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AGRICULTURAL RESEARCH IN THE PRIVATE SECTOR IN AFRICA: THE CASE OF KENYA

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Table of Contents

		Page
I.	AGRICULTURE IN KENYA	1
II.	AGRICULTURAL RESEARCH IN KENYA	2
III.	TYPES OF ORGANIZATIONS DOING PRIVATE AGRICULTURAL RESEARCH IN KENYA	3
	A. The Multinationals	3
	B. National Companies	3
	C. Family Enterprises	3
	D. Commodity Boards	3
	E. Non-Governmental Non-Profit Organizations	3
	F. Farmers	4
IV.	SOME EXAMPLES OF PRIVATE-SECTOR AGRICULTURAL RESEARCH IN KENYA	5
	A. The Multinationals	5
	B. National Companies	5
	C. Family Enterprises	6
	D. Commodity Boards	7
	E. Non-Governmental Non-Profit Organizations	8
	F. Farmers	8
V.	A MODEL FOR ANALYZING THE ROLE OF PRIVATE-SECTOR AGRICULTURAL RESEARCH IN KENYA	9
	A. Mechanical Technology	10
	B. Chemical Technology	11
	C. Biological Technology	12
	D. Agronomic Technology	14
	E. Management Technology	14
VI.	SOME OBSERVATIONS ON PRIVATE-SECTOR RESEARCH IN KENYA	16
VII.	CONCLUSIONS AND PROSPECTS	19

AGRICULTURAL RESEARCH IN THE PRIVATE SECTOR IN AFRICA: THE CASE OF KENYA

I. AGRICULTURE IN KENYA

Kenya is a predominantly agricultural country, with 85% of its 18 million people engaged primarily in agriculture. Agriculture contributes over 35% of the GDP and provides food, energy, incomes, and employment for most of the rural and urban populations.

Agriculture provides most of the basic raw materials for Kenya's growing manufacturing industries. Crop, livestock, and raw materials production have been the backbone of the economy since colonial times, with productivity increases made in maize, wheat, animal production, coffee, tea, and livestock disease control. Kenya was virtually self-sufficient in maize and in livestock products in the 1970s, and is a major exporter of coffee and tea. It is one of the few countries in sub-Saharan Africa with a good record of agricultural production and development, and where it is believed self-sufficiency in food can be attained. However, it needs to harness its resources more productively to cope with the rapid increases in population.

Kenya's agriculture is characterized by dualism. Traditional or small-scale farmers (farming two hectares or less) concentrate on the production of their own food, with limited use of improved technologies. They utilize the extra resources available to produce items such as milk, vegetables, and pulses for a semi-modernized market in the urban areas. Modern farmers are generally large-scale (50 hectares or more), they are more specialized, and produce items like maize, wheat, beans, barley, cotton, and beef cattle. They use inputs such as improved seeds, fertilizers, and pesticides, and benefit from organized marketing of their produce. Both small-scale and large-scale farmers are involved in the production of, and derive substantial income from, export crops such as coffee and tea.

II. AGRICULTURAL RESEARCH IN KENYA

Agricultural research has been the main vehicle for the development of Kenya's natural resources. Research in forestry, general agriculture, veterinary sciences, and coffee were initiated at the beginning of this century to respond to the needs of government and the farming community. Most of the early developments in research were in the public sector and, in the last three decades, the number of public-sector research stations and institutions has increased considerably. Also, during this period, regional research establishments in agriculture, forestry, and veterinary sciences were founded under the East African High Commission, and some of these operated in Kenya. The focus of research initially was in the introduction, testing, and production of crop varieties, and livestock adapted to Kenyan conditions. Later research emphasis was placed on the development of improved varieties and production technologies that markedly increased crop and livestock productivity in the high and medium potential areas. With pressure on land and post-independence land reforms, more attention is now expected to be given to developing and testing technologies for small-scale farmers, and for productive agriculture in the more marginal and semi-arid areas.

The public research sector enjoyed rapid growth in the last two decades, and in 1986 had about 34 national and regional research stations and substations, distributed throughout the country. In addition, public-sector financed research is undertaken in the universities and in other semi-autonomous institutions. The government and the farming community have remained the major end-users of the results of research emanating from this huge public research machine.

The private sector has, however, had an important role in developing Kenya's agricultural potential. This paper will seek to describe what the role of private agricultural research in Kenya has been, what the impact of this research has been, and to review the coordinating mechanisms that have been created in agricultural research between the public and private sectors.

III. TYPES OF ORGANIZATIONS DOING PRIVATE AGRICULTURAL RESEARCH IN KENYA

The organizations doing private agricultural research in Kenya can be divided into six groups: multinationals; national companies started with foreign investment; family enterprises; commodity boards; religious organizations; and farmers.

