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Ghana's Tradition Makers

*Changing Patterns in Food Crops
Research, Extension, and Production*



Ghana's Tradition Makers



The personal fortunes of Kwaku Yamoah-Boampong, like the collective fortunes of his native Ghana, have been fickle to say the least—and the two appear to be intertwined. During the late 1970s, he tried to disentangle one from the other by emigrating to Nigeria. But whatever relief he and thousands of his countrymen found there from Ghana's economic troubles was relatively short-lived, and they returned en masse in 1983. Although the economy subsequently took a turn for the better, it was hardly prepared at that time for the precipitous arrival of nearly a million of its citizens.

Like many other "returnees," Kwaku, a teacher by training, eventually turned to farming on land that had belonged to his parents in the village of Atrunsu-Techiman in Brong Ahafo Region. The first year, 1984, was touch and go. Since Kwaku had no cash with which to get established and got no help from the banks, he had to borrow money privately at high interest rates. Good harvests in both the major and minor seasons, however, enabled him to pay off the loan and put aside enough cash to cover the next season's production expenses. About the time Kwaku's personal economy began to improve, so did the nation's in response to an

Maize is Ghana's most important cereal, providing food for rural and urban communities and income for the nation's farmers. According to Ministry of Agriculture estimates, about two-thirds of production is sold, much of it flowing into markets like this one at Kumasi.

economic recovery program. Inflation dropped from 122% in 1983 to 23% in 1986, and gross domestic product grew at a rate of 5.3% in 1985 and 5.6% in 1986.

Kwaku's prosperity was partly fortuitous: he had command of 10 acres of good farmland and was aided in his critical first year by favorable weather. But even with adequate rainfall, the year probably could not have been the success it was without a combination of three things: 1) improved maize and cowpea varieties released by the Crops Research Institute (CRI), 2) row planting, and 3) "two bags/two bags" (the rates, in bags per acre, recommended by the agricultural extension services for application of compound fertilizer and ammonium sulfate on maize fields like Kwaku's).

That he even had those options is largely the result of work done by the Ghana Grains Development Project (GGDP), which was set up in 1979 with the aim of improving production of maize, an important source of calories, and cowpea, an excellent provider of protein. The Project is being executed by CRI and the International Maize and Wheat Improvement Center (CIMMYT), with funding from the government of Ghana and the Canadian International Development Agency (CIDA). Other agencies taking part in the project are Ghana's Ministry of Agriculture (MOA) and Grains and Legumes Development Board (GLDB), whose extension staff are

heavily involved in the Project's on-farm work, and the International Institute of Tropical Agriculture (IITA), which is currently conducting research on cowpeas and will soon be working on cassava in Ghana under a separate project.

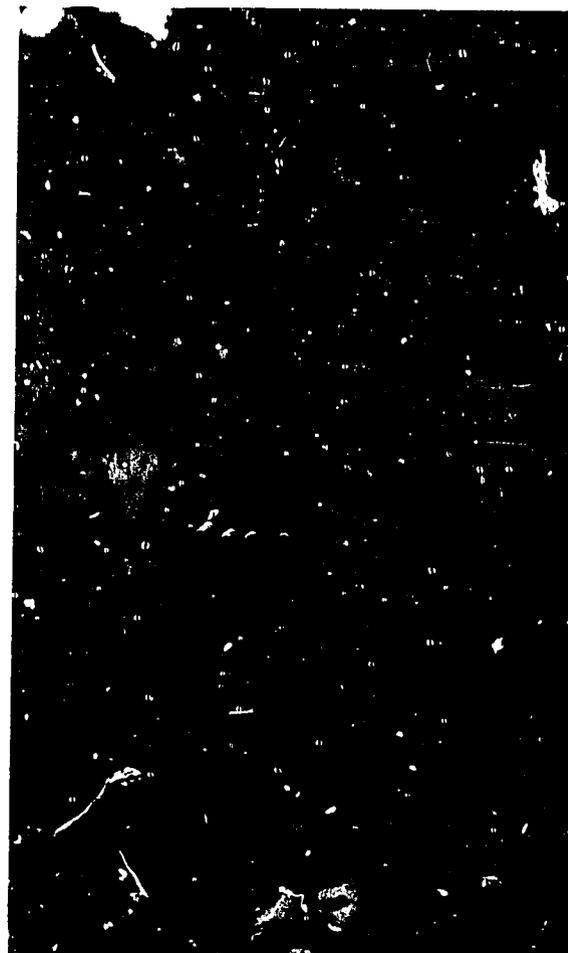
One of the most important lessons, to be sure, is that agricultural research, extension, and policy must be based firmly on the needs and circumstances of farmers.

This publication gives an account of how those organizations are acting in concert to help ensure that the country's current economic recovery is accompanied by some measure of development for its rural people, most of whom make their living from food production. In doing so it distills from the GGDP's experience various insights into agricultural research and extension, which could be applied more widely in Ghana and may prove useful to development workers elsewhere in sub-Saharan Africa.

One of the most important lessons, to be sure, is that agricultural research, extension, and policy must be based firmly on the needs and circumstances of farmers. Development is not a

likely outcome where scientists limit themselves to topics that are remote from problems faced by the nation's food producers, where extension agents have nothing concrete and reliable to offer (nor even the means of moving about the countryside), or where policy makers operate in a vacuum, cut off from the realities of rural life. But it can take place when researchers from various disciplines, extension workers, and farmers together focus their efforts on ways of making food production more efficient and when policy derives from information generated through the meeting of those groups.

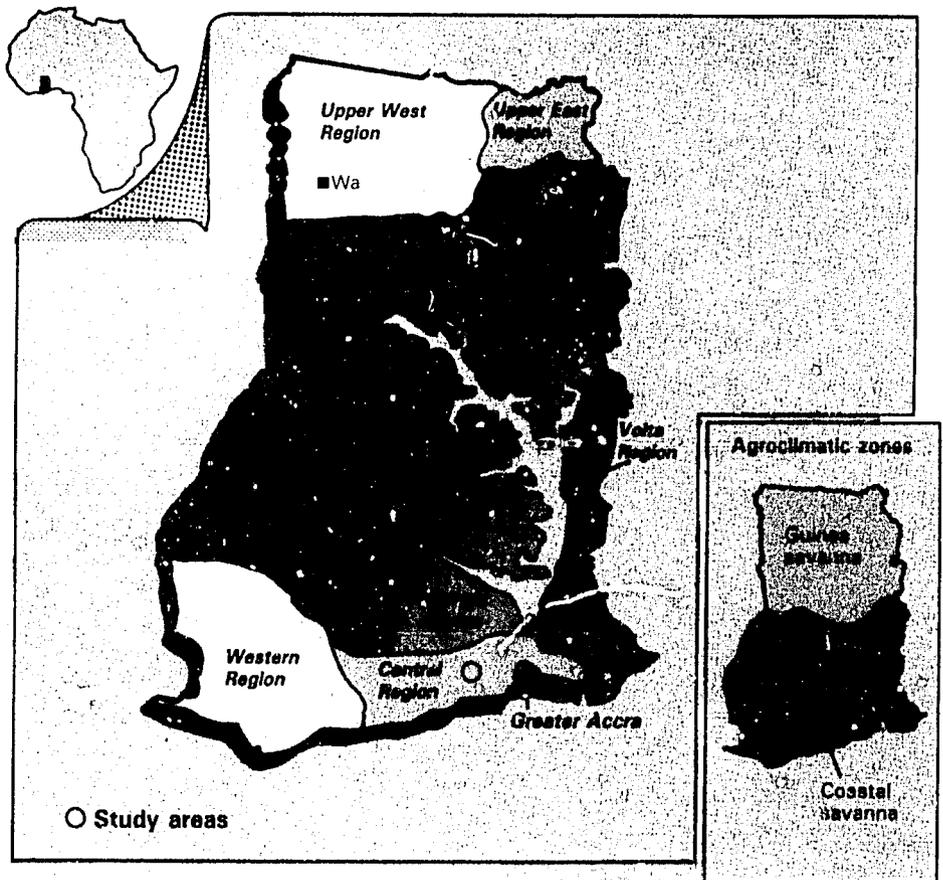
After a difficult homcoming, Kwaku Yamoah-Boampong, who returned to Ghana from Nigeria in 1983, has gained a measure of prosperity through farming in Brong Ahafo Region. Although he gave up a teaching career to farm, Kwaku still has plenty of lessons to share.



That approach is being put into practice in selected areas of Ghana and has been most successful to date in the transition zone (between forest and savanna), where Kwaku Yamoah-Boampong lives. In explaining what has been accomplished so far, this publication starts with the farmers, continues to the link between them, extension, and research, goes on to the content of current on-farm and experiment station research, and concludes with a discussion of issues affecting the longevity and ultimate impact of the GGDP's work.

Ghana's Farming Traditions

Ghana is not a very large or populous country (see accompanying table and map), and one can easily gain an overall grasp of its agroclimatic zones and of other features that are relevant to crop production. Closer examination, however, reveals tremendous diversity in farming traditions and in the social, economic, and physical circumstances that have shaped them. Moreover, those traditions are not just static bodies of farming lore but changing combinations of food production practices and strategies that are made by successive generations of farmers, as circumstances vary and as new information, technology, and genetic material become available. Changes often come slowly, though, and may not keep pace with increased demand for food.



Major political and geographical divisions in Ghana and the distribution of study areas where the Ghana Grains Development Project (GGDP) is concentrating its on-farm research program.

Selected statistics on Ghana's resources and crop production

Land area (million ha)	
Total	23.9
Agricultural	13.6
Under cultivation	4.0
Population (million)	
Total in 1988	13.3
Farm	7.0
Projected size in 2020	32.0
Crop production in 1987 (000 t)	
Maize	553
Cassava (net weight)	2943
Sorghum/millet	300

Source: Policy Planning, Monitoring, and Evaluation Department, Ministry of Agriculture, Accra, Ghana.

