library which was designated as the primary information coordinating body for that sector. For example, the Institute of Industrial Research library was the sectoral node for institutions in the industry and technology sector. This library was responsible for identifying other libraries or information units in that sector, and working with them so that information resources are shared among them effectively.

OBJECTIVE OF GHASTINET

The ultimate objective of the project was to establish a sustainable national network system for the identification, collection, storage, retrieval, repackaging and timely dissemination of science and technology information for various user categories such as research scientists, government planners and policy makers, public and private industrialists and farmers. It was to provide leadership in activities concerning S&T information including strengthening human resource development and institutional capabilities and establish linkages with regional and international databases and information centres.

COLLABORATION

A collaborative and decentralized network system was considered more appropriate to ensure growth and development of information services in the various sectors, with particular regard to locally generated information than a highly centralized system. The emphasis on collaboration and cooperation is based on the firm conviction that effective persuasion yields better and long lasting results than coercion.

FIRST PHASE – IMPLEMENTATION PHASE

The first phase of the project started in May, 1988 and ended in November, 1993. This was the implementation phase and the objective was to put in place the basic infrastructure and facilities that would enable the network to provide the necessary outreach for participating agencies in the network. The second phase was planned to emphasize on the promotion and marketing of S&T information services and facilities to maximize their use.

Specifically, the project aimed to achieve the following objectives within two years of the implementation phase:

(a) to develop an efficient system for the bibliographic control of indigenous S&T literature, with priority being given to agricultural and industrial information, and the energy aspects therein;

(b) to create computerized databases for: indigenous S&T literature, On-going research projects, High level S&T manpower, and Union list of S&T periodicals;

(c) to generate and produce from the databases, the following publications: Ghana Science Abstracts bulletin at regular intervals, Directory of scientific research projects, Directory of high level scientific and technical manpower, and Union list of scientific and technical periodicals;

(d) to identify and fill gaps in S&T literature collections, particularly journals and other standard reference materials;

(e) to promote by various means, the implementation of the network and its services.

ACCOMPLISHMENT

Most of the activities planned for the first phase and successfully implemented included the development of four databases of indigenous literature, on-going research projects, high level manpower and union list of serials. These were developed using the CDS/ISIS software. Hardcopy versions of all these databases were produced and distributed in the country.

- Ghastinet produced the *Ghana Science Abstracts*, a printed bulletin whose goals were to collect, document and disseminate indigenous scientific and technological literature from Ghana. The publication sought to 'provide a means of current awareness and bibliographic control of such materials for the benefit of the scientific community in Ghana'[8].

- To serve the needs of researchers, Ghastinet also published a Directory of Ongoing Research projects. This publication serves as a communication vehicle and speeds research by providing information on developments so as to minimise duplication of effort.

During the first phase, staff at the NFP were trained in the use of modern information technology and the facilities at the focal point was also improved. Various services were also provided to users among which are: E-Mail services, CD-ROM services, computer-based literature search services, desk top publishing services, and reprographic services.

The second phase which was to consolidate what was achieved in the first phase and to promote and market S&T information services could not get off the ground due to lack of funds. However, one of the nodes, with the support of the World Bank and the Government of Ghana is still functioning. This is the GAINS project.

- **GAINS PROJECT**

The Ghana Agricultural Information Network System (GAINS) is a World Bank/Government of Ghana sponsored project which seeks to bring together the fragmented agricultural research information in Ghana so that a greater impact will be made on research endeavour which will ultimately lead to a steady growth in agricultural production to the economic and social benefit of the country. It was also to facilitate the dissemination of agricultural information to policy makers, research scientists, lecturers, students and farmers. GAINS has its focal point located at Institute for Scientific and Technological Information (INSTI) and links libraries of all the agricultural research institutes of the CSIR, the Universities, the Ministry of Food and Agriculture and the Biotechnology and Nuclear Agriculture Research Institute (BNARI).

Other network goals include establishment of formalized inter-library loan services, a document delivery service, a union list of agricultural serials, circulation of journals contents pages, formal linkages with international agriculture information centres.

