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Highlights of the Situation with Linkages among Researchers, Transfer Agents, and Farmers in Ghana

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ABSTRACT

The capacity of agricultural technology systems to establish and manage good linkages between researchers and technology transfer agents strongly influences the extent to which farmers end up gaining access to relevant and useful technologies. This report attempts to highlight the situation of linkages among researchers, transfer agents, and farmers in Ghana. Two examples of technologies (quality protein maize – QPM and conservation tillage) which are being transferred to smallholder farmers and how the farmers have embraced these technologies are discussed in this report.

Introduction

One of the biggest challenges now facing Ghana is to reverse the negative trend in agricultural productivity and the deterioration of the productive resource base. Access to more-productive and sustainable agricultural technologies by resource-poor farmers, who make up the majority of the farming community, is a prerequisite to meeting this challenge. For years, technocrats as well as donors have emphasized the importance of the policy environment, the availability of support services, research and extension services, and effective and sustainable credit systems.

Attempts have been made to improve the effectiveness of agricultural research at both national and regional levels. However, linkages among various players in the agricultural technology system such as farmers' organizations, extension services agents, researchers and non-governmental organizations (NGOs) were not considered until recently to be a key factor in ensuring farmers' access to new technologies.

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Most farmers in Ghana still produce food by subsistence farming. Their ability to adopt new technologies is constrained by their difficult economic conditions (high poverty levels), as well as their beliefs and culture. They are logically risk averse, and they do not respond to market signals, as do commercial farmers, even when reliable signals are forthcoming. Because of this, all aspects of their production systems and economic behavior must be taken into account when technologies are developed. Location-specific variables must also be considered. Thus, strong linkages are necessary if researchers are to be made aware of farmers' needs.

Literature Review

According to many technology system analysts, leadership from policymakers might not be sufficient to ensure integration of research and technology transfer. Policymakers, farmers, and donors must also exert pressure on the system to achieve that end (Sims and Leonard, 1989; Kaimowitz, 1991). Sims and Leonard (1989) asserted that in the absence of pressure or when "default incentives" exist in the system, researchers pursue their own interests and address issues unlikely to be relevant to the needs of farmers, particularly resource-poor farmers. This can only result in poor integration between research and technology transfer. Kaimowitz (1991) identified specific mechanisms that can be used to exert pressure. Policymakers can clearly define goals for institutions. By setting up joint campaigns and programs, eliminating constraints and gaps, and providing a system of sanctions, they can force institutions to work together. He cites the case of the Masagana 99 rice production program launched by then President Marcos in the Philippines in the early 1970s. The program was both an attempt to reduce political instabilities and a response to the need for large rice imports caused by several crop failures. The program was successful, and 3 years later, the Philippines became self-sufficient because of strong integration of research and technology transfer. Kaimowitz also points to the example of rice in the Dominican Republic. After years of pressure, rice yields more than doubled. Political pressure has often been exerted by authoritarian regimes or when a serious crisis arose (for example, Senegal's cowpea crisis in 1985). It should be noted that such tactics have several shortcomings: results may not be cost-effective, secondary effects may be overlooked, and emphasis may be placed on short-term problems or symptoms rather than on basic causes.

Donor agencies can also exert pressure because they provide an important share of resources. The mechanisms at their disposal include the provision of operating funds for specific activities, substantial individual incentives, and constant monitoring and evaluation. In many cases, for example, the Ghana grain development project (Annor-Frempong, 1988), the Dutch technology project (Engel, 1989), the Philippine farming system development project for Eastern Visayas (Bernardo, 1989), and the coconut project in Tanzania (Lupanga, 1990), integration improved because donor agencies applied these mechanisms. Monitoring and evaluation, as well as making future funding conditional on the success of on-going activities, have served as powerful ways of exerting pressure on donor projects encountered in case studies. Unfortunately, pressure is not usually sustained once the projects end (Kaimowitz, 1991). Funding of research or technology transfer, participation in decision-making bodies, and protests and unrest can be used as pressure mechanisms by farmers. The Colombian Rice Growers Federation (FEDEARROZ) is a good illustration. It has been successful in defining constraints and seeking solutions by attempting to bring together all the organizations working on rice. Farmer pressure has also been recognized as an important factor in the performance of agricultural technology institutions in Japan, Taiwan, and the Netherlands (Röling, 1989; Sims and Leonard, 1989).