A. Multinationals

The Kenyan subsidiaries of multinational companies are large-scale businesses that within Kenya generally dominate the market for their products. British American Tobacco Limited (BAT) processes and markets all the tobacco produced in the country. Kenya Canners, Ltd., a subsidiary of Del Monte, supplies most of the European demand for canned pineapples from Kenya. Other companies, such as Brooke Bond Ltd. or East African Industries (subsidiary of Unilever) have very large market shares in their product lines.

B. National Companies

Starting in 1966, a policy of increasing Kenyan ownership of private-sector firms founded by colonial immigrants led to the selling of majority shares to Kenyan nationals in some companies. By 1977, a number of these firms, such as MEA Ltd. (fertilizers, pesticides) and Kenya Breweries Ltd. (beer), were 100% owned by Kenya nationals.

C. Family Enterprises

Family enterprises are involved in food processing, and fresh fruit and vegetable exports. They are sometimes involved in some adaptive research in the crops they commercialize. While they are Kenyan nationals, these families tend to be of Asian origin.

D. Commodity Boards

Although commodity boards are not strictly private, they largely operate with the flexibility of private-sector organizations. Commodity boards in Kenya represent both the private and public-sector producers, processors, and exporters of a given commodity. Kenya has commodity boards for crops such as tea, coffee, sugar, and cotton, but only the boards for coffee and tea are responsible for research on these commodities. Sugar and cotton are still catered for by public-sector research in the Ministry of Agriculture.

E. Non-Governmental Non-Profit Organizations

Non-governmental non-profit organizations are principally religious institutions which are very active in Kenya (as they are in much of sub-Saharan Africa). Many of these institutions have initiated projects in agricultural investigations and development. They engage in the testing and adaptation of some new technologies in collaboration with

local communities in different parts of Kenya.

F. Farmers

While all farmers can be considered "de facto" agricultural researchers, some private farmers in Kenya are actively pursuing the development of new breeding lines, introducing and testing new crops, or seeking new planting and harvesting techniques to increase productivity.

IV. SOME EXAMPLES OF PRIVATE-SECTOR AGRICULTURAL RESEARCH IN KENYA

A. Multinationals

The multinationals have been highly successful in introducing specific new crops in Kenya. BAT has a team of nine persons doing research in tobacco, and a team of 150 doing extension. Since BAT started this program, tobacco production in Kenya has increased from 170 tons in 1974 to 5200 tons in 1983. Nine thousand two hundred farmers participated in the program in 1983, and many more wanted to join. Essentially, BAT offers farmers a complete package, including seed, financing, agronomic recommendations, and guaranteed price and market. With success, BAT's research priorities have had to change. Whereas, previous to 1983, they were chiefly concerned with varieties that maximized yield, current production leaves the company with a surplus of 10% over national consumption. The company's research is currently focused on increasing the quality of tobacco, to be able to compete in export markets. In addition, they have diversified into poultry production and other promising agricultural enterprises.

Other multinationals, such as East African Industries (EAI), impressed with BAT's success, are trying not only to reproduce the same package in other crops, but are even interested on relying on the same, or similar, groups of farmers. Since 1983, EAI has offered these same farmers a similar package for producing rapeseed. Many of these farmers are rotating three to four tobacco crops for BAT with one rapeseed crop for EAI.

Some multinationals grow their own agricultural produce. Kenya Canners grows 100% of its pineapple requirements and cans 100 tons a day for the 10 months it operates the processing plant. Agricultural research, involving a team of one expatriate scientist, seven technicians, and 22 support staff, has focused on controlling the mealybug, improving quality through new clones, and developing improved agronomic techniques.

The sophistication of the research of these multinationals varies significantly, even within the same company. Brooke Bond has based its own worldwide tea research program within Kenya, and at the same time, has only one researcher testing and adapting varieties of carnations. Brooke Bond has long been the largest single tea exporter from Kenya (exporting 17,606 tons in 1983). In 1979 Brooke Bond began the commercial production of carnations, and in 1983 they exported 125 million stems, representing three jet loads a week to Europe over the winter months.

B. National Companies

The national companies have generally flourished in a situation where they have had no significant national competition. With a monopoly at home, these companies have felt no need to seek other markets. In an insulated market, these companies had no compelling need to undertake research. However, the foreign exchange crisis which has affected so

many developing countries, has also limited Kenya's ability to import. Companies like Kenya Breweries Ltd. suddenly found themselves without products like malting barley. MEA Ltd, a company importing, bagging, and selling fertilizer, suddenly found itself unable to import one of their best-selling phosphates. These companies were driven into research by the need to develop substitutes for imports.

