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**U.S. ASSISTANCE TO
AFRICAN SCIENCE AND TECHNOLOGY:
CONTRIBUTIONS AND ISSUES IN INSTITUTION BUILDING**

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**The views and interpretations expressed in this report are those of the author
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U.S. ASSISTANCE TO AFRICAN SCIENCE AND TECHNOLOGY: CONTRIBUTIONS AND ISSUES IN INSTITUTION BUILDING

INTRODUCTION

The United States, through its foreign economic and technical assistance program, has had a long-standing interest in the advancement of African science and technology. This interest has been evident from the early days of U.S. development assistance programs in Africa. The initial impetus was the commitment of President Truman in his 1949 Inaugural address to "make the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas" and the organization in 1950 of the Technical Cooperation Administration (TCA), one of the predecessors to A.I.D.

The first programs in Africa were in Liberia¹ and Ethiopia beginning in 1950, with agricultural development the priority. It was in Ethiopia that the Point Four concept of technical assistance was first translated into institution building in collaboration with a U.S. university -- a pattern that was to evolve in other parts of the world as well, most notably in India. Beginning in 1951, U.S. assistance to Ethiopia concentrated on creating an agricultural education system. An agricultural technical school was established in Jimma in southwest Ethiopia to prepare students for entry into a university program. The Agricultural College at Alemaya was built and staffed. Both institutions included research programs on domestic crops.

U.S. assistance to Africa increased rapidly throughout the 1950s, with new programs in Kenya, Sierra Leone, Uganda, and Nigeria in addition to those in Ethiopia and Liberia. The basic thrust of these programs was in agriculture, public health, education, and water resources. By 1959, the Foreign Operations Administration, the International Cooperation Administration, and the Development Loan Fund (successors to TCA and later to be reorganized as the Agency for International Development (A.I.D.) in 1961)

¹ U.S. assistance to Liberia began in the 1940's with projects to organize the Department of Agriculture and the Central Agricultural Research Station at Suakoko.

had expended \$163 million for these programs. From these modest beginnings, U.S. assistance has grown both in the number of countries being assisted and in the range of activities covered. A.I.D. is now active in development, economic, and food assistance programs in 42 countries in Sub-Saharan Africa, with a budget in FY 1987 of about \$800 million.

A common thread throughout the past 30 years has been an interest in helping to develop African institutional capabilities in science and technology. I will review in this paper some of the major dimensions of this interest as manifested in the ebb and flow of assistance programs in the agricultural and health sciences, as well as some related aspects of U.S. assistance to African education. I will also discuss some of the principal recent developments in these fields and lessons learned about the task of institution building.

THE HARRAR REPORT

The first major milestone in U.S. assistance to African science and technology was the National Academy of Science (NAS) report on "Recommendations for Strengthening Science and Technology in Selected Areas of Africa South of the Sahara," better known as the Harrar Report (NAS 1959).

In 1958, Mr. James Smith, Director of the International Cooperation Administration, asked the NAS "to explore ways in which science and technology can best be used to maximize the effectiveness of United States foreign aid in that part of the world" (NAS 1959, i). Dr. George Harrar, at that time the Vice President of The Rockefeller Foundation, was selected by the NAS to lead a team of specialists in a review of African science and technology. His report, completed in July 1959, provided "observations and recommendations in the fields of agriculture, medicine and public health, natural resources, engineering and industrial development and general observations in the field of education" (NAS 1959, i). The Harrar group visited 10 African countries, only three of which were independent at that time, namely Ethiopia, Liberia, and Sudan. (The other seven are today the

countries of Zimbabwe, Ghana, Somalia, Uganda, Nigeria, Kenya, and Tanzania)

The dominant theme of the report is the recognition that "Africa's greatest resource...is manpower. The rate at which it can be further developed and utilized will establish the tempo of progress." More explicitly,

Every effort should be made to encourage Africans to engage in private and public enterprises of all dimensions. Local human resources should be developed and utilized to the fullest possible extent in support of national and local enterprise for the exploitation of natural resources, the manufacture of goods, and the development of services. Eventually there will be vast opportunities for entrepreneurial activities by Africans that will create employment and wealth and, at the same time, reduce the outflow of foreign exchange for the purchases of goods and materials that can be produced locally.

None of these developments will be possible, however, without a significant increase in the numbers of Africans qualified to fill positions of national responsibility. ... Nevertheless, with the sympathetic and effective assistance of foreign countries, it can be expected that over a period of years sufficient numbers of trained nationals will become available to satisfy local needs" (NAS 1959, 3).

The report stressed that "there must be a definite trend toward general literacy, an expansion of elementary and secondary education and increased emphasis on university and professional education if Africa is to make substantial economic advances within a reasonable period of time. Every other consideration is subordinate to that of education. and it should be a major area for planning and investment. A major consideration should be the strengthening of established

institutions dedicated to the improvement of African education at all levels" (NAS 1959, 20-21).