According to Kaimowitz (1991), farmer pressure is stronger when farmers are affluent, politically influential, few in number, educated, and motivated to invest, and when they are already users of research-generated technologies. Unfortunately, case studies have shown that only large commercial farmers fall into this category. In many cases, pressure must be exerted by policy makers.

Technology system analysts believe that, given the current state of systems in many developing countries, farmer pressure must be created in cases where it does not exist. Röling and Seegers (1991) advocated inducing small farmers to apply pressure: they should have some control over research, technology transfer, public organizations in the technology system, and technology budgets.

The private sector can exert pressure through financing and contractual arrangements. Private companies can conduct their own research and thus provide pressure in the form of competition with government research. It is important to note that applying pressure does not necessarily lead to better performance. Managers may resist pressure when they perceive it as interference. Resources, in line with the system's mandate, must be available before pressure can yield positive results.

Agricultural Institutional Linkages in Ghana

Linkages among researchers, technology-transfer agencies, and farmers are far from effective in Ghana. This is due largely to the following factors.

1. Missing functions

In many cases, critical steps for generating and transferring technology are missing. One such step is seed multiplication; program formulation and priority setting are other critical steps. In some instances, institutions do not have formal processes for formulating their research programs or for setting priorities. As a consequence, researchers do not interact with technology-transfer agencies or farmers and cannot incorporate input from these two groups into the research agenda. The national research program is simply an aggregate of activities defined by individual scientists, activities that may have little or no relation to national development objectives, where they exist, or to farmers' needs.

2. Missing linkages

Most of the research systems in Ghana have significant areas of missing linkages, usually due to bureaucratic and institutional barriers, especially in cases where research and extension are based in different government ministries or are located in organizations with differing legal by-laws. In these cases, effective, continuous cooperation between research and extension is difficult.

3. Idle and ineffective mechanisms

Formal mechanisms for cooperation exist, but they are not being used, or are used so poorly that the intended objectives cannot be achieved. Mechanisms for formulating programs and setting priorities are typical examples. People involved in both research and extension are supposed to meet and formulate research programs together. However, during these meetings, researchers merely present their current results and their plan of activities for the following year. In other cases, research managers never even organized the meetings. There have been cuts in financing for linkages, and many linkage mechanisms, such as annual planning, technology review meetings, or publication of annual reports, no longer function.

4. Duplication of effort

Despite the seriousness of the financial constraints facing research and extension, many activities are duplicated. This occurs mainly in diagnosing farmers' problems, which has become "fashionable", and is a task all organizations involved in the technology-generation and -transfer process believe they must do, regardless of whether or not they have personnel with the necessary skills. Because donors make linkages with partners a condition of their research and extension projects, diagnosing farmers' problems is undertaken by all players involved in technology generation and transfer, and has become something of an end in itself.

5. Fluctuations in the use and performance of linkage mechanisms

Because donor resources are often made available to only one player in the system, linkage mechanisms may be put in place and may achieve a high degree of effectiveness for only a short period, often the duration of a project. As soon as the project is over, performance drops sharply. It improves only when donor resources again become available. Thus, fluctuations in linkages are due to the fact that most linkage mechanisms are related to donor projects; they are not likely to be financed from core resources because of limited funding.

6. Limited input from farmers in formulating research agendas

In Ghana, only a few formal mechanisms exist to ensure that farmers have an influence on research agendas. This is despite the fact that farmers' participation is generally recognized as one of the key factors for ensuring the success of agricultural technology transfer systems. Farmers' involvement is often limited to on-farm trials; however, there is evidence that involving farmers only in on-farm research does not allow them any real input into the research agenda. Nor does it allow them to become part of the decision-making process. Because of poor linkages between station and on-farm research, research managers often blame poor farmer linkages on the lack of traditional involvement of farmers in decision-making in public institutions, on the ineffective organization of farmers, and on their inability to participate effectively.

7. Research and farmers' organizations

Financial and intellectual efforts have been directed towards making public-sector research and extension in Ghana more responsive to the technology needs of small-scale farmers. Farmer-oriented research methods have underscored the importance of farmer participation in technology development and transfer. They also have increased researchers' awareness of farmers' conditions. Regardless, the institutional changes needed to ensure farmers' inputs in forming agendas and priorities of research and technology transfer agencies have not taken place in many cases. Examples from industrialized countries point to the importance of farmers' organizations in bringing about such institutional changes, primarily through their actions as pressure groups demanding greater accountability and responsiveness from research and extension agencies.