Kenya Breweries first looked to the public sector for an answer to the problem of developing a domestic source of malting barley. Malting barley was a low-priority concern to the public sector; so in 1975 Kenya Breweries hired the three most experienced small-grain researchers in the public sector to focus on malting barley, while maintaining their links to the public-sector small cereals research station at Njoro. For three years Kenya Breweries maintained a joint research program with the Public Research Station at Njoro. However, in 1978, Kenya Breweries decided it required an independent research effort to assure a greater focus of research on cost savings, and developed a package acceptable to farmers. Kenya Breweries offers farmers a package including seed, chemical inputs, finance, technical assistance, and a market for the product. Kenya Breweries has become self-sufficient in malting barley, and yields of participating farmers have doubled between 1977 and 1983. In 1986, Kenya Breweries had a malting barley program that included two breeders, one agronomist, 22 support staff, and 10 extension officers. Kenya Breweries has maintained contact with the public-sector research station at Njoro through joint testing of varieties, and participation in a barley research committee. The foundation seed produced by Kenya Breweries has been turned over to the Kenya Seed Company, which multiplies the seed, and after government inspection and certification, returns the multiplied seed to the Kenya Breweries for distribution.

The Kenya Seed Company is a private-sector company in which the Government of Kenya has bought a majority interest. It has done very productive agricultural research. Started in 1956 by expatriate farmers to produce seed for pastures, in the mid-1960s it faced a crisis as expatriate farmers stopped investing in their lands. The company began to work on hybrid maize. By the mid-1970s, the company was selling over 10,000 tons of hybrid maize seed a year, and has been a crucial factor in nearly tripling Kenya's maize production between the mid-1960s and the 1980s. Some significant achievements were also made in the production of seed for export. The Kenya Seed Company is expanding into sunflower seed production. The breeder seed they will multiply will be provided by EAI. In 1986 EAI, facing a constraint in importing vegetable oils, has decided to participate in a joint research program in sunflower with the public sector, similar to the arrangement made in barley between the public-sector research and Kenya Breweries in 1975.

C. Family Enterprises

The family enterprises in vegetable processing, fresh fruit, and vegetable exports, while not directly involved in farming, see their growth seriously constrained by the poor availability and low quality of the agricultural products they use. These firms are knowledgeable about the product characteristics their markets are demanding (e.g., thinner-skinned fruit, or deeper-colored vegetables), but are unable to find suitable raw materials. To help overcome these supply and quality

problems, these companies typically hire an agronomist to advise contracted farmers on quality standards, and to recommend some cultural practices which may improve the quality of the raw material. The companies often provide farmers with the seeds, chemical inputs, and financing for labor as a way of helping to assure a supply of raw materials.

The companies themselves are dependent on the seed and agrochemical importers for recommendations on what products to use. These firms tend to rely on European seeds, as they consider these will most closely match developed-country requirements, and gamble that these seeds will produce in a different environment. One tomato paste manufacturer distributes seven different varieties of tomato to his contracted farmers as a defence against disease. While the agronomists are in effect doing screenings on farmers' fields, supervising harvesting and some fine-tuning of the package they offer farmers, these enterprises do not have the knowledge or resources to undertake the required research effort. Furthermore, most being of Asian origin and feeling uneasy about their continued acceptance by the African community, their interest is almost exclusively focused on the short term and annual crops. They are unwilling to be burdened with the long-term commitments that tree crops, or research, would entail.

D. Commodity Boards

The Tea Commodity Board and the Coffee Commodity Board have been very successful. Tea production in Kenya has increased from 36.3 million kg in 1971 to 96.0 million kg in 1982, and coffee production has increased from 59.9 million kg in 1970/71 to 86.1 million kg in 1982/83. Both of these commodity boards support a research program undertaken by a research foundation involving 20-30 scientists and technicians. The research is funded through a cess on the commodity. The Coffee Board, while authorized to assess a cess of 3% on the selling price of coffee, has in recent years chosen to collect a cess of only 1.5%. The Tea Board collects a cess on land area and volume produced. The Coffee Board plans to open a second research station and feel few funding constraints for research from their membership. The Coffee Board supervises and coordinates the research for the national coffee industry. For all practical purposes the Tea and Coffee Research Foundations, although classified as parastatals, operate as private-sector research.

Three organizations in the national tea industry are actively involved in agricultural research: the Commodity Board's research station, (the Tea Research Foundation of Kenya), Brooke Bond (which centers its worldwide research efforts in Kenya), and African Highlands Produce (a large private estate). These organizations share research information, and will not release research information (particularly in the area of processing) to others without authorization of the organization which did the research. The success of coffee and tea research seems due to three strategies: 1) appropriate research, 2) good extension, and 3) rapid, painstaking and accurate reporting on all financial expenditures. These are also characteristics of most private-sector research in Kenya.

E. Non-Governmental Non-Profit Organizations

A large number of religious institutions have chosen to be involved in agricultural development. This often involves trying to introduce a new crop or practice. One of the larger religious institutions in Kenya has been screening different varieties of flowers (principally carnations), and distributing the seed; another has been working with local communities on the production and export of green beans and peas; a third is promoting the introduction, testing, and production of oilseeds.

F. Farmers

The level of agricultural research being done by private farmers is difficult to document. However, some private large-scale farmers in Kenya are very consciously pursuing some form of research in introducing and testing improved lines of livestock, beans, and jojoba, and in developing production technologies for these. It is notable that in carnation production for export, one progressive farmer has carried out much research and technology development to suit his circumstances. In a pragmatic way, all farmers are continually researching, fine-tuning the technologies they use, and often extending their knowledge through informal information exchange.