The Harrar Report recommended that U.S. development assistance be guided by this view of the preeminence of education and institution building as a basis for development. The report then elaborated on the "specific fields and disciplines that should be given major consideration by foreign aid agencies." It identified "education, medical and public health services, agriculture, natural resources, engineering, technology and industry.... The most significant opportunities are to be found primarily in the fields of agriculture and public health" (NAS 1959, 4).

In its support for the advancement of African science and technology, the Harrar Report gave the highest priority to the agricultural sciences. It recommended a 10 year program with funding of \$149 million. It proposed support to agricultural experiment stations, extension services, vocational agricultural schools, agricultural colleges, veterinary education, tsetse fly control, soil surveys, crop inventories, and animal pathology. "The most pressing need is for the greater production of basic food crops to provide an adequate diet for an increasing number of inhabitants." It was optimistic about the "great opportunities for the improvement of maize, sorghum, millet, rice, for significant increases in the production of a variety of leguminous food crops and for the expansion of acreage in citrus, and other tropical fruits, oil crops and vegetables" (NAS 1959, 57).

Foreseeing the difficulties of agricultural development, the report spoke of the "bewildering array of agricultural problems which represent both a challenge and a danger to foreign aid efforts. The challenge lies in the multitude of opportunities; the danger is that funds and manpower may be so diluted that too little progress is made on too many fronts" (NAS 1959, 62).

While noting the number of excellent research stations already operating in 1959, the report pointed out the need for supplementary

research stations devoted to the food crops and animals that were "most basic to dietary needs and patterns. These stations would deal with land management, soil fertility, rotation patterns, irrigation, disease and pest control, crop and animal breeding, harvesting and processing practices and all aspects of agricultural economics" (NAS 1959, 63).

The report makes an interesting point concerning the transfer of Western technologies that is especially appropriate given recent criticisms of U.S. technical assistance to Africa and reputed attempts to impose Western technology.

It is not possible to transpose the results obtained in the U.S. experiment station system directly into the African situation. However, the development of a comparable pattern of research centers in sub-Saharan Africa would be one of the greatest contributions which the U.S. could make to the African people.

Properly organized and developed, these centers would provide a continuing source of information and materials adapted to the areas in which they are to be produced in quantity. They would serve as introduction and testing stations, as sites for varietal improvement through breeding programs, as locations for studies on soil management and fertility, and as livestock centers for research and experimentation on the management of domestic animals. The role of the proposed experiment stations as training centers for Africans is at least of equal importance to their role as research establishments. Each would provide opportunities for the utilization of significant numbers of African personnel as employees and in-service trainees at sub-professional and professional levels. Eventually some

of these individuals would begin to assume full responsibility for the station program and others would be available for assignment elsewhere in response to growing need" (NAS 1959, 63).

The vision in the Harrar Report for U.S. assistance for African agricultural development was of institution building and the development of indigenous capabilities oriented to the local environment and needs.

In discussing the siting of these agricultural experiment stations, the report recommended that they "be associated with an agricultural college so that ultimately the three principal facets of agricultural science would be brought into phase, i.e. education, research and extension" NAS 1959, 64-65). Subsequent developments have shown how difficult the attainment of this objective was to be.

In public health, the Harrar Report stressed the importance of developing field training at the assistant medical officer and paramedical levels and professional postgraduate training. The report identified institutional development as the main priority and recommended efforts that would building on existing institutions -- such as the medical schools in Dakar, Ibadan, Kampala, Kinshasa, and Khartoum. It also cited good subprofessional training programs already underway in Ghana, Kenya, Ethiopia, and Sudan, which would serve as bases for expanded training programs.

The report identified several African diseases requiring further research and control efforts. But it cautioned about entering into major control programs until trained personnel were available and more was known about the incidence of the diseases and the appropriate priorities for their control. Malaria, nutritional disorders, bilharzia, tuberculosis, enteric diseases, trypanosomiasis, and onchocerciasis were given prominence. A major allocation of funds for a West African vaccination program against smallpox, DPT and yellow fever was proposed. African education, training, and research on the incidence and characteristics of diseases was the recommended focus for U.S. assistance (NAS 1959, 22-52).

In its concluding chapter, the report summarizes its priorities, as they were viewed by the NAS team 30 years ago.

... [T]he rate of progress of the emerging countries of Sub-Saharan Africa will depend completely upon the speed with which manpower becomes available to carry out the multitude of tasks essential to social and economic growth. The political evolution of the African community has moved far more rapidly than the social evolution, and as a consequence the new political entities are generally ill-equipped to handle the technical and scientific responsibilities so fundamental to their sound future development The major emphasis must be placed upon ways and means to educate a very much larger percentage of the African population to the point where they can assume responsibility for the variety of tasks necessary to national well-being.... Aid to education must be directed toward providing more and more persons trained as teachers, medical doctors, veterinarians, specialists in agriculture and engineers.