Monocropping in the transition zone

The exact shape of the farming traditions that emerge is determined to a large extent by the physical environment (obviously, the forest zone offers very different resources and opportunities from the savanna) and also by the ends they must accomplish. Take again the case of Kwaku Yamoah-Boampong, who lives in an area that is transitional between forest and savanna and that provides favorable conditions for farming. Over the last three years, he has grown maize as a monocrop during the major season (March or April to July) and in the minor season (September to November) has generally planted cowpea and vegetables. He and his

family do not eat much of what they grow but sell it, as do most maize farmers in the vicinity, and with some of the proceeds obtain cassava and plantain, yam, or cocoyam for making *fufu*, the preferred dish in their part of the country (see page 6).

The essentially commercial aim of Kwaku's maize and cowpea production account in part for his monocropping and for the entrepreneurial spirit in which he puts his resources to work. His attitude is that to make money from farming, he has to invest money: to hire a tractor for land preparation, purchase seed of improved varieties, obtain fertilizer and so forth. Various circumstances have contributed both to his willingness and ability to adopt such an approach. A great deal of research has been done on monocropped maize in Ghana during recent years. On the basis of this work, recommendations have been developed and thoroughly tested on farm, and these are being actively promoted by the extension services.

Maize-cassava intercropping

About a third of the farmers in Kwaku's area intercrop maize and cassava, a system that is even more widespread in the forest zone of southern Ghana. In one of the GGDP's study areas, for example, it is practiced by more than 90% of maize farmers during the major season. Since both maize and cassava are important parts of the southern diet, a portion of each crop is consumed at home, though most farmers also market a sizeable share of their harvest.

Adoption of improved varieties and other innovations has generally occurred at a lower rate in the southern forest than in the transition zone and for a number of reasons. Until a few years ago, less research had been done on the more complex maize-cassava system than on monocropped maize, so only recently have agricultural researchers been able to formulate and verify recommendations for the intercrops. In studying this

system, they have uncovered a number of specific circumstances that help explain why its practitioners might be less inclined to adopt improved technologies. For example, in the forest zone, researchers have found that intercropped fields frequently are cultivated for shorter periods than monocropped fields and thus lie fallow for longer periods; since soil regeneration proceeds more rapidly under

Continued on page 7



Ama Amponsah, who grows maize, cassava, and a variety of other crops in Ashanti Region, is literally her family's breadwinner.

A particularly common and (to the outsider at least) engaging feature of rural life in Ghana is the "tro-tro," a type of truck used to transport people, their goods and animals. By means of its brightly painted slogans, the tro-tro also conveys bits of traditional wisdom. "One Man No Chop" being an example. The phrase is intended to suggest that food, among other good things such as money and books, should not be consumed ("chopped") by one person only but shared among friends (Gyinaye Kyei and Schreckenback 1975). The unlimited application of this generous sentiment, however, is made difficult by Ghana's regional food preferences. Their power is suggested by the following comment by a resident

of Brong-Ahafo Region about the principal maize preparation of his southern neighbors: "To make an Ashanti man eat *kenkey* is to make him suffer."

To determine whether food preferences have implications for maize breeding, GGDP staff are testing improved varieties for their suitability in preparing certain maize dishes. So far, the results have been inconclusive. Nevertheless, researchers will continue monitoring consumer preference for their germplasm products from time to time since, like the cropping systems in which maize is produced, the methods by which it is prepared are both various and subject to change.

Two of the country's maize preparations are *kenkey* (of which two major types are Fanti and Ga) and *tuo zafi*. In the preparation of *kenkey*, maize grains are soaked for three days, milled or ground finely, and mixed with water to make a dough; most of this is allowed to ferment for three days and is then partially cooked, with constant turning. The cooked, fermented dough is mixed with a bit of unfermented dough and molded into balls. For Fanti *kenkey* (the type preferred among the Fanti-speaking people of Central Region), the balls of dough are wrapped in plantain leaves and boiled; with Ga *kenkey* maize husks are used for this purpose. The size of a ball of Ga *kenkey* sold in the market, a Ghanaian politician once said, is a sure indicator of how the economy is faring, although it is actually more a reflection of the price of maize. *Tuo zafi*, the dish preferred in northern Ghana, is prepared by drying the grain, milling or grinding it, and pouring the resulting powder into boiling water to make a thick porridge. Traditionally, *tuo zafi* has been made from sorghum or millet, but as the cultivation of maize has spread in the savanna, so has its use in the preparation of *tuo zafi*.

Both of these preparations, however, are scorned by the tui-speaking people of the middle belt of Ghana, who are major producers of maize but who stand by their *fufu* (a preparation of cassava plus plantain, yam, or cocoyam) and sell maize, mainly to southerners.



For Ghanaian women the rhythm of life includes an endless round of food preparation tasks, such as sun-drying ground maize for *tuo zafi* in the north and mixing dough for *kenkey* in the south.

fallow than under cultivation, the intercropped fields tend to be more fertile, making fertilizer application less advantageous.

It is also instructive to bear in mind one of the farmers' main reasons for intercropping in the first place, which is to obtain a steady and secure supply of diverse food items for their families, making the best use of the resources available. That is the foremost concern of Ama Amponsah, a farmer living near Mampong in Ashanti Region, whose management of her maize-cassava system reflects its food-security orientation in various

ways. She grows a wide variety of species (not just maize and cassava, but plantain, cocoyam, yam, and vegetables) in quite complex cropping cycles, and she plants them randomly, using in the case of maize a high number of seeds per hill.

Although she has heard about improved maize varieties and fertilizer, she has never tried them (see page 10). The reason is not that she is unfamiliar with the idea of investing money to make money in farming (her husband, after all, grows cocoa and other cash crops and manages them accordingly) but rather that she

tends to view such an approach as irrelevant to food production. What researchers hope to demonstrate to farmers like her is that they can accomplish either aim—production of maize and cassava for food or cash—more efficiently with appropriate improved technologies.

Maize-sorghum intercropping

Other equally complicated cropping systems are practiced in the savanna of northern Ghana under distinct social and economic arrangements and fairly harsh environmental conditions. The north receives less total rainfall than the south, and it is often distributed very unevenly over a single cropping season.

The maize-sorghum cropping pattern employed by the Hussein family at Taha near Tamale in Northern Region is among the more common systems, and their practices are fairly illustrative both of the system's functioning and its purpose (although they are not growing groundnuts, which is often a major component of the cropping system in their area). Land is abundant near their village, so they are under no pressure to extend the cultivation of a given field beyond three or four years. Moreover, they have access to tractor services, which they use for land preparation, making it fairly easy to abandon one field and move on to another. In the first year of a crop cycle, they plant yams in mounds,

With each successive year of maize-sorghum cultivation on the same plot, the men of the Hussein family near Tamale in Northern Region invest greater amounts of backbreaking labor in controlling grassy weeds. For that reason and because of a precipitous decline in fertility, they allow this plot to return to fallow and shift to another after three or four years.



scatter a few maize seeds around them, and generally establish borders of cassava to delimit the field. During subsequent years of cropping, they plant maize in rows during early June (assuming that the rains have come by then), with wide spacing between maize hills to make way for the sorghum, which is planted about a week later. As the maize develops and matures, the sorghum plants remain fairly small. In September, when the maize has reached maturity, the Hussein brothers bend the plants over, a practice that cuts off the flow of nutrients to the ear and accelerates its drying, while also permitting more sunlight to reach the sorghum plants. By that time the daylength is such that the rate of sorghum floral development increases, and it matures on residual moisture by November or December, some two months after maize harvest and the end of the rainy season. The combined yield of the intercropping is critical to enabling the family to stretch their food supply through the so-called "hungry season," which may set in around May or June, before the previous year's dwindling harvest can be replenished.

That is not a danger to be taken lightly, since, as Alhassan Hussein explains, their family is quite large. His father, a chief, has numerous wives, children, grandchildren, and other dependents and as head of the extended family is responsible for meeting all of their needs. He does so by drawing upon a common stock of food and cash, to which Alhassan, his brothers, and other family members contribute all of their produce or its proceeds. Obviously, they have found some

innovations (including the use of a tractor, row planting of an improved maize variety, and fertilizer application) to be compatible with achieving the social aims of their food production system.

Shaping the traditions

Apart from demonstrating Ghana's variety of farming traditions, the foregoing examples suggest that deliberately managed change is inherent to them. That such was the case long before agricultural researchers entered the scene is evident from some of the cropping systems we have examined, which contain numerous species that are not even indigenous to sub-Saharan Africa. The maize-sorghum system, for example, is a particularly clever combination of a 16th century import with an indigenous crop. (It is interesting to note that during the epoch in which maize arrived in Africa from Central America, sorghum completed the opposite journey, and farmers in both parts of the world hit upon the same opportunity for an efficient association of the two crops.)

Against that background of change, agricultural research has provided a more systematic approach to the development, testing, and introduction of innovations that can increase the pace of change. Farmers' responses have varied, with rates of adoption of recommended technology ranging from 0% for farmers like Ama Amponsah to 100% for others like Kwaku Yamoah-Boampong, who have made a headlong dash into modern agriculture, taking up nearly every recommendation that researchers have put forward.

Farmers are not unthinking manual laborers but tradition makers, who are adept at examining new options and often know best how to adapt them to particular circumstances.