V. A MODEL FOR ANALYZING THE ROLE OF PRIVATE-SECTOR RESEARCH IN KENYA

Agricultural research can result in the production of four different kinds of technologies which are distinguishable by their physical characteristics:

Mechanical: tractors, seeders, plows, pumps, sprayers, etc.

Chemical: fertilizers, insecticides, herbicides, etc.

Biological: seeds, tubers, cuttings, etc.

Agronomic: planting date, planting density, spray regimes, weeding strategies, etc.

There are structural reasons in each of these types of technologies as to why the private or public sectors may play the greater role. For example, the private sector will have a greater interest in the type of technology depending on the ability to establish ownership over the technology.

The private sector is most attracted to mechanical technology; there simply is no question of who owns a tractor. Mechanical technology represents hard goods which are easily definable, identifiable, and where ownership can be sold from one actor to another.

Chemical technology can also be bought and sold, but for the organization generating the good, ownership is more difficult to control; the product is a chemical formula which can be pirated, the end-user may well not recognize the product without a branded packag-, or the branded package may contain a counterfeit product.

Ownership of biological technology is even harder to establish. It is difficult to distinguish differences between seeds before planting. Most hybrids, by reverting with repeated use, have given the producers of biological technology an ability to establish ownership. In improved non-hybrid seeds (and some stable hybrids, such as closed-pollinated grasses, like rice) where ownership has been more difficult to establish, there has been an attempt to establish legal ownership, and therefore the appeals for "breeder's rights". Breeder's right has been an issue of conflict, as it centers on the capability of establishing or denying ownership of biological technology. This is due to the widely held view that the generation of biological technology through breeding depends more on existing biological materials in nature and less on creativity *per se*.

Agronomic technology is the most difficult for establishing ownership. Date of planting, or spray regimes, or planting densities are not an "embodied" technology and therefore very difficult for the private sector to sell (later in the paper it will be explained the situations in which agronomic technology is of particular interest to the private sector).

While ability to establish proprietorship is a key consideration for private-sector interest in a particular kind of technology, this paper will examine a number of structural differences of each of these kinds of technology which has helped define the roles of the private-sector agricultural research, with particular reference to Kenya.

A. Mechanical Technology

Mechanical technology requires:

Manufacturing capability. The resources required to produce these goods (engineering, property, plant and equipment, finance, scale of production) are of a scale and nature that virtually require the participation of a multinational.

Distribution Network. By its very nature, a distribution network has to be in-country, but the level of investment and support needed to sustain a distribution outlet will require either direct participation by the multinational, or participation of national capital in association with the multinational.

Supply of spare parts. The supply of spare parts will usually overlap with the original product distribution network, but because of the lower level of investment needed to maintain an inventory of certain spare parts, the number of outlets carrying spare parts could be more extensive and localized (a customer may be willing to travel significantly to purchase a new tractor, but will travel less for a new filter). Often, spare parts may be difficult to find (due to import restrictions or high cost of maintaining full spare parts inventories), in which case there will be a lot of local adaptation of parts. This can be considered creative repair work, or a kind of adaptive research and technology development.

Financing. The larger mechanical goods (tractors, combines) may require financing for a sale. Once a product is sold, the multinational in most cases will not be interested in the increased risk of financing the sale. Local finance institutions (usually private-sector) would be in the best position to evaluate the risks and make the appropriate financing available.

Information on the proper use and maintenance of the product. The distribution networks would be interested in disseminating this information. Under particular circumstances, the public sector, particularly with smaller mechanical goods such as insecticide sprayers, would also be involved in disseminating this information.

By the nature of the product, the private sector, and particularly the multinational, will have a critical role to play in the generation and transfer of mechanical technology. Mechanical technology will to a great extent [illegible] brought to Kenya by multinationals. There will be little adaptation of the product (other than in spare parts), though occasionally relatively small amounts of simple equipment may be crafted in small-scale shops. The multinational will require national partners (usually private sector) to sell distribute, sell, finance, and support the use of the product in Kenya.

B. Chemical Technology

Chemical Technology will require:

Manufacturing capability. Again, the level of resources required to produce this technology (research and development, property, plant and equipment, access to raw materials) indicate that the multinational will play the major role in the manufacturing of this technology. However, there is an important distinction about chemical technology from mechanical technology; while the manufacturing itself will be done by multinational concerns, often the final assembly (e.g., mixing and bagging of fertilizers) can be done by a national concern (as is the case in Kenya with MFA Ltd.). The final assembly or formulating of the product is relatively simple and inexpensive.