The project started in 1991 and it is still on-going though the World Bank funding has lapsed. A database of agricultural literature in Ghana, Ghana Agricultural Research Information (GHAGRI), has been created and distributed to members of GAINS. A bimonthly accession list is issued by the focal point aimed at bringing to the notice of researchers what information is available. A database has also been created which has all agricultural journals in the country. This is to facilitate information exchange and transfer of data among network members. Research scientists are in a position to know which libraries has what journal in a timely manner.
Services aimed at the transfer of information are provided by GAINS among which are: CD-ROM searches, electronic database searches, internet access, advisory services and literature search services.

- **FIN PROJECT**

The Forestry Information Network (FIN) project was developed by the Forestry Research Institute of Ghana (FORIG) of the CSIR and the British Council and is being sponsored by the Department for International Development (DfID) of UK. The project started in January 1997 and it is for a two-year period. The main objectives of the project are:

(a) to improve the quality of research;

(b) to strengthen the professional capability of researchers, trainers and policy makers in the forestry sector;

(c) to enhance their access to up to date published information and grey literature;

(d) to contribute to the sustainable use of the country's forest resources[9].

The immediate objective of the project is to provide targeted information to forestry researchers, trainers, practitioners and forestry-related professionals in forty institutions through the establishment of a forestry information centre at FORIG. The network also aims to track all forestry information published either in Ghana by Ghanaians or foreigners and about Ghana. It emphasizes the sharing of information through document delivery.

A major consideration in the development of any information system is the users. However, different users normally have different needs, therefore targeting the intended users is an essential first step in the process. A user needs analysis was therefore conducted over a 6 month period. The results from the needs analysis formed the basis for developing the network

Various services are conducted by the network aimed at providing current and timely information to users. These are: literature searches, document delivery, compilation of annotated bibliographies, photocopying services. E-mail services, Internet access and making potential users aware of collections, facilities and services that are available in an information centre.

- **STICH**

STICH is an acronym for Science and Technology Information Clearing House which is responsible for the collection, processing, storage and dissemination of S&T information for the benefit of small and medium scale producers and entrepreneurs[10]. This is an initiative undertaken by the then Social Science sector of the CSIR under a UNDP-sponsored project known as Capacity Development and Utilization Project (CDUP). It publishes a monthly current awareness bulletin *What is New in STICH?* which it distributes to industrial producers, users of small scale equipment, small business houses. Follow-up requests from clients are met by reproducing the relevant material. The intention is to encourage micro, small and medium scale producers to improve on the quality of their products and increase their productivity, apart from enabling prospective small-scale entrepreneurs to embark on new ventures. In this connection, a list of technologies developed within the CSIR and a list of technologies produced by Ghanaian S&T institutions that have the potential for adoption by entrepreneurs has been compiled.

- **TECHNOLOGY FOR LIVELIHOOD PROGRAMME**

This is a 30-minute Television programme launched by the CSIR/CDUP in cooperation with GBC-TV and aims at popularizing some simple technologies developed by the CSIR to enable small and medium scale industries and other entrepreneurs establish new industries, expand existing industries or simply to improve upon their operations[11].

OTHER INITIATIVES

There are other initiatives aimed at improving information availability and accessibility the CSIR is involved in.

- **INTIB**

INTIB is the acronym for The Information Networking for Technology, Investment and Business (INTIB). It is a UNIDO (United Nations Development Organization) sponsored project which has the objective to meet the information needs of industry, particularly the Small and Medium Scale Industries in Africa. Ghana is one of five African countries selected for this project of which INSTI is the national focal point. Through this globalized network of industrial and technological institutions, UNIDO hopes to stimulate demand at national level as well as from other continents. By so doing, fuller use will be made of existing information resources which have been grossly under-utilized. It is the conviction of UNIDO that this can partly be achieved

by marketing and promoting INTIB information services and products among potential and existing information users.

So far a national seminar has been held with the view to creating the necessary awareness of the existence of INTIB focal point in the country among institutions whose activities impact directly on SMEs. It was also to solicit the active cooperation of these participating institutions through the establishment of appropriate linkages to facilitate the formation of Ghana's industrial and technological information network.