Neither of those responses, however, is the prevalent one in the transition zone, where research and extension efforts have been most vigorous so far, nor are they likely to be in the forest and savanna, which are now receiving greater attention from the GGDP. On the contrary, farmers surveyed in a study on the adoption of new practices in Brong Ahafo Region clearly prefer a cautious approach involving "stepwise testing of the components of the recommended alternatives, rather than a sudden switch to the complete set of recommended practices" (Tripp et al. 1987). That approach is readily apparent in the data given in the accompanying table on the adoption by farmers of three recommendations. About half started off by adopting only one recommendation, a quarter adopted two, and the remaining quarter all three. Moreover, there is a very compelling logic to the sequence of their step-by-step adoption. Thus, of the farmers that began with only one recommendation, most went either for the variety or fertilizer, either

of which by itself would give them a profitable return. Those starting with two recommendations chose the pairs that interact significantly (variety and fertilizer, for example) and ignored the single combination that offers no interaction. The image of farmers that we form from such evidence is not of unthinking manual laborers who act predictably according to fixed habits and traditions (an image still preferred by a few agricultural leaders) but of tradition makers, who are quite adept at examining new information and options and who often know best how to adapt them to particular circumstances.

Barriers to change

Given that image of farmers, they are clearly a critical source of information about both the attractions of new technologies and the constraints that limit their adoption. Fairly typical are the comments of E. Ankoma Cudjoe, a

farmer living at Gomoa Mankessim in Central Region, who is conducting an on-farm evaluation of recommendations being developed by the GGDP for maize-cassava intercropping. He says that it is apparent even to passersby that the maize variety he is testing is better yielding than the local alternative and that its short height makes it less prone to lodging, or falling over.

At the same time, however, he and others are quick to point out serious obstacles to adoption of the improved technology, even by farmers who are convinced of its advantages. They complain that fluctuations in the prices of produce and a lack of appropriate technology for protecting stored grain make it difficult for them to obtain an adequate return on their investment, that fertilizer is often not available in sufficient quantities or at the right time, and that they cannot obtain loans for purchasing seed, fertilizer, and

other inputs. John Wobil, the GLDB extension officer responsible for Brong-Ahafo Region, aptly expressed the plight of these farmers in a Fanti proverb: "When the poor man sets a trap, he catches only frustration."

Research and Extension: Opening New Pathways to Change

Another proverb seems to point the way to a solution: "If you wish to speak with God, you must talk to the air." In the context of the conversation, this remark suggested that to obtain assistance from the powers that be you must convey your message to their representative. There is obviously a note of skepticism in the saying as well. Since farmers have little confidence that their requests will be granted, they consider the exercise about as effectual as "talking to the air."

So, wherein lies the solution? At least partly in the efforts of the GGDP to establish an on-farm research program through which farmers can be heard and have their comments acted upon in a search for solutions to production problems. And if the approach the Project has taken proves to be long-lived, its impact could be at least as important as the technologies being developed at CRI. For, it would provide not only solutions to individual production constraints but an efficient means of advancing the country's agricultural development in the future.

Sequence of adoption by farmers in Brong-Ahafo Region who adopted three components of a recommended technology package

One recommendation	27	50.9
Fertilizer	13	24.5
Improved variety	10	18.9
Row planting	4	7.5
Two recommendations	13	24.5
Row planting and fertilizer	9	17.0
Improved variety and fertilizer	4	7.5
Improved variety and row planting	0	0.0
All three recommendations	13	24.5

Source: Tripp et al. (1987)

Continued on page 11

The notion suggested by this "tro-tro" slogan—of men as providers and of women as consumers of family resources—has been one of the underlying assumptions of many agricultural development projects. As a result, they have tended to direct their technologies, messages, and services primarily toward men, while virtually ignoring women's role in farm enterprises, their contribution to family income, and their potential for bringing about—or being harmed by—technical change. The error both of the assumption and its consequent practice is made apparent by the circumstances of women like Ama Amponsah, who is her family's main food producer—literally its breadwinner.

After her husband has cleared land for food production (which he does in addition to managing cocoa and other cash crops), Ama carries out all subsequent operations in their maize-cassava system, including planting, weeding, and harvesting. Since she has heard about but not adopted any of the improved practices pertaining to those operations (even though they are being actively promoted by the extension services in her district of Ashanti Region), one wonders whether the extension message is being conveyed to her adequately.

Project staff have taken several steps to ensure that women are not bypassed as food production is altered through technical change. For example, the field days conducted in conjunction with demonstrations have been attended by large numbers of women, and the results of a study of technology adoption in the Brong-Ahafo Region suggest that female maize farmers have

adopted the recommended practices to about the same extent as men. The study also indicates, however, that there is little correlation between attendance at field days and adoption of technology. This is not a very surprising outcome considering that, in addition to conducting field days, the GLDB and MOA extension officers have many other contacts with farmers, including frequent conversations with individuals or small groups. It is precisely under the latter circumstances that women are liable to be neglected in the exchange of information. Project staff note that, on the occasions when they have deliberately included women in their discussions with farmers, women have tended to defer to their husbands and offer few opinions of their own. A further difficulty in obtaining women's views is that private conversations between a male extension officer and female farmer are not generally considered proper, and this communications barrier is considerable since almost all extension officers are men.

The preponderance of men in the extension services may decrease, however, as a result of measures now being taken by the MOA. The most important consequence for women is that they will no longer be relegated automatically to home sciences but will receive

training and responsibilities in other areas, including crop production. In 1988, for example, the production courses offered by the GGDP for extension officers were well attended by women. According to the Project's training coordinator, Collins Osei-Kwabena, the widening role of women in extension could help increase the rate at which production of cowpea (traditionally a northern crop) is expanding in the south, since former specialists in home sciences will bring to the task a knowledge both of cowpea production and utilization. In general, as women become more fully involved in the extension of crop production practices, female farmers will have a better guarantee of receiving adequate information on improved technology and opportunities to express their own views about it.

 Are these two generations of food producers—Ama Amponsah (foreground) with her mother and sister—being overlooked as new agricultural technology comes to the Ashanti Region?



The evolution of an on-farm research program

Almost from the GGDP's inception, a large part of its work has consisted of on-farm research, the agenda and organization of which have been shaped by particular circumstances in Ghana. It is important to bear in mind, for example, that the Project operates in a complex institutional environment, in which responsibilities for distinct, but mutually dependent, activities reside with different organizations whose circumstances and effectiveness vary. As a consequence, Project staff have adopted a flexible approach to the organization of on-farm research, extension, seed production, and other key activities, taking into account the ability of participating organizations to do a given job at a certain time and place.

In doing so Project staff have worked hard at strengthening ties that previously were somewhat tenuous, particularly between research and extension. Administratively, the two are separate, with research in the Ministry of Industry, Science, and Technology and extension in the Ministry of Agriculture. That is not an uncommon arrangement, however, and in fact it offers



Extension officers like Owusu Kwarteng, who is responsible for activities of the Grains and Legumes Development Board (GLDB) in Ghana's Ashanti Region, are among the contributors to change in the country's farming traditions. The farmer with whom he is talking has already shifted from random to row planting. And if Owusu's explanation is convincing enough, she will start using her cutlass to gauge the recommended interrow distance for maize planting and a sighting pole instead of string to keep the rows straight.

certain advantages and can be effective. But it does require that research and extension make special efforts to coordinate their activities through on-farm research and related work.

A second circumstance determining the emphasis of the on-farm research program was that it began at a time of extreme economic difficulties, perhaps the worst Ghana has ever experienced. Thus, the Project was under considerable pressure to achieve quick results, whereby it could provide some immediate assistance to farmers, demonstrate the value of investments in research and extension, and thus improve the likelihood that these activities would be adequately supported over the long term.

In pursuit of those objectives, the Project initiated a program of farm surveys conducted by CIMMYT, GLDB, and MOA staff in four of Ghana's key maize production zones and on-farm trials carried out nationwide by staff of CRI, GLDB, and MOA. By such means the Project was able to identify the primary constraints of maize production and within a few years to formulate and test a set of recommended practices. These were made available to farmers through demonstrations, which compared the improved practices with the farmers' and were conducted first by extension officers of the GLDB and later by MOA staff as well. Analysis of the results over several years has shown that the recommendations for variety, planting, and fertilization give an increase of about 1 t/ha over the farmers' practice (see table) and generally offer them a very attractive economic return. The demonstrations also accomplished their purpose as extension tools,

contributing to high adoption rates in the Brong-Ahafo Region, according to the results of the adoption survey mentioned previously.

That the recommendations were most widely adopted among farmers that monocrop maize was predictable. Project staff had decided from the beginning to focus initially on monocropping, first, because it is the simplest of Ghana's various cropping systems and therefore the easiest with which to make rapid progress and, second, because it is practiced all over the country, though mostly in the transition zone that extends across Brong-Ahafo. At the same time, however, the Project initiated research on intercropping, mainly a maize-cowpea system found in northern Ghana, since those are the two crops with which the Project is primarily concerned. In addition to studying that and other maize-legume combinations, researchers subsequently turned their attention to maize-cassava intercropping, which is practiced in southern Ghana, and soon will be working on maize-sorghum in the north.

A focus on complex cropping systems

The shift in emphasis to intercropping was made possible by various circumstances and led to several changes in the way the on-farm program is organized. One crucial development was the return of growing numbers of Ghanaian research staff who had been completing their master's degrees or doctorates abroad and the completion by additional Ghanaian staff of in-service training at CIMMYT and other institutions. Previously, much of the research load had been borne by the single CIMMYT agronomist (Greg Edmeades) in the Project during phase I, which ended in 1983. By the middle of phase II, the Ghanaian complement was large enough that a sizeable portion of the Project's specialists could be divided into various interdisciplinary research teams under the coordination of the two CIMMYT agronomists (Roberto Arias and Mike Read) who have been involved in the Project during phase II. By that time, too, there was a sizeable group of experienced GLDB and MOA extension officers, whose growing participation in the on-farm program has permitted better supervision of trials over larger areas.