Distribution network. The distribution network may overlap with the mechanical technology distribution network but may be more extensive, since less investment is required to enter the business. The retail outlets of these farm inputs may be public or private sector, but the key service these outlets must provide is availability of the product when it is needed by farmers. By the nature of having to depend on sales, the private sector may do this better than the public sector. (The public sector may not feel the immediate impact of a lost sale.) Multinationals, or the national concerns branding the product (recall that a label is required to distinguish the product) will support the brand with advertising and promotion. However, again there is an important distinction about chemical technology from mechanical technology, and this is demonstrated in Kenya by the private and public sectors playing divergent roles on the distribution of chemical technology.

The distribution of chemical technology will have the private and public sectors playing increasingly divergent roles. The research and production of the chemical products will remain in the hands of multinationals and their subsidiaries, but the public sector will increasingly control the diffusion of the product. The established private sector in Kenya is of two minds about government regulation of the industry: on the one hand the established private sector has been seeking and has welcomed the setting and enforcing of standards for chemicals by government, as a way of combating adulterated and pirated chemicals; on the other hand, the stringent government requirements for approval for commercializing a chemical product in Kenya has, in the opinion of the established private sector, significantly slowed the introduction of new chemical products. The private sector sees the approval process as unbearably slow and inefficient. The public sector sees the approval process as a laborious prerequisite that must be gone through to protect product users and the environment. As the public sector becomes more sophisticated and knowledgeable about chemicals, while possibly becoming more efficient, it will become more assertive in seeking control of distribution.

Financing. The financing that chemical technology may require may come from the same sources as financing mechanical technology, or from other sources as the level of investment (and therefore the risk) is less, and

more agents (e.g., middlemen/transporters) will be willing to provide the financing.

Information. The information requirements of chemical technology are more complex than of mechanical technology. Not only must information on recommended dosages be passed on to the end-user, but handling of the product itself may present health risks. Often information must also be collected from end-users for appropriate product use (e.g., farmers having to provide soil samples to identify appropriate fertilizer formulations for those soils). It is in the interest of the manufacturers and distributors of chemical products to transmit the information on proper use. However, these concerns may have a bias towards transmitting information that may result in more use of the chemical than may be appropriate. As discussed above, the public sector does have a key role to play in evaluating the use of chemical technology and providing objective advice to users.

C. Biological Technology

Biological technology will require:

Research capability. Much has been written about the various levels of research in biological technology (i.e., basic, applied, strategic, adaptive). However, the key structural distinction of biological technology is that it requires, at the miminum, local verification. Thus, an in-country capability is required for testing biological technology. As has been discussed previously, the private sector's attraction to biological technology will depend on the ability to establish ownership over the product. As this is intrinsically difficult, much of the activity in generating biological technology has been left to the public sector. The public sector, both at the international level (e.g., the CGIAR) and the national level (as in Kenya) have generally done a commendable job of generating this technology. Indeed, it is the nature of biological technology that has provided the opportunity for the development of significant public-sector agricultural research institutions in developing countries. These institutions have been playing a critical role which the private sector has not found it profitable to play. However, as the case of Kenya clearly demonstrates, it is in the field of biological technology that the private and public sectors will most come into conflict as they continue to define their roles in agricultural research.

The single issue most emotionally expressed by public-sector researchers in Kenya is what they see as their mandate to assure that the private sector does not achieve monopoly control over varieties and take advantage of farmers. Public researchers see as their chief weapon to combat that danger the maintaining of an alternative supply of all germplasm. Private-sector researchers express a continuing commitment to share their varieties with the public sector, but seldom do so. It is curious to note that the issue of private-sector control over varieties does not arise in the crops where the private sector has complete control over varieties, such as in tobacco and pineapples. Rather, the conflict centers on crops in which the private sector has chosen (or found it necessary) to make a sudden entrance; such as in barley or sunflower.

This brings the second point, the perceived role of the public sector. Public-sector researchers consider they have a role in the generation and adaptation of technology and in its regulation. To the private sector, and most certainly the multinational group, the public sector may be a source of talent for recruiting, but certainly not a constant source of appropriate technology, and in the government's role as regulator, a constraint to rapid and efficient solution to problems. Examples abound, but one may suffice. A multinational contracted with a prestigious national seed supplier to produce a large quantity of a certain seed to be distributed under contract to farmers. Two weeks before planting date, it became obvious that the seed company could not deliver more than 5% of the seed. The multinational used its worldwide contacts to locate a large supply of seed (found in Nebraska, USA), chartered a 747 jet at significant expense, and flew-in the seed in time to distribute. When the seed arrived at the airport, the public sector refused to authorize its entry, on the grounds that the seed could introduce new diseases into Kenya, that the variety had not been tested in Kenya, and represented too great a risk for the Kenyan farmer. Eventually, a high-level decision permitted the entry of the seed, though slightly delayed for the planting season. The conflict has generated a lot of animosity between all parties involved. The multinational has decided it has no choice but to embark on its own seed production program. Its relations with public-sector researchers is so poor that the company has decided to rely on expatriate research staff. The public research staff are seeking the affirmation at the highest level possible of their statutory right to supervise and control the dissemination of varieties in that crop.