- ILL/DD

The Interlibrary Lending and Document Delivery (ILL/DD) is a very useful programme which seeks to establish electronic network links with a regional and global approach in order to improve universal availability of publications and information. The Ghana project is a trial one and links all the five University Libraries and INSTI. The Coordinating Centre is at the Balme library, University of Ghana. Researchers within the NARS stand to gain from the facility. They can obtain full-length articles in a relatively short period of time.

CONCLUSION

Mr. Chairman, it would be seen from the foregoing that the CSIR library system has made significant advances in the acquisition and dissemination of information on technologies for entrepreneurial development in the country. I hasten to add, however, that no matter how significant the advances are, there is always room for improvement. This is particularly so since current and more relevant information is being generated throughout the world by the day. So also are the technologies that are used in sourcing and bringing the relevant information to the doorstep of the end user of the information. Obviously this calls for regular and adequate funding to enable the CSIR library system to be abreast with what is happening in the field elsewhere in order to be able to provide the needs of the Ghanaian entrepreneur on a constant basis.

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USING THE INTERNET FOR ACCESSING AND TRANSFERRING TECHNOLOGIES FOR ENTERPRENEURIAL DEVELOPMENT

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ABSTRACT

The transfer of technology is an important element in sustaining momentum in development planning. Most traditional means of transferring technologies are costly. They also have various human, cultural and geographical problems. In addition to the hiring of experts, books and journals there is the need for stronger links of communication which will make accessing and transfer of technologies easier, timely and at less cost to the farmer or entrepreneur.

The Internet as the technology of the day has a huge potential for arresting the lapses in the older and traditional way of extension work and transfer of technology whilst at the same time removing geographical and cultural barriers to information. The paper looks at the traditional modes of extension and the various applications which are facilitating easier access to information transfer via the internet. It also looks at the problems and constraints.

INTRODUCTION

Through the introduction of the Internet, providers and users of information have been able to

i) considerably shorten the timing process for the access and delivery of information,

ii) increase communication across various boundaries and

iii) share relevant information which can be utilized to achieve their objectives.

As a result of the Internet and various modes of Information Technology (IT) the world has been overwhelmed by what has been termed the information explosion due to the fast developments of electronic technology system and media equipment. This is giving a clear indication that the extension agents and farmers currently depending on the traditional means of information delivery systems for technology transfer cannot remain insulated or isolated any longer from the latest developments in information technology in order to save themselves from the explosion of information.

The definition of technology transfer, which limits it to specific activities like farming and industry, makes it rather narrow. The definition of technology transfer must transcend the physical factors of every activity to the importance

of behavioral changes as well as the total acceptance of the technology transferred. The definition must have two purposes; the imparting of technical advice on improving and co-ordinating various physical components of enterpreneurship for maximizing production and profits and the education of the key actors for bringing a positive change in their knowledge, skills and attitudes resulting in the recommended practice.

It is also important that technology transferred should be better and superior than the one to be replaced in terms of its profitability, level of production and lesser or minimal threats to the environment. In sum it must take cognizance of the human factor.

Again it is important to use every available means to transfer appropriate and timely information to help speed up entrepreneurial development which is a good medium for accelerating development

TRADITIONAL MODES OF TECHNOLOGY TRANSFER

BOOKS

The book has been the traditional source of technology transfer information. Most people prefer to have their own copies but in certain cases the prices of the book constrain some to acquire it. Some of these books are clearly marked do-it-yourself with clear illustrations and procedures on what needs to be done. Areas covered by such books include gardening, carpentry and some small-scale businesses. The critical constraint here is illiteracy of most rural farmers, time to read a whole book and adaptability of some of the concepts raised.

Other means for the transfer of technology include:

1. EXTENSION SERVICES

This system is an amalgam of extension agents, researchers and farmers. The information flow is generally from the researchers to extension agents and then to the farmers on one level. The other level is from the farmers to the Agricultural Extension agent and then to the Researchers. The system is generally dependent on training and visits. By their nature, the lack of logistics and funding act as serious limitations.

RURAL INDIGENOUS INFORMATION SYSTEMS

The main actors in this system are the farmers themselves. This system operates fairly well in farming societies. By this system farmers learn from their neighbours in an informal manner.