Results of verification trials conducted across Ghana's transition zone
Ghana's transition zone

	1980	1981	1982	1983	1984
Farmers practice	1780	1880	1580	1950	1680
Recommended practice	3150	3200	2500	3050	3450
Difference	1370	1320	920	1100	1770
Number of sites	21	71	77	93	69

Source: Tripp et al. (1987)



Intercropping of maize and cassava is one of various practices that enable Ghanaian farmers to make efficient use of their limited resources in securing a steady food supply. The GGDP has nearly completed development of a set of recommendations that should increase the productivity of resources that farmers commit to this farming system.

In seeking to develop recommendations for various cropping systems, Project staff are concentrating on six study areas, which are representative segments of larger areas in which farmers' production systems, circumstances, and problems are, if not uniform, at least broadly similar. In the Central Region study area, for example, most farmers intercrop maize and cassava, whereas around Tamale, the cropping systems include maize and legumes or other cereals. The selection of study areas has also been governed by several other

considerations: the need to cover all of the country's major agroclimatic zones, a desire to distribute Project efforts equitably among regions, and the location of the most experienced, enthusiastic, and effective extension officers.

The research carried out in a study area is coordinated by an agronomist and economist, who draw upon the services of colleagues in their own and other disciplines and work closely with the extension officers responsible for on-farm trial management. At the outset of its work in a given study area, this interdisciplinary group conducts informal and/or formal surveys. The former involve extensive discussion with farmers and observation of their fields and the latter a more rigorous effort to quantify certain features of farmers' operations. An informal survey recently completed by Project staff in a new study area around Wa, Upper West Region, was the first conducted entirely by Ghanaian staff, with no participation by CIMMYT or IITA agronomists and economists. Together, the two types of surveys enable researchers to accomplish various purposes:

- Characterize farmers' socioeconomic conditions and their primary cropping systems
- Identify major constraints to production
- Decide whether technologies are already available that could alleviate some constraints
- Identify new opportunities for research

- Determine what other organizations are working on agriculture in the area and whether they would be willing and able to participate in the on-farm program

On the basis of that information, the agronomist and economist, with assistance from extension officers and other specialists, design a program of on-farm research, supported by studies conducted at one of CRI's experiment stations. The purpose of the latter is to gather basic biological information about alternative practices under conditions permitting adequate control of several factors. The on-farm trials, on the other hand, are intended to determine the advantages of improved technology under farmers' conditions and therefore require their direct participation.

If the study area team determines that they already have technologies that could benefit at least some farmers, these are tested in verification trials and shown in demonstrations, as are the new technologies developed subsequently through the combined on-farm and experiment station research (see figure, page 14). In organizing these trials, the Project recently tried a new approach called "adopt a farmer," in which extension officers give the participating farmers technical advice and some logistical (but not financial) assistance in obtaining seed and fertilizer for the demonstrations. About 50 maize farmers took part in the 1988 major season, and a similar program for cowpea farmers is planned for the minor season. The trials provide sites for field days, at which farmers can express their views on the improved technology.

Researchers adopt farmers' recommendations

It is tempting for researchers to give only lip service to the importance of listening to farmers, then to essentially ignore what they say, and develop the kinds of cropping systems and practices that researchers would adopt if they were farmers. But that has decidedly not been the case in the GGDP, and specific comments made by farmers have altered both the emphasis of the research programs and the content of the recommendations.

One of the criticisms that farmers most frequently recite is that the improved maize varieties are more susceptible than the local ones to insect damage once the grain has been stored. The problem, according to Baffour Badu-Apraku (maize breeder and joint coordinator of the Grains Project),

is that the husks on a small percentage of the plants of improved varieties tend not to cover the ear as completely as they should and are consequently more easily infested by weevils and other insects while the crop is still in the field. The infestation spreads to other ears when the maize is stored in cribs, which by the nature of their construction are subject to even further insect infestation. The response, says Badu-Apraku, has been to select intensively for improved husk cover in the maize breeding program and to initiate studies comparing various chemicals as well as local materials for their effectiveness in controlling storage pests of maize and cowpea.

Another of farmers' suggestions that was put into practice had to do with the timing of fertilizer

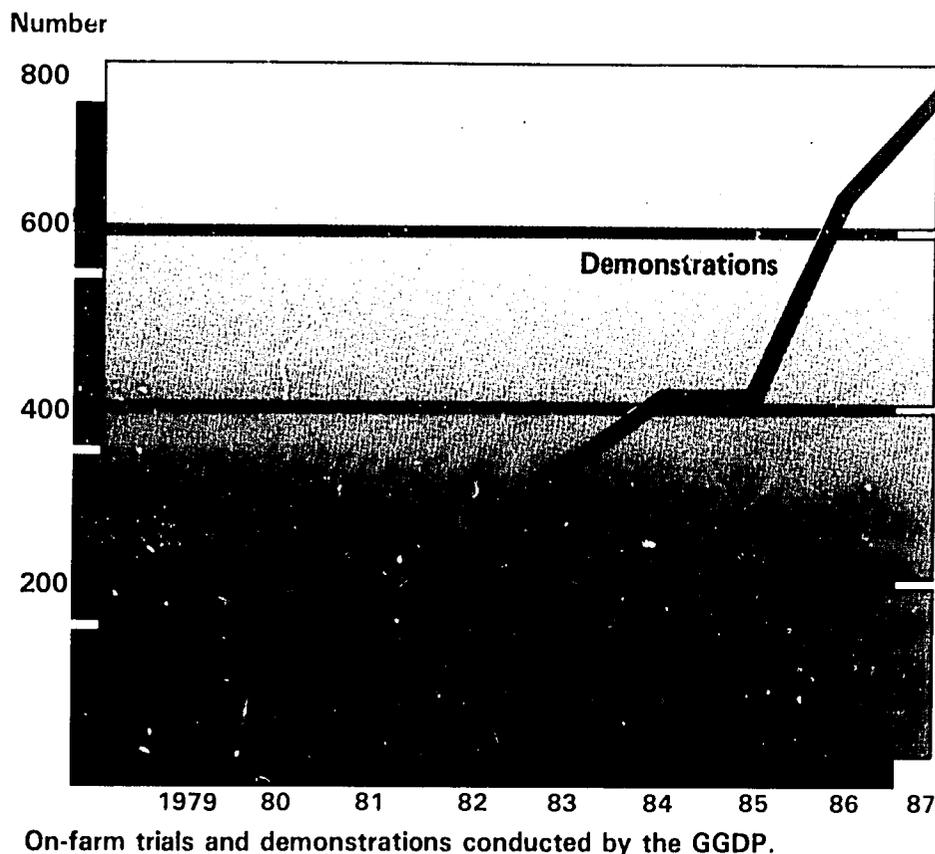
Just as researchers and extension workers are listening more closely to farmers these days, the farmers in turn are paying more attention to them.

application in maize. Previously, it had been recommended that starter fertilizer be applied at planting, but farmers preferred to delay application until two weeks later. They argued that this delay reduced the heavy demand for labor at planting and gave them time to determine whether the rains and other conditions would permit the crop to become well established and thus whether the investment in fertilizer was even warranted. Upon comparing fertilization at planting and two weeks afterwards, researchers found virtually no difference in the effect on yield and so promptly adopted the farmers' recommendation.

Gaining confidence and earning credibility

One of the pitfalls for researchers that work largely within the confines of their experiment stations is that they have little contact with extension, except on occasion to "hand down" new technologies for dissemination among farmers. Much experience in developing countries has shown that this agricultural version of the "trickle down" theory is a poor approach to moving technology.

In searching for an alternative, the GGDP has learned that extension officers are most likely to obtain the necessary information from farmers and persuasively present





recommendations to them if their work is closely tied to the research program. The exact division of responsibilities between researcher and extension is a somewhat controversial issue in the international discussion of on-farm research. But as far as Project staff are concerned, the question of whether a research program should dabble in extension or whether an extension program should meddle with research is irrelevant. What matters is that someone take the initiative to ensure that these two groups communicate with one another effectively.

That is a task in which the Project has made a large investment, one that is paying sizeable dividends. The most significant benefit accruing to participants in the GGDP is increased credibility in the countryside. Just as researchers and extension workers are listening more closely to farmers these days, the farmers in turn are paying more attention to them, mainly because the Project has something to offer as well as a structure within which farmers themselves can test and discuss new technology. Moreover, the researchers are continually generating new options and information, on the basis of which they can modify recommended

practices. Those steps keep extension personnel from getting "tired of singing the same old song," a danger CIMMYT agronomist Greg Edmeades cautioned against at the outset of the Project and which would seriously erode the confidence and credibility that GLDB and MOA have gained among their clients.

Working with a research program that is responsive to farmers' needs and able to develop appropriate technology for meeting them has made a big difference to Owusu Ansah, MOA extension officer in Mampong. In his district he has become so well



Given a reliable set of information, adequate mobility, and effective means of examining new practices with farmers, extension officers are more strongly motivated to bring their personal talents to bear on the task of transferring technology. GLDB extension officer Owusu Mensah, for example, combines instruction with entertainment, partly by using proverbs to drive home points about crop production practices.

known and respected, partly through his frequent visits to on-farm trials and presence at field days, that rare is the week when a farmer does not stop him as he passes by on his motorcycle to ask a question or even offer a spontaneous dinner invitation. Ansah also derives satisfaction from the way in which the on-farm program is conducted: researchers consult him about the design, scheduling, and location of the research trials, visit the trials with him a few times in the course of the growing season, and are on hand at harvest to discuss the results with him and the cooperating farmers.