The animosity of the public researchers is exacerbated by a final issue: the wealth of resources seemingly available to the private sector. Public-sector researchers in Kenya (and in most developing countries) are working with severely limited operational funds. Working under such stringent conditions can only cause resentment of a group which seems less affected by such constraints.

Reproduction capability. Seeds, tubers, and cuttings need not only to be produced, but multiplied for distribution to farmers. In Kenya, in general terms the Kenya Seed Co. has provided an appropriate vehicle, and an appropriate model, for commercial seed production. It is clear that the guaranteeing of the product, through seed certification, is a task for the public sector. While the Kenya Seed Co. has had a good working relationship with the government seed inspection service, other private-sector concerns indicate that public-sector researchers manipulate the certification process as part of the perceived competition between public and private-sector researchers.

Distribution network. The success of the Kenya Seed Co. in extending the use of hybrid maize seed in Kenya may be more due to its distribution system than to its ability to produce good seed (which is also vital). The Kenya Seed Co. has distributed its seed extensively, often through neighborhood shops in villages, with the seed packaged in 5-kilo bags which the small-scale farmer can easily buy and transport. The key factor in a distribution network of biological technology is availability at the right time and place, and in this sense is similar to chemical technology.

Financing for seeds will usually not be a large investment, except in the case of tubers, where the biological material may represent a substantial part of the costs of production. Biological research is already developing methods for minimizing these costs, e.g., in yams and potatoes.

Information on biological technology will be largely of an agronomic character. Agronomic technology will now be discussed.

D. Agronomic Technology

Agronomic Technology will require:

Generating/testing/adapting agronomic technology, which by its very nature requires a local focus. As it is difficult to establish ownership over agronomic technology, as has been discussed, the private sector will not seek a large role in doing this kind of research. A key distinction to make among private-sector companies (be they multinationals, national companies, family enterprises) involved in agronomic research is between those companies that seek to:

Improve their own agricultural productivity. This is the case of Kenya Canners. They have no interest in disseminating their research results. Kenya Canners does not welcome visitors to its pineapple plantation. They did set up a demonstration plot, in association with the public-sector horticultural institute in Thika, so that visitors can be taken there to look at pineapples without stepping onto the company plantation.

Sell the product they manufacture and/or distribute. This is the case of MEA Ltd, which will do soil tests for farmers in order to help sell fertilizer. They will have an interest in disseminating recommendations to potential clients, but no more.

Capture the harvest of certain agricultural commodities. This is the case of BAT Ltd., which does research on tobacco as a way of helping to offer a package to farmers which will assure the company the quantity and quality of tobacco they require. These companies will be interested in disseminating recommendations to specific groups of farmers.

E. Management Technology

The complexity of the structural aspects of each of these types of technologies point out the need for an additional technology, and that is management technology. As we have seen, for a mechanical good to reach a farmer many things are needed: manufacturing capability, distribution network, financing, supply of parts, information, fuel, etc. These different aspects of the product must be coordinated, aligned, or phased; they must be managed. In part, the private sector does this by maintaining a client focus and a systems perspective. Thus, most private-sector companies and most farmers share two common perspectives:

1) They seek to improve their economic well-being.

2) They seek to realize that goal by putting together a package (of activities, crops, resources) which will deliver what they need at minimum cost and with limited risk.

By sharing an income-seeking orientation with the farmer, the private sector is more attuned to the goals of the farmer than is the public sector. The private sector can focus on the needs of its client, and can deliver what the client needs for a price. The public sector has great difficulty maintaining a client focus for two essential reasons: 1) the public sector has a multitude of clienteles, and it is difficult for it to focus on one at the expense of the others, and 2) while the private sector receives an immediate benefit from meeting a need (income from sale), the "payments" the public sector receives for its services are much less direct.

Furthermore, both the private sector and the farmer know that delivering a product requires combining and managing a number of resources. The public sector is, of course, also aware of this. The key factor is that while the private sector (and the farmer) can organize itself along product lines to deliver the product, the public sector, because of its diverse and large clientele, will have great difficulty in streamlining its operations to focus on a specific product (e.g., combining research, production, distribution, financing, information dissemination, etc.).

A systems perspective also allows the private sector, and the farmer, the orientation to continually scan the environment, and adjust to changes or new opportunities. The bureaucratic nature of the public sector makes this a very difficult task.

VI. SOME OBSERVATIONS ON PRIVATE-SECTOR RESEARCH IN KENYA

In general terms, as sketched below, the private sector will have an increasing interest and capability to generate and deliver agricultural technology as it moves from agronomic to mechanical technology. The public sector will have an increasing role as it moves from mechanical to agronomic technologies.

	Private Sector	Public Sector
Mechanical Chemical Biological Agronomic	↑	↓

The private sector in Kenya has demonstrated this capability.