EDUCATIONAL INSTITUTIONS

Universities, colleges and schools constitute a real source of information for transfer of technologies in their outreach programmes. The most important

ones are the ones which are situated in the rural areas and who can relate to the farmers and entrepreneurs.

RESEARCH SYSTEMS

Research institutes, experimental stations and their networks do not only provide technology generation and testing but also contribute to the task of technology transfer. The transfer is done through meetings with extension agents, farmers and Agri-business firms.

INFORMATION TECHNOLOGY

Information technology has been acclaimed as the new tool for development with regard to the speed of gathering, processing, storage, retrieval and general management of information. With the convergence of the computer, audio, video and graphics a lot more is being achieved which hitherto was unachievable. General transfer of information has improved tremendously. Information processing which took years now takes weeks thanks to information technology and various systems in place.

Inspite of advantages it must be noted that installation and information technology comes at a price. Some of the key issues here include

a) Cost of computers

The cost of computers in most third world countries takes a huge part of the budget of institutions and organizations. In Ghana now a good pc with its accessories comes to about $2500

b) Power/energy for rural communities/ urban

The issue of power is now a critical issue since most rural communities do not have electricity. Even in the case of urban areas the recent power situation that affected the country is a key lesson for all planners. It goes without saying that without electricity the power of information technology will remain an illusion for many especially those who need it most. Again the issue of solar energy which has been touted as the saviour of rural communities in tropical Africa also comes with a price.

c) Language

The issue of language is also a problem with most Information Technology applications. The language of these applications has been captured in major languages like English French. German, Russian and Japanese. For the rural illiterate and those who do not understand these languages, the vast opportunities available will be a mirage.

Having mentioned these problems with information technology in is appropriate to mention a few of the systems for transfer of technology in Information technology.

Among others I will like to mention

i) Expert systems

The use of computerized knowledge base for obtaining technical advice by agricultural producers and extension agents for solving technical subject matter related problems. By this, information on any particular topic is stored on a computer diskette or CD-ROM. In using the system the user makes a series of choices till he/she ends up with the kind of result expected. This is of important value to an extension agent who does not have instant access to subject matter specialists or researchers. These services can now be found in most libraries. The Institute for Scientific and Technological Information (INSTI) of the CSIR has this facility

This comes closer to what has been termed as

ii) Virtual packages

This employ the use of Computer based CD-ROM for the transfer of technology and information between research stations, extension staff, farmers and other stakeholders. These CD-ROMs could be made available to our Ghanaian Extension workers.

iii) Telecentres

Telecentres are one stop shops where information seekers can go for various kinds of information. Sometimes they are referred to as virtual halls. There are facilities like faxes, telephones, photocopying, typewriter and computers. This phenomenon is new in Africa but it has been tried in Laos and Viet Nam. The United Nations Educational Scientific and Cultural Organisation (UNESCO) in association with the World Bank InfoDev project is planning to set up one in Accra.

With these systems the critical issues sometimes involve timeliness of the information. The CD-ROMs will have to be updated regularly. Also the CD-ROMS themselves can be expensive even for most governments. In spite of the expense CD-ROM writers are becoming cheaper and the Institutions that organise extension like DAPIT, GRATIS and the NBSSI could purchase and have their technology written for their frontline staff.

iv) The Internet

What is the Internet?

The Internet is defined as a huge link up of computers. It is also known as a network of networks. At the moment the internet has more than 20 million computers connected and the number keeps on increasing.

How does it work?

The Internet uses what is referred to as the Transport Control Protocol/ Internet Protocol (TCP/IP) and the HyperText Transfer Protocol (HTTP) to facilitate links through hyperlinks to various other computers. For a connection to the Internet the the minimum requirement includes;

- a computer with at least 16mb. of memory
- a modem of at least 28800kbps
- a phone line

Some of the notable applications on the Internet include;

a) Telnet

Telnet is an Internet application used for logging into other computers on the Internet. It is used to access lots of public services including library card catalogs and other kinds of databases. Simply it enables you to sit at a keyboard connected to one computer and log on to another remote one on the Internet. Once connected it takes you to the computer as if you are sitting right in front of it.