The stimulating circumstances of their work have given Ansah and other GLDB and MOA extension officers a high degree of motivation that would be difficult for them to muster if they lacked such support and that helps explain why they are doing imaginative rather than perfunctory work. One area in which some extension officers (such as J.W. Arkorful, the GLDB officer responsible for Central Region) have made special efforts is in the coordination of work done by GLDB and MOA extension staff, which has contributed much to the efficiency of on-farm research in various regions. Adequate support and high motivation also help account for the GLDB's willingness and ability to take on the additional

responsibility of seed production, which does not normally fall within the realm of extension. That activity, according to John Koampah, deputy director of GLDB, is an important source of revenue for supporting other extension work, and it gives his staff the satisfaction of being able to contribute directly to meeting the growing demand among farmers for improved seed (see figure).

Staff development

None of the developments described above—the evolution of a nationwide on-farm research program and the growing confidence of researchers and extension officers—would have taken place if the GGDP had not established from the start a diverse and systematic program for training Ghanaian staff at all levels. The success of that program in turn depended upon

the existence of a sizeable pool of talented people, many of whom had already received training through Ghanaian universities, government agencies, and previous development projects and were anxious to grow as professionals.

Three types of staff development were initiated at the beginning of the Project and have continued up to the present: 1) graduate study, 2) in-service courses on specific areas or topics of research, and 3) in-country training, largely for extension officers.

The Project has made a sizeable investment in augmenting the country's research capability by sending some staff for graduate training in various fields, including plant breeding, agronomy, agricultural economics, entomology, seed production technology, and biometrics. During phase I six people earned

As part of the training program organized by the GGDP, John Koampah (right), deputy director of the GLDB, travelled to CIMMYT headquarters in Mexico for a one-month stay as a visiting scientist. While there he participated in a course on maize seed production (a primary task of his organization) and acquired, among other skills, the ability to use a chemical test for determining seed viability.



master's degrees, five of whom went on for their doctorates in phase II. An additional eight persons obtained master's degrees in phase II. Although all of the degree candidates went abroad for their graduate studies (to Canada, the USA, and UK), some carried out research for their master's or doctoral theses in Ghana or at IITA headquarters in Ibadan, Nigeria.

During the 1970s seven Ghanaians participated in five-month courses at CIMMYT on maize improvement, crop management research, or experiment station management, and others took part in short courses at IITA on maize and cowpea production, among other topics. Thus, by the time the Grains Project began in 1979, the national program already possessed a core of technical staff to help initiate the research program, particularly its on-farm component. As the program expanded, this type of training was much intensified. By the end of phase I, 27 people had taken part in courses and in phase II another 38 at CIMMYT, IITA, the University of Guelph in Canada, University of Reading in the UK, and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India.

The kinds of skills acquired in those courses, along with much additional knowledge generated by the GGDP's own activities and experience, is shared each year with growing numbers of GLDB and MOA extension officers through in-country courses coordinated by the Project's Training and Communications Unit (see page 18). One objective of those courses is to keep

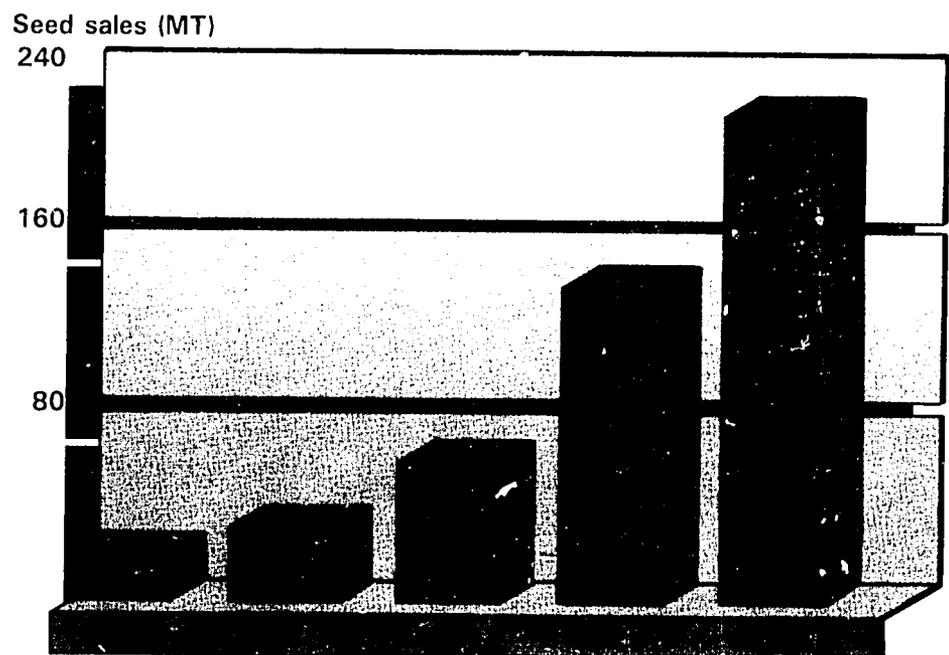
extension staff well informed about any changes in the recommendations for maize and cowpea production (which are published in an annually updated booklet) and about the latest developments in the research programs for these crops. Another aim is to train extension officers in conducting on-farm trials or demonstrations and in organizing field days and other activities intended both to promote the adoption of improved technologies by farmers and obtain their comments on these innovations. In addition to being an effective way of imparting skills and knowledge to a large number of staff, the courses have had the more profound effect of building and continually reinforcing vital links between farmers, extension workers, and researchers. In view of the importance of that contribution, the GGDP has expanded and improved its in-service training by making it the

full-time responsibility of two staff, providing extensive training for these trainers, and by obtaining input from training and extension specialists at the University of Guelph.

Agricultural development as a national project

A distinctive feature of the in-country training and of the extensive research that puts content into the training is that it all revolves around a little green book, which, despite its unassuming appearance (soon to be much improved), represents a rare and impressive achievement. It is the GGDP's *Maize and Cowpea Production Guide for Ghana*, which has become the authoritative source of information on its subject, not just within the realm of a single project or region, but throughout the country.

Continued on page 19



Sale of improved maize seed in Ghana.

This is what Collins Osei-Kwabena and Seth Ashiamah are—and it is what they do—in the Training and Communications Unit of the GGDP. Not as a part-time or temporary assignment, but as a full-time profession, they try to develop skills and instill professional attitudes in more than a thousand Ghanaian extension officers each year. They also help researchers communicate their results and insights more effectively to various audiences.

Setting up a special unit just to handle those activities would be considered an unaffordable luxury by most agricultural development projects and national crop research programs, and many would prefer to spend the funds on an extra plant breeder or agronomist. But in the GGDP, professional handling of training and communications is considered indispensable to one of its principal aims, which is to maintain strong links between farmers, extension officers, and researchers.

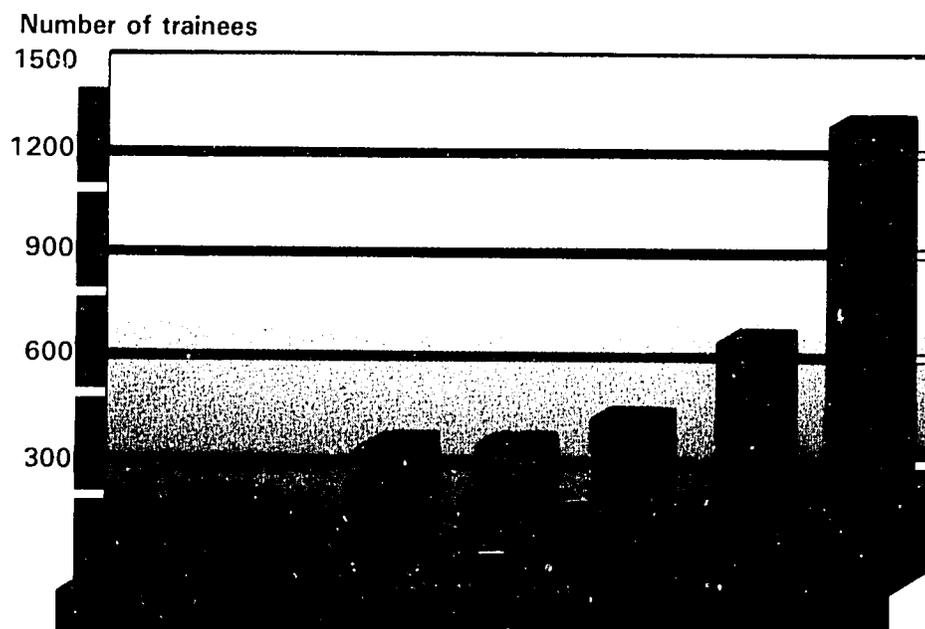
The need to train large numbers of extension staff—primarily to conduct on-farm research trials and demonstrations—was apparent from the beginning of the Project, and it has been met through annual in-service training courses given in all regions of the country. During these two-day sessions, participants go over the previous year's research results, discuss modifications in the annually updated recommendations for maize and cowpea production, and receive specific instructions for the coming year's on-farm activities. They also gain field experience in such operations as laying out a trial, calibrating and maintaining a sprayer, and

applying fertilizer. As the staff of the Project and the complexity of its research have grown, so has the training program: the number of participants has increased sharply (see figure), adjustments have been made to accommodate them, and especially since 1987 (when Training and Communications was established as a special unit within the Project), various techniques have been adopted to make training even more effective.

One adjustment dictated by the size and nationwide coverage of the program was to divide the extension officers into two groups: those who are responsible for on-farm research trials and a larger group that organizes demonstrations of research results. The latter continue to receive in-country training in the various regions much as before, though sometimes with a few twists. One of those is the use of role playing to teach extension agents how to lead effective

discussions during field days. Collins usually takes the part of the wily farmer, who always seems to come up with the most difficult and embarrassing questions, while Seth films the exchange with a video camera. As the extension officer watches his performance being played back, he and other course participants ask questions or make comments about how he could improve his handling of the discussion.