While the above illustration seems to hold in Kenya, it is true that the private sector has focused almost exclusively on the commercial farming sector (indeed, as has been indicated, the large private-sector concerns such as BAT, EAI, and Kenya Breweries are all seeking activities with the same group of farmers). The traditional farming sector must be serviced by the public sector (though the Kenya Seed Co. has done an excellent job of disseminating the use of hybrid maize seed in the traditional sector).

Private-sector companies embark on agricultural research for different reasons. Those involved in agricultural production seek a competitive edge. Those selling agricultural inputs seek information that will help sell the product. Some are concerned principally with capturing the harvest of a specific commodity.

The private-sector companies seeking to capture the harvest of a specific commodity have generally entered into agricultural research quite reluctanly, or by default.

First, they have generally looked to the public-sector research for answers. They are soon discouraged to find out that there are no "on-the-shelf" answers.

Second, aware that the public-sector research system is where the key human resources are, they generally offer to help fund the research on a specific commodity or with a specific focus. This is defeated in a short time, if attempted at all. Public-sector regulations in Kenya do not allow for private-sector grants to specific public-sector research projects. Funds must go through the Central Treasury, and great difficulty exists in getting such funds allocated and used for the specific research project.

The next step has been to seek a joint research project, involving a partnership of a public research station (providing the human resources, and often the test plots), and the company (usually providing the

inputs). This usually falls through as the companies become impatient for the kind of research results they need. Public-sector researchers have a bias for increasing yields and for critically establishing scientific reliability in their research results. Private-sector companies have a bias for cost-reducing research and quick results.

Finally, the company simply lures away the researchers to work for them. They are able to do this easily because of their value and reward systems.

Private-sector research has proceeded without conflict with the public sector in commodities where the public sector was not doing research (e.g., tobacco). Conflict has arisen when the private sector has initiated research into crops on which the public sector was active, and where the process described above was not followed. When a multinational has simply brought in its expertise from outside Kenya, very bitter conflict has ensued about public-sector jurisdiction over that specific commodity. The process described above, while potentially slow, has served to ease the entry of the private sector into commodities with which the public sector has been active.

The single most successful coordinating mechanism between public and private-sector research in Kenya is simply the informal contacts that public research staff moving to the private sector maintain with their colleagues and friends in the public sector.

The private sector can hire the research expertise it requires; the public sector has to develop it. While training of research staff can be an appropriate public-sector task, it can place great strains on public research efforts (in this respect, it is interesting to note that in the USA, ten agricultural scientists received a university degree for every one agricultural scientist who went into the public sector).

Researchers who have left the public sector may become more productive in the private sector because they have more adequate resources at their disposal, because they have very specific objectives to work for, and because they are being evaluated on the utility of their work. The improved productivity of the researchers who moved to the private sector may simply be another proof of the "Hawthorne effect". (In 1941, experiments in worker productivity were conducted at the Hawthorne plant of an American electrical manufacturing company. It was postulated that as working conditions improved, worker productivity would be improved. The lighting within the factory was improved, and worker productivity did indeed improve. To further test this concept, the lights were dimmed, and worker productivity increased again. The conclusion drawn was that workers were simply responding to the unaccustomed attention they were getting).

The private-sector companies involved in agricultural research often bring a worldwide perspective to their activities. A multinational will use its worldwide network to find promising technology to import, a family enterprise will distribute European seeds to its contracted farmers, as those seed may better meet European market requirements, a non-governmental organization will contact its headquarters in a developed country in seeking outside assistance.

Import restrictions (legal or de facto) have been an effective incentive for private-sector companies to pursue locally generated agricultural technology.

Private-sector companies have generated technological packages for commodities for which they have a monopoly interest (e.g., tobacco, malting barley), and this has not seemed to lead to an exploitation of farmers growing those commodities. While the companies may have a monopoly in the processing of the commodity, the farmers have had alternative crop choices.

The assignment by government or a national plan of the principal research responsibility for a given commodity to a private firm or foundation has the potential of: preventing the duplication of research activities between the public and private sectors; preventing the scattering of scarce public-sector research resources over a great range of crops; preventing the direction of scarce public-sector resources to research areas where the private sector has a competitive advantage; and reducing friction between public and private-sector research staff.

The public-sector researchers in Kenya see as part of their role that at the minimum they must maintain viable germplasm in some crops to assure an alternative supply of planting materials to farmers. This raises the difficult issue of plant breeder's rights. During 1984, Kenya's largest vegetable export, French haricot beans, was seriously impaired by a conflict between the government and an international seed company over production and distribution rights of the principal french haricot bean variety grown for export. Control over biological technology will continue to be an issue of contention between the private and public sectors. There are no easy answers.

Private-sector firms involved in agricultural research in Kenya have been shifting research resources from the field to the factory. Processing requires more fuel than farming. The increasing price of fuel over the last decade, plus the growing scarcity of foreign exchange to pay for imported fuel, has directed these companies to focus on energy-saving areas for research. Most of the multinationals that have been mentioned are currently directing roughly half of their research budgets to decreasing energy use in processing. BAT Ltd. is developing a farming system to intercrop fuelwood with tobacco in order to be self-sufficient in wood for curing tobacco. An additional incentive for processing research is simply that processing happens indoors; a competitive edge found in the factory is easier to shield from competitors.