b) **File Transfer Protocol (FTP)**

As the name goes file transfer Protocol is the fundamental method of transferring files around the world. The distance between the two computers does not matter. FTP helps to move bigger files, software, databases and whole archives like climatic data, satellite images and other materials from the host machine to your machine.

c) **Electronic Mail (E-mail)**

E-mail is a replacement for the traditional postal service also referred to as snail mail. It is a faster and cheaper way of communicating today. As compared to fax or voice the e-mail affords the user a quick opportunity to get in touch with peers or experts for the transfer of information and technology. Email enables the user to send any file as an attachment whilst offering an effective method for storing any message so received.

d) **News groups**

This facility on the Internet enables groups of individual who share the same ideas to come together to discuss pertinent issues affecting them. These discussions are organised on subject areas. There are groups for pest control, animal husbandry, avi-culture, credit business, alternative sources of energy, world peace, sports and many others.

e) **Mailing list**

This is a list of recipients of particular types of mails or discussion groups. The rational is that the same mail is sent to XYZ. Any change made for one person affects all. This is achieved through a mail reflector. A member of the list subscribes to it and opts out when he wishes. Mailing lists are useful for many reasons. They engender discussions, disseminating of Information, electronic meetings and location of colleagues.

f) **The World Wide Web (www)**

The World Wide Web has become an important tool for searching for information. The web is replete with a host of database, which needs to be queried. Through a system of hyper links and the hypertext markup language, the user is able to search the whole world for topics covering every human endeavour using various search techniques.

Some of the ways by which information can be accessed on the Internet has been largely used by businesses - as static web pages which serve as electronic billboards for enterprises, or organizations to exchange documents through corporate intranets. The web page is presenting the organization to the public and normally contain information which would otherwise be in a brochure. Examples of typical pages are: FAO (www.fao.org) UNDP (www.undp.org) . There are those sites that present the latest technologies like CNN. In the CNN site www.cnn.com, information can be had from earthmatters, science and technology, business news; www.cnnfn.com

There are also a series of search engines which look for information on the internet. Some of these search engines include ;

- YAHOO (www.yahoo.com)
- EXCITE (www.excite.com
- INFOSEEK (www.infoseek.com)
- WEBCRAWLER (www.webcrawler.com)
- ALTAVISTA (www.altavista.com)
- There are other equally important sites for example: USDA-National Agricultural Library- http://www.agnic.org,
  International Post Harvest Network (HTTP://www.fao.org/inpho
  Electronic Global Forum for Agricultural Research (EGFAR) Http://wbln0018.worldbank.org/egfar/shared.nsf

The Internet employs various search techniques in looking for information. Presently there are about two important modes of searching. These are: subject search and keyword search.

SUBJECT SEARCH PATTERN

By this search pattern, the user of the internet goes to a search engine like Yahoo and picks a subject area and continues to make choices until he arrives at the desired topic of interest. For example a search for agronomic practices will have to begin from Agriculture.

KEYWORD SEARCH

This involves the selection of the appropriate keyword that comes closest to the topic or term that is needed. This has the advantage of reducing the time of search as well as limiting the result of the search. If these patterns are not used the user ends up hitting a lot of results, which would not come up with anything closest to what is expected.

The use of multimedia applications on world wide web through Graphic User Interface packages makes it even more interesting to appreciate information and materials obtained from the Internet.

The creation of web-pages is an important element for both seekers of information as well as those who need information. The design of the page form an indispensable part of the whole process. The inclusion of important facts as well as regular updates elevates institutions as well as aid technology transfer. Factual data, ease of reading and loading the pages once connected, easy search patterns are all attributes of a good site. All these help in marketing the institution as well as finding collaborators for projects which require international output.

In spite of the problems enumerated earlier with the Internet it appears that it is impossible to have the Internet. This is not true. New approaches have been found which will involve whole communities. For example rural communities who have electricity could come together and purchase a few computers, which will be linked, to the Internet. Educated community members could help with the translation of useful technologies.

In other situations common accounts for groups can reduce the cost of connections.