The extension officers that conduct on-farm trials are brought from all over the country to three locations for a review of research findings and training on one or more new topics not covered in previous courses. During the same session, they also take part with researchers in planning the on-farm program, establishing priorities democratically rather than letting them be dictated by one or a few senior people.



Training of extension officers by the GGDP.

Although the bulk of their time is consumed in organizing in-service training, Collins and Seth are involved in other programs as well. One of those is to promote effective communication among research staff, some of whom used to read aloud from notes and documents, teaching very much as they were taught from primary school to college. Recently, they have learned how to present their work more effectively and interestingly by using various types of visual aids and by adjusting the level of complexity of their presentations to the audience.

Another project that Collins and Seth have just started is an effort to get extra mileage from the videotapes they are making in the course of their work throughout the country. The two are convinced that the training courses, field days, and other activities they are filming have given extension officers a better understanding of research and Project researchers a fuller awareness of farmers' circumstances and problems. Now what Collins and Seth hope to do is to share their record of the partnership they have helped form between farmers, extension officers, and researchers with an even wider audience. One means of doing so, which they have already begun to explore, is to share their tapes with the producers of Agrimag, a nationwide television program that features interviews with farmers, researchers, and public officials. Another will be to show their films at the next annual Maize and Cowpea National Workshop as a means of reinforcing the essential message of this event—namely that Ghana's agricultural development is a truly national project.

What Ghana has gained are the elements of change: an array of technologies for meeting farmers' current needs and an indigenous capacity to cope with future food shortages.

Authority, of course, must have some basis, and that of the little green book has been established by several means: first, through the Project's nationwide program of experiment station and on-farm research; second, through its in-country training program, which has reached hundreds of extension agents across the country; and third, through the annual National Maize and Cowpea Workshop, first organized by the Project in 1982. Attendance was high from the start but reached 400 in 1988, including key agricultural decision makers and representatives of every organization or project in Ghana that has a research or extension program for maize or cowpea. By providing a national forum in which researchers can exchange and discuss their results, the event has virtually brought an end to the confusion that existed previously about recommended production practices.

But with the single exception of the recommendations, the workshop was never intended to achieve any sort of rigid uniformity of approach among the various agricultural agencies operating in the country. What has been accomplished is far more important, namely a greater

degree of cooperation and coordination between the organizations directly involved in the GGDP and numerous other groups, including Food and Agriculture Organization (FAO) projects, the World Bank agricultural development projects (URADEP in Upper West and East Regions and VORADEP in Volta Region), the Nyankpala Agricultural Experiment Station (whose work is funded by GTZ, the German Agency for Technical Cooperation), and the Sasakawa Global 2000 Project. In addition to promoting communication among them, the workshop has enabled all of those groups to convey their concerns more forcefully to Ghana's agricultural policy makers. That dialog has helped move the country away from piecemeal approaches to agricultural development and toward the view of this task as a national project.

The Elements of Change

If what Ghana needed most in 1979 was new agricultural technology for maize and cowpea production, the GGDP could perhaps have provided it by bringing in a horde of expatriate scientists. Project staff decided instead to initiate as large a research program as could be handled by one CIMMYT scientist and the Ghanaian staff then available at CRI and to establish training programs that would steadily increase the size and skill of the latter, accompanied by only modest growth in expatriate staff. What Ghana has gained after nearly 10 years are the elements of change: an array of technologies for meeting many of farmers'

current requirements and a rapidly growing indigenous capacity to cope with future needs and contingencies.

Maize improvement

The major achievement of the Project's maize breeding program so far has been to develop and release six open-pollinated varieties (consisting of materials obtained from CIMMYT and IITA) that together meet the germplasm needs of the entire country and that show a distinct advantage in yield and other traits over the local varieties they are replacing. Although it is not unheard of for an improved variety to remain on the market for a decade or more, Project breeders do not intend to let that happen and are working to replace the current generation of varieties with new materials having additional traits that farmers are demanding.

One trait breeders are trying to develop in their entire stock of germplasm is uniformly good husk cover, which reduces ear rots and infestation by storage insects while maize is still in the field. Another serious problem that became apparent in Ghana during 1983 is maize streak virus, a disease that is endemic in Africa. Using resistant germplasm developed in Nigeria by CIMMYT and IITA, maize breeders are working to replace five of the current varieties with streak resistant versions that also have improved husk cover. One of those, named Okomasa (meaning "no more hunger") was released in 1988 and will be available to

farmers by the next major growing season. Those achievements reflect marked progress toward a goal the Project's breeders share with most developing country maize improvement programs, which is to become ever more efficient in employing germplasm products and information supplied by the international agricultural research centers and other sources to develop a complete line of final products for farmers.

With increased expertise in breeding, the program has conceived new ambitions, including the development of maize hybrids. There is already some demand for them among Ghana's relatively few large-scale commercial farmers, and the Ghana Seed Company (which is the major seed supplier but has been inhibited by financial and other problems) is arguing that it would stand a better chance of becoming a commercially viable enterprise—as have its counterparts in Kenya and Zimbabwe—if, like them, it could market hybrids.

That is a very big "if," however, since hybrids impose heavy demands both on seed producers and farmers. Although production of hybrid maize seed involves many of the same operations as does efficient maize grain production, it requires a number of extra steps that must be executed with extreme care and that increase the price of the final product. Moreover, farmers who purchase hybrid seed must be willing to pay that price every



Poor husk cover invites infestation of maize with storage pests and has therefore been assigned high priority by maize breeders in the GGDP.

year (not every two or three years, as is the case with open-pollinated varieties). And unless the level of crop management is quite high, there will be no discernible difference between the performance of the hybrids and the varieties already available to farmers and, as a result, they will not receive the greater return from production that would be required to cover the higher cost of hybrid seed (CIMMYT 1987).

There is no question that Ghana's seed production capacity has increased over the years and that there are fairly good prospects for additional improvement. CRI is contributing to the development of the country's seed production capacity by supplying producers with high quality breeder's seed (from which they in turn produce

foundation seed and then certified seed for farmers) and by conducting research on the agronomy of seed production. In addition, the GGDP has recently begun to offer in-country training in seed production. The level of farmers' crop management has also been improved through the efforts of the Project, particularly

in the transition zone, where commercial production of monocropped maize is common. Nevertheless, Project maize breeder Baffour Badu-Apraku suggests that it will be another five years or so before the country will be capable of producing high quality hybrid seed and at least that long before it will have an expanding market for the product. He has chosen the optimistic but cautious view that, as the country gradually becomes prepared for hybrid seed, the maize program should start with a modest effort to develop hybrids, primarily the so-called nonconventional types. These can be developed more quickly and seed production is simpler to manage than with the conventional hybrids grown universally in North America and Europe and quite widely in some developing countries, such as Brazil and China (CIMMYT 1987).

Grain legume improvement

Since 1985, when the complement of grain legume breeders in the GGDP was brought to three (including IITA scientist M.A. Hossain), the breeding program has rapidly gained momentum. Most of its resources are being channeled into a cowpea crossing program, although breeders are also evaluating promising groundnut varieties and soybean lines. The primary aim of the crossing program is to incorporate genes for resistance to various insects and diseases into selected



Baffour Badu-Apraku (left), maize breeder and joint coordinator of the GGDP, in consultation with Tom Bonney of the Ghana Seed Company. The Project's maize improvement program has supported the country's fledgling seed industry by providing seed, conducting research on the agronomy of seed production, and offering training.

local cowpea varieties. Unquestionably, the most significant problem with cowpea in Ghana and West Africa generally is the damage caused by various insect species, and the most difficult challenge for GGDP staff working on cowpea is to develop varieties with enough insect resistance, if not to eliminate the need for spraying with insecticide, at least to reduce the number of sprayings from three or four to two.

So far, the grain legume breeding program has released four cowpea varieties for distribution to farmers. And although it would be premature to conduct an adoption study of cowpea varieties and crop management practices (as was done for maize in Brong-Ahafo Region), it certainly seems that someone is excited about them and is sharing his enthusiasm with a fairly large rural audience. The individual in question is a "tro-tro" driver in Ashanti Region, whose vehicle bears in brightly colored letters, not the usual bit of folk wisdom, but the name of a new cowpea variety, Asontem.

Crop management

A rule of thumb observed by GGDP agronomists is that they do not engage in a particular piece of research unless it can be expected to produce information that is useful to farmers. Largely as a result of that very practical orientation, they have been able to develop technology (through a judicious mixture of experiment station and on-farm research) that in research trials can increase maize yields by three times that

obtained in southern Ghana with unimproved practices and up to five times in the northern savanna. Equally impressive gains are to be had from adoption of improved practices for cowpea production. Moreover, Project researchers have demonstrated that 50% of the maize yield increase is attributable to fertilizer, 20% to improved varieties, and the remaining 30% to other agronomic factors. The recommended practices responsible for those increases have been generated through investigations of such questions as the timing and placement of fertilizer and plant density and arrangement, first in connection

with monocropping and later with various intercropping systems, including maize-cowpea, maize-cassava, and cowpea-cassava.