Contract research is a mechanism that remains virtually untapped in Kenya. Private-sector firms tend to import their technology or, if necessary, develop or adapt their own. The private sector has generally not called on the research talent available in the universities, and the universities have not attracted private-sector funding for research. For contract research to be a viable mechanism, the research objective must be very specific and tangible. It would most often have to lead to the delivery of a specific output, such as an improved seed. The universities have an opportunity to exploit the scarcest resource for private-sector research in Kenya: trained manpower. But they must be short-term product-oriented research activities to interest the private sector.

VII. CONCLUSIONS AND PROSPECTS

The following could be summarized as conclusions and prospects for private-sector organizations involved in agricultural research in Kenya:

The Multinationals

The multinationals have had some impressive success stories in researching and developing new crops and production technologies. Examples are BAT in tobacco and Brooke Bond in carnations.

The multinationals have been less successful at initiating activities in commodities where the public sector is already active. They have been particularly unsuccessful when they have attempted to import all of the key research manpower, creating strong animosity and probable lack of cooperation with the public research establishment.

National Companies

National companies also have to their credit some impressive success stories, such as the Kenya Seed Co. with hybrid maize seed, and the Kenya Breweries with malting barley. In these cases import substitution and possible foreign exchange earnings have been compelling factors for generating successful research initiatives in the private sector.

Family Enterprises

Family enterprises do not have access to the agricultural technology they need, nor do they have the resources to acquire it. However, there seems to be significant potential for some modest research endeavors in specific fruits and vegetables, possibly on a contract basis with the universities and institutes.

Commodity Boards

The tea and coffee commodity boards have done a very good job of coordinating the interests of government, small-holder farm representatives, and the private estates in supporting research. Duplicating the success of the tea and coffee boards and their foundations in other commodities in Kenya will be very difficult. Large crop volumes are required if a small cess on production is to raise enough money to finance an adequate research program. (A large cess, like a large tax, will merely decrease production.) Furthermore, commodity boards in export markets must master what are often complex marketing rules and practices.

A vegetable commodity board would be extremely difficult, due to the number of crops involved, the relatively small volumes grown in Kenya, and the complexity and exactness of the marketing demands. The Kenya Horticultural Development Authority has tried to fill this role, and has failed. Kenya Canners Ltd. has succeeded in canned pineapples because they can control marketing up to the supermarket door, and because canned pineapples are not perishable.

A sugar commodity board would face the daunting tasks of struggling in a world market where production continues to increase and world demand for cane sugar continues to plummet as artificial sweeteners and other sources of sugar replace cane sugar.

A cotton commodity board cess to finance research would be crippled by the structure of the Kenyan cotton processing industry. The large number of government-owned, unporfitable cotton processing mills seem to effectively preclude the setting aside of significant financing for cotton research.

A maize commodity board that could collect a small cess to finance maize research seems to be a viable possibility. The volume is high enough that a small cess would not adversely affect production, and the National Cereals & Produce Board provides a mechanism for collecting the cess. Nevertheless, to assure the long-term viability of this mechanism, the link between the cess and maize research and increased productivity must be clearly established in the minds of the producers.

Non-Governmental Non-Profit Organizations

These organizations generally focus on small-scale farmers, and thus reach a group the other private-sector organizations do not reach. An important advantage these organizations have over other private sector organizations, and the public sector, is that they generally inspire trust in the people they do reach and, therefore, have an easier task of getting recommendations accepted. However, these organizations lack two critical factors for success: 1) they generally do not have a market for the produce of the technology they extend (and the other private-sector groups usually do), and 2) these organizations rely heavily on voluntary labor; thus the technical assistance they offer may be amateurish, and even potentially counterproductive.

Farmers

Historically, the farmer was the first agricultural researcher and, ultimately, the farmer is the verifier of all agricultural technology. Perhaps the final observation that can be made on the role of the private sector in agricultural research in Kenya is that the farmer can only benefit by having more suppliers of technology, including the public sector, the multinationals, the national companies, the family enterprises, the commodity boards, the non-govermental non-profit organizations, and himself.

It is clear that, in a country like Kenya and perhaps in many similar developing countries in Africa, some attempts should be made at achieving some complementarity between agricultural research in the private and public sectors. The private sector could be encouraged to pursue research in areas of comparative advantage, while the public sector focussed more on areas of biological and agronomic technologies aimed at increasing agricultural productivity at the farm level. Such research would invariably involve strategic quality control and less glamorous research, as well as research aimed at generating information for natural resource management and conservation, and at the small resource-poor farmer in his evolving socioeconomic condition. The resulting

complementarity should bring increased and more effective resources to agricultural research and enhance its contribution to national development.