Advantages of using the Internet

i) Transfer charges for text over the Internet as store and forward e-mail between continents amounts to about two-hundredths of the transfer costs of the same words spoken on the telephone, and about one-twentieth of the fax charges. Of course its much faster than snail mail. In many developing countries, it is much more dependable. Hence, data networking facilitates basic communication.

ii) Medical expertise becomes accessible from anywhere. Why should the doctor reading an Xray or electrocardiogram have to be in the same location as the patient? Telemedicine can and will eradicate much geographic inequality in the availability of medical services.

iii) In a wider sense, data communication can eliminate the shortage or absence of magazines, encyclopaedias, books and databases in places where they should abound such as libraries, schools and Universities.

iv) A lot of work can be moved by data communications, and so can the results. Example India has many good and cheap software engineers, though the markets are mainly in the West. Data communication can put them in touch with each other because both software problems and smoothly running software are made of bits, only in different sequence. The same goes for a great deal of the administrative work from the west that is being done in low wage countries.

v) Access to a comprehensive repository of community service. On the internet there is access to databases which have been set up and are updated regularly.

vi) There are also applications that serve professionals in training as well as those who are continuing education. Training programs and other useful information are stored in World Wide Web servers that ensures that vast amounts of information is accessible to the extension worker.

vii) Teleconferencing cuts costs in linking experts to field staff.

viii) Linking people.

The promise of the Internet technology extends way beyond the examples given. Internet, essentially, is an enterprise information integration technology and such integration has tremendous implications for transacting cost savings for businesses.

CONCLUSION

The Internet has some shortcomings. It cannot take the place of face to face interactions. This is because face to face interactions are very good for reaching consensus on agendas. Because some unstructured discussions, cannot be carried in text form.

Sometimes the Internet leads to proliferation of junk. By this means prospective information users will have to browse through a host of materials before they can find what they want.

There is a greater need to prepare traditional extension workers and research staff for the emerging technology for information and technology transfer. This could be done through various in-service and external training. Another is to find ways of finding the needed funds to equip extension institutions with computers and other accessories and to provide the needed training for them to harness the power of these emerging technologies.

The point of this paper is not to abandon existing technologies but to look forward to integrating emerging technologies into older systems of transferring technology in a manner that will make us reap the full benefits of technology and to be able to sustain our development.

The cost of computers notwithstanding the Internet remains a powerful tool for accessing and transferring technologies for entrepreneurial development.

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DISCUSSION

Fatima Addy:	How do I benefit from the Internet since I am a farmer in the village.
Mr. Anim Dankwa:	Solar energy can be used to bring the farmers together. Rural farmers can come together to buy a solar system.
Prof Norman:	The technology is new and they are trying to satisfy the city before the rural area.
Mrs. Kordylas:	The banking system is intimidating. CSIR is also very intimidating to small scale industries and farmers. We should start looking at why they are intimidating.
Mrs. Andah:	Through the Technology for Livelihood programme, Food Research Institute received several requests. Some time ago we were not promoting ourselves but not now. We have already started the demystification process.
Prof. Norman:	It seems many of us are not seeing what is being presented on TV. Is it not possible for the CSIR to change the time so that ordinary people can view it? The information should be sent to the Deputy Director General in charge of the sector.
Dr. Prakah-Asante:	How much does it cost to create a web page?
Mr. Anim Dankwa:	¢10,000.00 per page.
Dr. Amezah:	MOFA is linking all the regional capitals. It is hoped that the districts will be linked in future.

RECOMMENDATIONS OF WORKING GROUPS

During discussion sessions on the first day, some issues which came up could not be fully addressed. Four working groups were therefore formed on the second day to further discuss these issues which were mainly concerned with constraints to agricultural development in general and small and micro enterprises development in particular. At the end of the discussions, the groups made various recommendations which are shown below as answers to questions which were used to facilitate the discussions.

WORKING GROUP 1

Membership

Prof. E. O. Otchere – Chairperson
Prof. B. K. Ahunu
Mr. E. O. Boateng
Mr. S.K. Dotse
Dr. J. A. Azu
Mr. E. O. Darko
Mrs. J. M. Kordylas
Mr. K. S. Nketiah

Question 1: What are the areas of training that small and micro-scale agro-processors need so as to improve their entrepreneurship?