The practices developed to date are aided by the relative abundance of farmland in Ghana (particularly in the north), which by and large has kept the pressure off farmers' shifting cultivation systems, except around cities and in certain areas of the south. Current recommendations also assume a relatively high degree of dependence on fertilizer. Certainly that could not be otherwise, since as many Ghanaian farmers are finding out, they can improve the efficiency of their production only



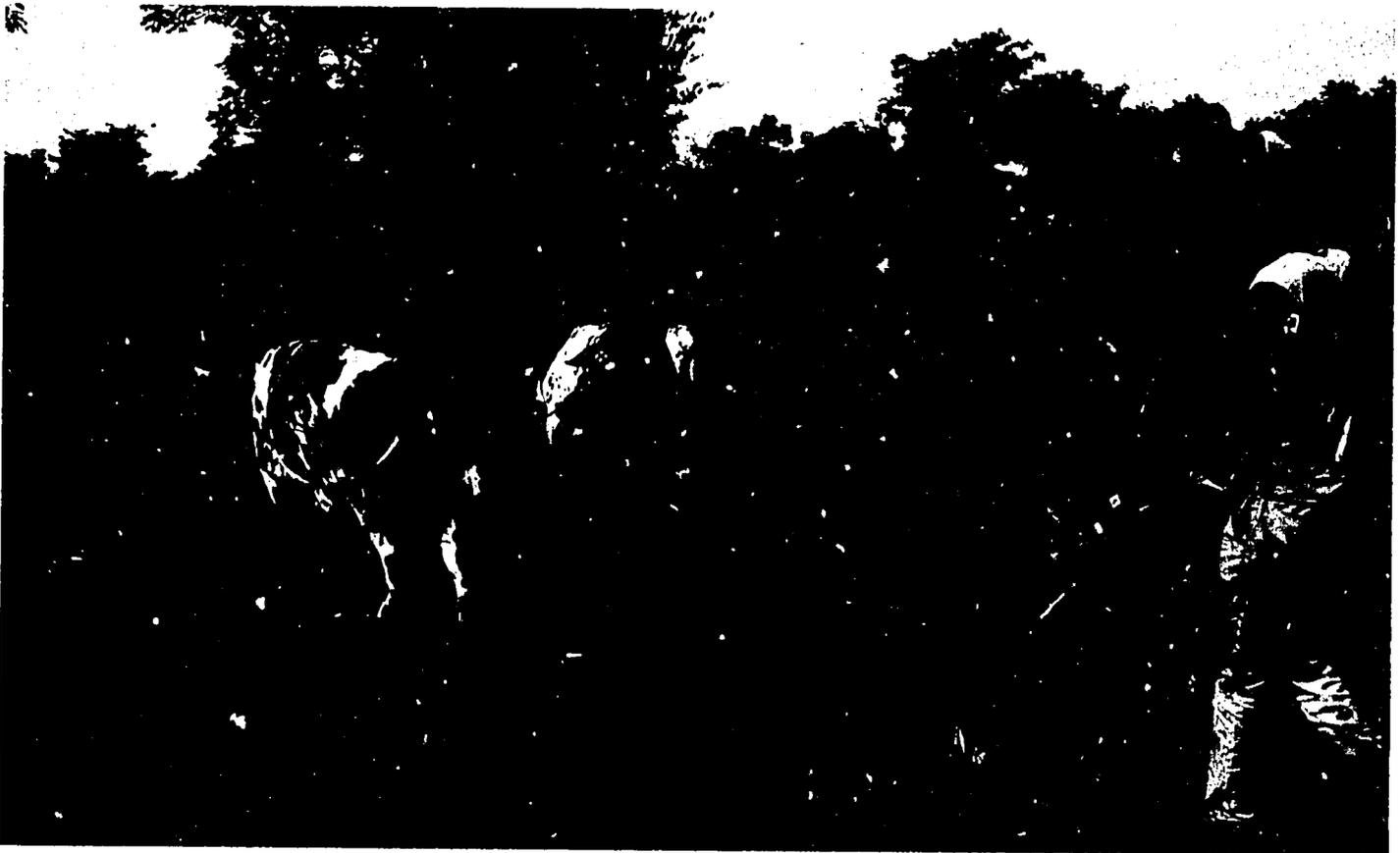
Legume breeder Ben Asafo-Adjei examines cowpeas ready for harvest at a CRI experiment station. He and other legume researchers with the GGDP seek to develop varieties with enough insect resistance to permit a reduction in the number of insecticide sprayings needed to obtain good cowpea yields.

by investing more in it, and one of the best investments they have found so far is fertilizer. Although farmers continue to have difficulties obtaining fertilizer on time, this problem is being attended to and will probably be lessened in the coming years. What is more disturbing is that the assumption of abundant land is being invalidated by rapid population growth (see table, page 4), and the pressure on farmland can be expected to increase. Can Ghanaian farmers afford the even more extensive use of fertilizer that will be necessary to sustain production on more intensively cropped land, and if they can,

what ecological costs might be incurred through continuous cropping based on heavy use of agricultural chemicals?

Although it did not have the luxury of addressing such questions directly in its early years, the Project is now pursuing various lines of study that fall under the general rubric of sustainable cropping systems research. The purpose of that work is not to eliminate the need for chemical inputs altogether but to greatly increase the efficiency of their use.

Project agronomists made a start in that direction some years ago simply by developing appropriate recommendations for fertilizer application under diverse circumstances in various parts of the country. By distributing that information effectively through the extension services, the Project has (with the help of higher fertilizer prices) contributed to a reduction of indiscriminate fertilizer application and helped farmers make more efficient use of this input. Now, researchers are exploring the possibilities for reducing fertilizer application through maize-legume rotations



The relative abundance of land in Ghana, particularly in the less densely populated savanna of the north, has by and large kept pressure off farmers' shifting cultivation systems. Rapid population growth and concern about environmental degradation, however, make it imperative that researchers introduce alternative cropping systems that permit sustained production with minimal use of agricultural chemicals.

and in various other experiments are looking for ways of achieving better control of insects and weeds with minimum use of chemicals.

One promising approach is integrated pest management for cowpea, which is a means of reducing insect damage through a combination of the correct planting time, an early maturing variety that is tolerant to some insect species, and the least possible number of insecticide sprayings. Both in maize and cowpea, much of the damage caused by insects takes place in storage. While plant breeders are improving husk cover in maize and insect resistance in cowpea, Project agronomists and crop protection specialists are trying to develop practices (some of them involving knowledge or materials

already available to farmers) that could further reduce the predations of storage pests. In one series of experiments, agronomists are determining whether storage pest damage to maize can be reduced by adjusting the timing of nitrogen fertilizer application and bending plants over (a common practice in northern Ghana, as explained on page 8) to speed maturity and move the harvest date forward, thus shortening the period during which storage pests can infest maize while it is still in the field. In a laboratory experiment, a wide variety of local materials (such as groundnut oil, wood ash, and eucalyptus leaf powder) are being compared with the recommended chemical for their effect on storage pests of maize and cowpea. Another series of studies aims both to control weeds and improve fertility in maize production by using fast-growing food crops (cowpea and groundnut, for example) as "live mulches."

This last practice and various others are being investigated at IITA in Nigeria and show considerable promise, particularly a system called "alley cropping." This is a combination of crops with nitrogen-fixing shrubs that enables farmers to cultivate the same piece of land continuously with minimal fertilizer application. The system also supplies them with useful materials, including firewood, building materials, and

Research conducted by weed scientist Grace Bolfrey seems to have added one more item to the list of negative effects from stubble burning, namely that it lessens the effectiveness of weed control measures in maize. Burning of stubble is widely practiced by Ghanaian farmers to clear land for cultivation but is persistently opposed by the country's agricultural officials.

fodder for animals. The widespread transfer of such a technology, however, will probably require some time, since it deviates from farmers' current systems, though it is based on principles underlying the widespread practice of shifting cultivation. Clearly, Ghanaian farmers are prepared to alter their farming traditions, if the innovations offer readily apparent benefits, but there is also solid evidence that farmers tend to make adjustments in a cautious, step-wise manner; they do not switch from one farming system to another overnight.

...the country's agricultural officials.

The GGDP has been successful in promoting changes in farmers' practice precisely because it began by searching for ways of improving the efficiency and profitability of current farming systems, rather than trying to persuade farmers to exchange them for altogether different ones. An important outcome of that experience is that farmers now have more confidence in research and extension staff. One can only hope that their growing trust will eventually provide a basis for more radical innovation and introduction of sustainable cropping systems that serve the long-term interests of farmers and the nation.



Building the Momentum of Change

The pace at which Ghana's farming traditions develop toward more widespread and efficient use of modern inputs and greater productivity over the long term will depend on a different sort of sustainability from that discussed above, one having more to do with the country's institutional rather than natural resources. The question is whether the former will be sufficient to sustain and even increase the kinds of farmer services that are starting to become available and that should help rural communities increase their productive capacity and economic power.

Research and extension

Foremost among those services are 1) relevant agricultural research aimed at developing technologies that are appropriate for small-scale farmers and 2) mobile and well-trained extension services that have a compelling message and a strategy for conveying it to farmers effectively. The GGDP has made a dramatic and demonstrable impact on both of those by:

- Organizing its research around a few major commodities and the farming systems in which they are grown
- Forming multidisciplinary teams of researchers that distribute their time and resources appropriately between experiment station and on-farm activities

- Establishing strong links between researchers and extension officers and mechanisms by which both groups can communicate effectively with farmers
- Providing extensive training, with particular emphasis on the development of an indigenous capacity to offer superior instruction on a large scale to the extension services

If it turns out that, like farmers, researchers and extension officers are makers of tradition, then there is reason to believe that the activities listed above will become customary and will continue to be refined. Nevertheless, as CRI director E.A. Addison points out, "no one is under the illusion that the GGDP could have accomplished what it has so far or

that its activities could be sustained without a level of financial support comparable to that provided by CIDA." It is also apparent that the Project has placed heavy demands on management. Since both issues—funding and administration—are critical to the future course and impact of research and other activities initiated by the Project, they will be of special concern during its third phase, which will last from 1989 to 1994.