Experience indicates that small-scale, poor framers cannot continue to rely solely on the goodwill of public-sector organizations. Rather, organizations representing these farmers must be strengthened so that they can exert an effective demand for agriculture-related services and become active partners in the process of technological change.

In the past, farmers were encouraged to form cooperatives in order to have access to credit. These cooperatives are more or less community based. They are fragmented and have no regional or national chapters to coordinate their activities in order to exert the necessary pressure on the government or donors so that their concerns are factored into technology development and transfer.

8. Poor coordination between non-governmental organizations (NGOs) and national research organizations

In recent years, NGOs have emerged in Ghana and have become part of the agricultural technology transfer system. They supplement or complement the public extension system in some areas, and they compete with it in others. The relationships of these NGOs with public institutions, especially with research organizations, have not usually been cooperative. At best, NGOs maintain formal contacts with research. In some cases, because they question the relevance of the research agenda being implemented by public organizations, they conduct their own adaptive research.

As a consequence of the characteristics outlined above, the general results of agricultural research in Ghana can be summarized as follows.

1. Lack of relevant technologies produced by research

A significant number of technologies produced by research are rejected by farmers because they are not responsive to farmers' true needs. In Ghana, for example, farmers have adopted less than one-tenth of the crop varieties to which they have been exposed. One reason for this is that researchers tend to focus on yield improvement, while often other factors, such as early maturity and drought resistance, are more important to farmers.

2. Technologies remain on the shelf

Technologies remain on the "research shelf" simply because extension and farmers are unaware of their existence, or cannot use them. Research does not have the mechanisms for transferring technologies to extension, or existing mechanisms do not allow extension services to disseminate the technologies effectively. In some cases, the only channels for dissemination are annual reports (which do not have sufficient information on the technologies) or journal articles (which are generally not accessible to extension agents). In Ghana, because of financial problems, or simply neglect, an annual report might not even be produced regularly.

3. Absence of significant technological improvements in the subsistence sector

Most improvements have occurred in the commercial sector: in coffee, cocoa, rubber, palm oil, coconuts, pineapples, bananas, and cotton, but not in the subsistence sector such as maize, cassava, or other tubers.

An Overview of the Agricultural Sector in Ghana's Economy

Ghana's economy is not industrialized; it is largely based on agriculture. The agricultural sector's contribution toward the gross domestic product (GDP), employment, foreign exchange, and tax revenue in Ghana's economy is depicted in the table below. Note that growth fluctuated from 3.9% in 1999, to 2.1% in 2000 and 4.0% in 2001. Therefore, an average growth rate of 3.3% was recorded for 1999 to 2001.

Table 1. Agricultural growth in Ghana's economy since 1991.

Year	GDP (%)	Employment (%)	Tax revenue (%)	Foreign exchange (%)
1991	43.3	49.3	7.6	50.6
1992	41.4	48.7	9.5	41.3
1993	40.2	48.1	5.4	39.8
1994	40.8	47.5	10.6	40.3
1995	40.6	46.8	8.8	40.5
1996	40.8	44.9	12.2	43.2
1997	40.4	45.7	10.9	41.1
1998	40.5	47.6	12.6	43.1
1999	42.1	49.5	13.1	44.8
2000	43.0	50.5	13.4	45.7
2001	44.7	51.5	13.9	47.5

Agricultural Technology Development and Transfer in Ghana

In Ghana, the agricultural extension services under the Ministry of Food and Agriculture as well as some NGOs are at the forefront of technology transfer and information dissemination to farmers. Two of these NGOs are Sasakawa Global 2000 and the Adventist Relief Agency. The Centre for Biodiversity Utilization and Development (CBUD) is a governmental agency involved in the development/generation and dissemination of appropriate technology for farmers and end-users.

Although Sasakawa Global (SG) 2000 projects are not designed from one blueprint, they have similarities, especially in the technology transfer method employed (dynamic field demonstration programs) and the emphasis on improving food crop production. The crop demonstration priorities and programs vary from region to region within Ghana, are determined by the project, and involve working with national research and extension leaders and smallholder farmers. In recent years however, two specific crop technologies, quality protein maize and conservation tillage, have been taken up in most SG 2000 regions.