There is the need to include in our basic educational system, training in personal and environmental hygiene as well as basic handling, preservation techniques and storage of farm produce.

A lot of the indigenous knowledge/information which exist in these areas should be collated and documented to serve as base material for any future publication e.g. text books.

The CSIR, Universities and various tertiary institutions in the various localities should be encouraged to carry out this assignment.

Question 2: How can we enhance their access to such areas of training?

There is the need to train people in entrepreneurship awareness, basic business planning, book-keeping, financing packaging technology, acquisition/selection and quality control. These training facilities are available at the Business Advisory Centres, trade associations and some research institutions.

To improve access to such training programmes entrepreneurs must form strong Trade Associations. The various information organisations must also devise effective ways of marketing their information products/services.

Question 3: What should be done to remove the various constraints to small and micro-scale enterprise development identified during the workshop to enhance the prospects for their development in the 21st Century.

- There must be a policy to guide the development of micro and small scale enterprises.

- Strong linkages must also be encouraged among industry and researchers to address problems relating to quality control, technology (processing and equipment) etc.

- It would be very beneficial for entrepreneurs to form trade associations to be able to get better access to finance from the banks.

- It is also beneficial for trade associations to engage in bulk input purchase e.g. raw materials and packaging materials to reduce their production costs.

- Some aspects of the VAT being implemented should be reviewed to enable the micro and small-scale sectors market their products through the big shops.

WORKING GROUP 2

Membership

Dr O. B. Hemeng - Chairperson
Dr. K.O. Marfo
Dr. E. O. Asante
Dr. K. A. Ameza
Mr. J.K. Odzeyem
Mr. J. Sam
Mr. R. A. Abass
Mr. S. Amoako
Dr. J. K. Osei

Question 1: What are the reasons for the spread of unproven technologies in the country?

1. Anxieties of organisations especially NGOs, to introduce technologies into the country that seem to have worked in other countries.

2. Impatience of organisations especially NGOs to wait for the long gestation periods of research.

3. The unscrupulous activities of some individuals and organisations to cash-in on the ignorance of unsuspecting farmers.

4. Lack of capacity of research and extension institutions to address the constraints associated with all the agricultural commodities that include livestock and fisheries.

5. Lack of efficient communication links between research, NGOs extension farmers and other stakeholders.

Question 2: What can we do to reduce the spread of unproven technologies especially crops such as sunflower, cashew to unsuspecting farmers?

1. There should be a policy or legislative framework that will monitor effective technology transfer.

2. CSIR is to be mandated to evaluate all technologies (imported and local) before disseminating to end-users.

3. There should be intensive education of end-users of technologies.

4. Attempts should be made to strengthen collaboration of research extension, farmers and other stakeholders.

5. Government should strengthen the capacity of research institutions and extension to deal with the constraints that face farmers. Adequate funding should be made available to these institutions.

6. The Ministry of Food and Agriculture (MOFA) should enforce photosanitary regulations to check the importation of planting materials especially cashew and sunflower.

7. The Ghana National Association of Farmers and Fishermen should be encouraged to mount training on technology transfer for its members.

8. The ratio between extension and farmers should be narrowed.

Question 3: What should be done to remove the various constraints to small and micro scale development that were identified during the workshop and enhance the prospects for their development in the 21st century?

1. There should be training for end-users. There should be specific training programs, for which funding should be sought.

2. Training programs should be publicised well ahead or in advance to enable as many small scale entrepreneurs to plan to participate.

3. Research institutions should provide liberal terms such as instalment payments for services rendered to small and micro scale entrepreneurs.

4. Small and micro scale entrepreneurs should be supported to form strong marketing associations/co-operatives in order to be able to secure input supplies and marketing of products at competitive prices.

WORKING GROUP 3

Membership

Mrs. A. Andah - Chairperson
Mr. E. Dawoe
Dr. J. P. Tetteh
Mr. W. Anim-Dankwa
Mr. K. Nyamekye-Boamah
Mr. E. Udofia
Mrs. E. Afriyie-Maldini
Mr. M. Awoonor-Williams
Mad. F. Addy
Dr. Oti-Boateng

Question 1: What are the reasons for the poor linkages among the major stakeholders – Agricultural and Industrial Development?