Project staff are confident that, by the end of those five years, the management skills of Ghanaian staff will match their currently high level of technical ability if two essential steps are taken: 1) intensive management training



In Ashanti Region GLDB extension officers Owusu Kwarteng and Owusu Mensah (first and second from left) and MOA extensionist Owusu Ansah (right) are united, not just by the name they share, but by a common purpose, which, according to Kwarteng, is to "impart knowledge to farmers [like Yaw Nframah, shown here], obtain helpful information from them, and persuade them to adopt recommendations through such means as on-farm demonstrations."

and 2) a gradual transfer of administrative responsibilities from the CIMMYT scientist who currently shares them with a Ghanaian joint coordinator to a new, entirely Ghanaian management team.

The problem of continued funding does not lend itself so readily to a solution—or at least to one that is within the Project's grasp. Suffice it to say that it has done and will do all that it can, which, according to Roger Erhardt, first secretary for development at the Canadian High Commission in Accra, is to "enhance the effectiveness and reputation of the organization to the point that the government finds it difficult not to provide adequate funding when external assistance starts to taper off." There is no guarantee, of course, that the government will be in a position to provide the necessary funds, but there is encouraging evidence that if it can it will. In 1988, for example, 16.8% of the country's development budget was committed to food crops, second only to roads and transport and the highest priority the MOA has ever received. Moreover, in addition to inspiring confidence among government of Ghana decision makers, the successful efforts of the GGDP and others, such as the Sasakawa Global 2000 Project, are helping maintain the flow of donor funds into Ghana. The World Bank, for example, is currently planning a large-scale project for further strengthening the extension services of the MOA. But even assuming that CRI

researchers can sustain the flow of farmer-tested technologies and that these are effectively promoted through the extension services, a number of other steps must be taken to empower more farmers to adopt recommended practices and help them translate the resulting gains in efficiency and productivity into economic benefits.

A number of steps must be taken to empower more farmers to adopt recommended practices and translate the resulting productivity gains into economic benefits.

Improvement of grain storage

One of those steps is to improve grain storage capacity in rural communities, the need for which is particularly well illustrated by the plight of Yikpabongu, a remote village in Ghana's Northern Region. From June until December, Yikpabongu is nearly inaccessible because of flooding from the two rivers between which it lies, a phenomenon that has earned the village and surrounding area the name "overseas." Isolation has forced the community to be self-reliant, but it has also made the inhabitants easy prey for outsiders. Each year, for example, Yikpabongu is visited shortly after harvest by grain buyers, who offer miserably low prices because grain is relatively abundant at that time and because the villagers

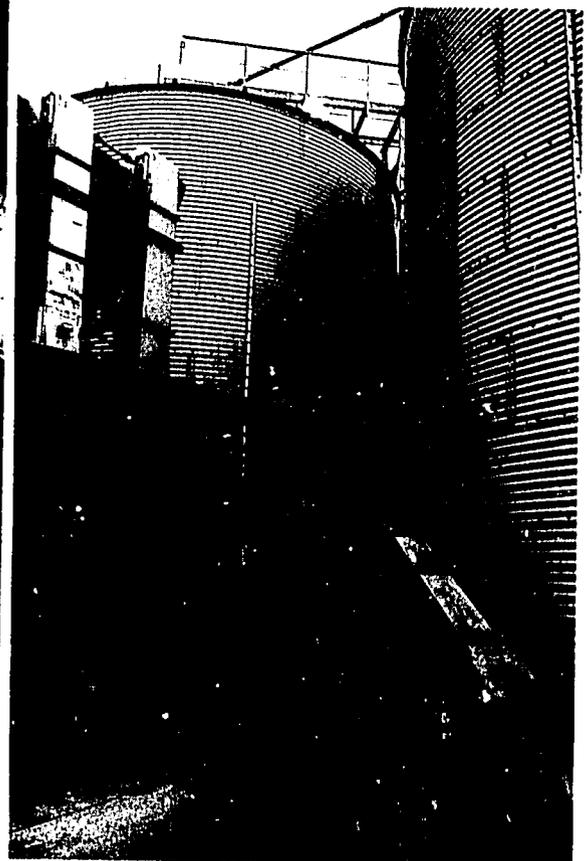
have no other marketing options. If the farmers refuse to sell, a large share of their produce is lost to insects during storage in the traditional wood and thatch structures. Improved storage would enable farmers to hold back a portion for marketing in April or May, when grain is scarce and prices are higher, and would boost their incentive to adopt practices aimed at increasing the efficiency of production.

The unique circumstances of "overseas" dramatize a problem that exists throughout the country and that is being addressed in various ways, one of which is improvement of on-farm storage. At Yikpabongu, for example, the GGDP is planning to try out improved storage facilities designed by the University of Science and Technology in Kumasi. Project staff are also hopeful that their research on control of storage pests will soon lead to effective and appropriate control measures that could be applied throughout the country. There is also undoubtedly a place for large-scale modern storage facilities. In an FAO project at Mampong, Ashanti Region, for example, farmers have access to such facilities and are participating in a cooperative scheme for grain marketing.



Availability of improved seed, fertilizer, and credit

In reporting on the results of an informal survey conducted near Wa in Upper West Region, GGDP staff recalled this rather caustic comment made by one northern farmer during a conversation about fertilizer: "I've already been shown how to apply it. Now, why don't you tell me when it's going to be here?" Like many Ghanaian farmers, he complains not so much about price as about late delivery. This problem has been created in part by the cumbersome procedures through which the government must



Improvement of grain storage in traditional structures, combined with expansion of modern storage facilities, would open up new options for farmers in marketing maize and provide them with an additional incentive to adopt practices that increase the efficiency of production.

obtain fertilizer from abroad and is magnified by the poor condition of Ghana's road network. Farmers meet with similar obstacles in trying to obtain improved maize seed, which, in spite of the efforts of the Ghana Seed Company and the GLDB, is not being produced in nearly the quantities that the nation's farmers require.

Moreover, even where those inputs can be obtained, many farmers do not have the cash to pay for them and can obtain it only by incurring high risks. Such was the case with Kwaku Yamoah-Boampong, the farmer in Brong-

Ahafo Region whose story is told at the outset of this report and who in his first year of farming had to borrow money at high interest rates to purchase seed and fertilizer and cover land clearing and labor costs.

One particularly noteworthy effort to deal with all of those problems at once is the Sasakawa Global 2000 Project, which was initiated in 1986. Its strategy is to involve thousands of Ghanaian farmers nationwide in planting maize and sorghum production test plots (PTPs), in which improved

technology, much of it developed by the GGDP, is compared with the farmers' practices on one acre. Participating farmers are provided with seed, fertilizer, and technical assistance by MOA extension officers and then at harvest pay for the inputs either in kind or cash. By 1988 the project was working with about 17 000 farmers in all regions of the country. Because cooperating farmers have realized substantial production increases by adopting the improved technology, the rate of loan repayment has been excellent, and, as a result, the project has been able to enlist support from the banks. According to a recent report on the project's impact, local banks provided financing to cover the production costs of 7000 farmers in 1988.

Another even more far-reaching effect of the Sasakawa Global 2000 Project is that, because of its large scale and the involvement in it of two well-known personalities, former US president Jimmy Carter and 1970 Nobel Peace Prize winner Norman Borlaug, it has commanded the attention of decision makers in government and given them a convincing illustration of what small-scale Ghanaian farmers can do if they are given a chance. Other individuals and organizations have been saying the same thing for a long time. But now the problems of funding for food crops research and availability of inputs and rural credit are being addressed more concretely by the government in its formulation of agricultural policies and strategies. Its Statement of Agricultural Policy,



Even farmers who are convinced of the advantages offered by improved maize varieties may not be able to adopt them because current seed supplies do not meet the growing demand. As a result, most maize farmers in Ghana still plant seed selected from their own harvest.

1989-1993 (prepared by the MOA's Policy Planning, Monitoring, and Evaluation Department, of which S.K. Dapaah is director:) frankly describes the problems discussed above and their consequences in stagnating production, and it spells out specific plans for coping with them. To improve the efficiency of fertilizer delivery, for example, the document outlines a scheme for privatizing fertilizer trade and gradually removing subsidies.

The foregoing comments on the improvement of services to farmers constitute only a cursory treatment of extremely complex questions, many of which remain unanswered, though at least they are being addressed by various groups and in various ways. The degree to which those issues can be satisfactorily resolved will determine the extent to which Ghana's economic recovery program can exert palpable effects on a greater share of the nation's largely rural population. In commenting on limitations of the recovery program, Reginald Green (1988) is no doubt right to caution that "triumphal march music is still dangerously premature." But who can blame Kwaku Yamoah-Boapong and hundreds of other Ghanaian farmers whose fortunes have improved if they turn out a little early for the parade?

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If given a chance Ghana's rural communities can make economic recovery more of a reality in the countryside.



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List of acronyms used in this publication:

CIDA	Canadian International Development Agency
CIMMYT	International Maize and Wheat Improvement Center
CRI	Crops Research Institute
FAO	Food and Agriculture Organization
GLDB	Grain and Legumes Development Board
GGDP	Ghana Grains Development Project
GTZ	German Agency for Technical Cooperation
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
MOA	Ministry of Agriculture
URADEP	Upper Region Agricultural Development Project
VORADEP	Volta Region Agricultural Development Project

The International Maize and Wheat Improvement Center (CIMMYT) is an internationally funded, nonprofit scientific research and training organization. Headquartered in Mexico, the Center is engaged in a worldwide research program for maize, wheat, and triticale, with emphasis on food production in developing countries. It is one of 13 nonprofit international agricultural research and training centers supported by the Consultative Group on International Agricultural Research (CGIAR), which is sponsored by the Food and Agriculture Organization (FAO) of the United Nations, the International Bank for Reconstruction and Development (World Bank), and the United Nations Development Programme (UNDP). Donors to the CGIAR system are a combined group of 40 donor countries, international and regional organizations, and private foundations.

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