1. Quality protein maize (QPM)

Nearly all maize varieties have significant nutritional shortcomings for humans (and other non-ruminant animals such as swine and poultry) that eat maize-heavy diets. Tryptophan and lysine, two of the amino acids essential for human growth, occur in low concentrations in most maize varieties. Because of the low levels of these amino acids, humans are unable to metabolize all of the protein in the maize they eat.

Four decades ago, scientists at Purdue University of the US found that grains of a few rare maize varieties from the Andean highlands of South America contain sufficient tryptophan and lysine for good nutrition. Known as opaque-2 varieties, they were largely genetic curiosities. Their grains were dull and chalky, they gave poor yields, and they were vulnerable to attach from insects and diseases.

Breeding the genes for high protein quality into maize varieties required by farmers was a painstaking effort that took decades. The International Maize and Wheat Improvement Center (CIMMYT) in Mexico undertook the work. Because protein quality is not visible in the maize kernel, laboratory procedures had to be developed for testing the amino acid content of thousands of samples at each stage of the breeding process. Unfortunately, just when superior varieties were ready for release to farmers, budget cuts led to the suspension of the CIMMYT program, although a few breeders particularly in Brazil, China, and South Africa, continued the work.

Ghana's Crop Research Institute (CRI) played a crucial role in reviving what came to be called quality protein maize, or QPM. Starting in 1990, the SG 2000 country director at the time, Dr. Wayne Haag (a former CIMMYT maize breeder), worked with CRI maize breeders to evaluate advanced QPM experimental varieties from the discontinued CIMMYT program. One experimental variety, which had been improved for resistance to maize streak virus at the International Institute of Tropical Agriculture in Nigeria, was found to produce exceptional yields in multi-location trails in Ghana. RI released a selection of this breed in 1992. It is called Obatanpa, which means "good nursing mother" in the Ashanti dialect. Farmers in Ghana now grow this QPM variety on upwards of 200,000 ha because of its good yield; the better protein quality is a bonus. CRI has since released three QPM hybrids and has shared its QPM genetic materials and expertise with scientists elsewhere in Africa.

What began as a small QPM research effort in Ghana has now spread to a dozen African countries. PM varieties based on Obatanpa have been released for commercial production in Burkina Faso, Mali, Mozambique, and Uganda. Other QPM hybrids have been released in Ghana, Guinea, Ethiopia, Tanzania, and Zimbabwe. QPM varieties and hybrids will soon be released in Nigeria and Malawi. The Africa-wide "QPM movement" which started in Ghana has shown tremendous promise.

QPM is not produced through genetic engineering. It is not a genetically modified organism (GMO). Rather, it was developed from a rare, but naturally occurring, South American maize type, and has been improved using conventional plant breeding methods. It offers all non-ruminant animals, such as human beings, poultry, and pigs, significant nutritional benefits compared to maize possessing normal proteins.

2. Conservation tillage

Sasakawa Global 2000's work with conservation tillage also started in Ghana nearly a decade ago, and the technology has now spread to most SG 2000 project countries. A recent study by CIMMYT and CRI indicates that some 100,000 ha, involving 45,000 farmers in Ghana are now planted using conservation tillage systems. This work involves an effective partnership between national research and extension programs, a special smallholder development program of Monsanto, and SG 2000. This partnership model has been extended to Mozambique, Ethiopia, Malawi, Nigeria, and Tanzania.

Compared with conventional tillage, which involves turning the soil repeatedly with a hoe or animal-drawn plow or tractor, conservation tillage requires little or no soil disturbances. And it has many other advantages: farmers can sow crops sooner after the first rains, in effect gaining a longer growing season; crops residues left on the ground form a mulch that slows rainwater runoff from the soil surface and reduces erosion; through repeated mulching over time, soil organic matter builds up and water penetration and retention improve; in multiple cropping systems, turnaround times between crops are quicker; labor costs are lower because little or no tillage or weeding is needed; and more land can be cropped without significant added investment – an important benefit for capital-starved small-scale farmers.

Conservation tillage methods promoted by SG 2000 involve spraying herbicides for thorough weed control before planting. The dead weeds dry up and become part of the mulch. Farmers can then plant the crop without mechanical tillage. They open a small hole or thin trench through the mulch, deposit the seed and apply fertilizer (usually phosphorus and a minimum amount to nitrogen), and cover it. The plant residues remain undisturbed after sowing.