The group listed the major stakeholders which included:

1. Policy/Extension – MOFA

2. Research

   a. CSRI – ARI, CRI, FRI, PGRC, FORIG, SRI, SARI, OPRI, WRI

   b. GAEC
   Biotechnology and Nuclear Agriculture Research Institute

   c. Universities/Schools
   University of Cape Coast, University of Ghana, University for Development Studies, Kwame Nkrumah University of Science and Technology.

   d. Cocoa Research Institute

3. NGOs
   a. Development Oriented e.g. Technoserve
   b. Churches/Not for profit
   c. Community based organisations.

4. Farmers

5. Processors

6. Consumers

7. Support Agencies like
   a. Financial Institutions
   b. Standards Board
   c. NBSSI, DAPIT, GRATIS

On the Main Question the group assigned the following reasons for poor linkages.

1. Absence of effective National Agricultural Co-ordinating body to kink up all stakeholders which lead to a lack of focus and clear cut goals.

2. Lack of effective communication

3. Initial mandates for institutions did not make provision for promoting linkages

4. Lack of Prioritisation

5. Lack of adequate funding for subvented stakeholders.

Question 2: What steps should be taken to improve linkages among all stakeholders in Agricultural and Industrial Development?

1. A Co-ordinating body under the CSIR should be mandated to co-ordinate activities of all stakeholders to strengthen linkages between agriculture and industry.

2. There should be a clearly defined focus to enable all stakeholders play their respective roles to achieve set targets.

3. Ensure effective communication among stakeholders.

4. Provision of adequate resources to support activities of subvented organisation.

Question 3: What should be done to remove the various constraints to small and micro scale enterprises development that were mentioned during the workshop and enhance the prospects of their development in the 21st Century?

1. Training in Business Planning and Management

2. Training in Technological know-how

3. Access to adequate credit with favourable terms.

4. Government to create enabling environment which allow our local enterprises to grow, thrive and to become competitive.

5. Products standardisation should be enforced.

WORKING GROUP 4

Membership:

Dr. K. A. Owusu-Ansah - Chairperson
Mrs G. Nerquaye-Tetteh
Mrs. G. Marfo
Mr. V. Pinga
Miss A. Badu Asante
Dr. W. A. Plahar

Question 1: What should we do to promote the standardisation of equipment of agro-processing?

1. Assessment of all agro-based equipment in the system.

   These include equipment in the system, their processing and production efficiencies etc.

2. Estimation of requirements for processing technologies, production and packaging technologies.

3. Setting of standards guided by some international standards.

4. Promote the standards using all linkage channels available in the country.

In all these, there will be the need to involve Ghana Standards Board which has the legal backing to set and promote standards in the country.

Question 2: How can we enhance the competitiveness of small and micro enterprises in a liberalised economy?

Constraints:

1. Lack of appropriate skills
2. Lack of appropriate environment to work
3. High cost of labour
4. Lack of training
5. Lack of marketing techniques and sales outlets
6. Packaging problems
7. Lack of raw materials
8. No clear policy for SMEs development.

In addressing these issues, the group suggests there should be:

1. Capacity building in the research institutions to enable them set up training programs for the SMS clients

2. They should also take up research in the production efficiency, and impart substitution.

3. Government has made a move to help the Private Sector for instance through the Private Sector Development Program but the biggest problem is trade liberalisation.

   This is the problem expressed by AGI, CSIR and similar institutions. Maybe this forum will add its view to other agencies for government to protect the small and medium scale entrepreneurs by:

   i. Setting aside certain percentage of trade volume for Ghanaian entrepreneurs.

   ii. Reducing tax levied on imports for products produced by SMEs

   iii. By prescribing for production inputs manufacture locally.

The Government should also help the research institutions to enable them help the SMEs financially.

In that respect, the Group suggests that:

i. Subventions allocated for research must be released on time.

ii. The commercialisation policy of the government is premature and must be suspended. We say this because we fell that SMEs cannot afford to buy the technologies of the research institutions.

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