Mulch management is perhaps is the most demanding aspect of conservation tillage. Farmers must preserve the mulch by controlling brush fires and preventing livestock from feeding on crop residues. As with conventional tillage, crop rotation plays a very important role in breaking potentially damaging disease and pest cycles.

Over time, conservation tillage can raise soil organic matter content, increase carbon dioxide sequestration, improve soil structure, reduce weed and pest problems (in conjunction with crop rotations), and enhance nutrient mobilization.

Smallholder farmers gain significant labor-related and economic benefits. By eliminating traditional land preparation and much of the need to weed, a farm family can save 20 to 25 person-days of labor per hectare of land. This is especially important for the millions of Ghanaian farmers who do not have draft animal due to endemic livestock diseases such as trypanosomiasis and East Cost fever. For women, conservation tillage can provide a substantial reprieve from the backbreaking drudgery of their traditional tasks of hand hoeing and weeding.

By saving time and reducing labor and drudgery, conservation tillage opens new vistas of income-earning activities for smallholder farmers. Farmers can cultivate more land, even without access to draft animals. When conservation tillage is complemented with rainwater harvesting and storage techniques, the time saved from growing crops can be dedicated to value-adding or high-value activities such as the growing of fruit trees and raising of livestock or poultry, fattening beef animals, producing milk, butter, and cheese, or beekeeping for honey production, as well as grass cutter rearing and snail farming for the local and city markets.

In addition, the laborsaving features of conservation tillage can be especially important in countries where endemic diseases like HIV/AIDS and malaria are crippling farm families.

The main disadvantage or constraint associated with conservation tillage is the need to regularly buy herbicides for controlling weeds.

Processing Programs

For 8 years, the Integrated Technology Transfer Unit (ITTU) in Ghana and the International Institute of Tropical Agriculture (IITA) in Nigeria have collaborated in introducing agro-processing equipment designed for small-scale farmers.

1. Linking industry and agriculture

One aim of the agro-processing program is to strengthen the link between agriculture and light industry, which is weak in many developing countries including Ghana. In Africa, and for that matter Ghana, industrial development tends to be regarded as an area for heavy, capital-intensive industry or large private factories. However, agricultural commodities are the main source of raw materials for major industries. Opportunities exist in these areas for small- and medium-scale agro-processing entrepreneurs, but they first need to increase their productivity through more-efficient crop production to enhance crop processing with improved equipment and link it with better marking.

2. Continuous evaluation

As part of the process to improve the performance of locally manufactured agro-processing equipment, agricultural extension workers collect feedback from farmers and processors, which the ITTU and IITA analyze and use to modify the designs.

In 2001, a survey was carried out to assess the program in Benin and Ghana. The assessment revealed that equipment designed by ITTU and IITA has been widely used in these two countries since 1994.

The survey also found that, almost all ITTU- and IITA-designed equipment in the field is still in use and functioning, even after several years of use, proving its durability and easy maintenance. It was also found that the cassava grater and multi-crop thresher/thrasher are generally owned by groups of farmers. The cassava-processing equipment reduces processing losses by 54% and saves as much as 7% of the labor required. In contrast, individual entrepreneurs tend to own the wet-type grinders and the palm oil digesters, which can process oilseeds. Demand for oilseed products has encouraged individual entrepreneurs to invest in the machinery.

Post-harvest Losses

One of the main problems facing agriculture and, for that matter, smallholder farmers in Ghana is post-harvest loss. Presently, post-harvest losses stand at 51% of all foodstuffs produced in Ghana. This can be attributed to a lack of agro-processing and storage at the required level.

This is clearly unacceptable. Great efforts must be directed towards this area of activity in the agricultural system in Ghana. This will go a long way to reducing poverty levels of farmers and also making foodstuffs available year round at cheaper costs.

Conclusions

Quality protein maize varieties and conservation tillage have much to offer Ghanaian farmers and farmers in Africa as a whole. These and other productivity-enhancing technologies are to be brought to smallholder farmers through appropriate linkages among researchers, extension agents and other technology transfer agents, farmers and farmers' organizations, and non-governmental organizations.

The technologies are available, and farmers are eager to adopt them. However, the full benefits of these scientific breakthroughs cannot reach the farmers unless much greater efforts by the national government, local governments, and donor organizations are forthcoming. The major challenges are political and economic, not technical.

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