Next to education, in order of priority, is agriculture. It is clear that food problems have long been and continue to be a major obstacle to human progress.

Along with agricultural development there must be the rational use of renewable and nonrenewable resources including forests, fisheries, wildlife and minerals.

There are great opportunities for improving the general level of public health throughout much of sub-Saharan Africa. The absence of sufficient numbers of qualified medical personnel, the lack of public health organizations and campaigns and the educational and economic levels of rural peoples combine to perpetuate

many of the contagious and epidemic diseases which have been stamped out elsewhere.

Investments in the broad fields of technology will provide an essential base for progress in other fields. Emphasis should be placed on those industrial developments which will most rapidly increase national wealth and hence stimulate economic growth (NAS 1959, 104-110).

I have referred to the Harrar Report at some length to convey the flavor of the first broad look by U.S. scientists at African development problems. Also, the report is important because it provided a foundation for subsequent decisions made on the allocation of U.S. assistance. While the Harrar Report's proposals were not followed as outlined, the philosophy and basic thrust of the report have continued to characterize much of the technical assistance provided by the United States since that time.

U.S. ASSISTANCE AND AFRICAN AGRICULTURAL SCIENCES AND TECHNOLOGY

Higher Agricultural Education

The full range of assistance to African agricultural development is too vast and complex for review in this paper. The heart of the program, particularly in the early years, and its most successful component has been U.S. technical assistance in support of agricultural education. From the beginnings in the 1950s with the Agricultural College in Ethiopia, U.S. assistance has helped promote the establishment of similar institutions in Nigeria (three agricultural faculties and a college of veterinary medicine), Kenya, Malawi, Morocco, Sierra Leone, Ghana, Tanzania, Uganda, Morocco, Liberia, and more recently in Botswana and Cameroon.

In several of these countries, U.S. assistance helped to create entirely new institutions such as the Hassan II Institute of Agriculture and Veterinary Medicine in Morocco, the University of Nigeria at Nsukka, Bunda Agricultural College in Malawi, and the Agricultural College in Alemaya,

Ethiopia. In others, U.S. technical assistance helped to establish new faculties or departments of agriculture within existing institutions, such as at Ahmadu Bello University and the University of Ife in Nigeria, or new animal science, soils, and extension programs, such as at the University of Ghana. In almost every instance, research programs were closely associated with the teaching programs, although usually on a modest scale.

A.I.D. is now completing a series of impact evaluations of its assistance to agricultural colleges and universities in 10 developing countries in Africa, Latin America, and Asia. The African phase has been completed, and the reports are now being published. Six African agricultural institutions were included in the series: the University of Nigeria at Nsukka, the University of Ife, and Ahmadu Bello University in Nigeria; Njala University College in Sierra Leone; the Hassan II Institute of Agriculture and Veterinary Medicine in Morocco, and Bunda Agriculture College in Malawi. A preliminary summary of recent findings, prepared by Gary Hansen, topic coordinator in A.I.D.'s Center for Development Information and Evaluation, observed for the 20 year period 1965-85,

All six agricultural colleges were newly created in the early 1960s and over the twenty years they have functioned primarily as teaching institutions. Thus, through rapid increases in number of students admitted and graduated, their major impact has been in the production of manpower, primarily at the undergraduate level. In most cases their graduates have been employed in the public sector, where they now fill middle and senior level positions in government agencies involved in agricultural research, extension, teaching, and administration. With few exceptions, college curricula and teaching programs have varied in quality from good to outstanding.

The rapid growth in student enrollments has been paralleled by rapid growth in faculty numbers and an upgrading in faculty training. All the colleges now have a solid core of PhD agricultural scientists.

Two of the colleges are establishing a significant record of impact in their research programs, whereas agricultural research at the other colleges has been less notable, primarily because of funding constraints, academic compartmentalization and faculty promotion incentives which do not support relevant research (Hansen 1986, 1).

From the perspective of the conclusion reached in the 1950s that the need for African professional manpower should be a prime concern in African agricultural development, the creation or strengthening of these institutions is a major achievement in U.S.-African collaboration on African scientific and technological development. The task at that time was the education of African agricultural scientists and the development of institutions to sustain that growth. In those countries where there were few, if any, African agricultural scientists during the 1950s and early 1960s and where expatriate specialists predominated, there was a powerful motivation to create indigenous institutions of higher agricultural education. The mission was clear and government commitment strong. As a result, agricultural programs and related institutions are today staffed and led by African scientists.

The Hansen report also identifies a number of "second generation issues" that must be addressed in the coming decades if institutional growth is to continue. Markets for undergraduates are saturated, and new employment opportunities outside public service must be identified. The scarcity of resources for research and outreach is undermining the effectiveness of the faculties and is resulting in cutbacks in laboratory and fieldwork and a shortage of locally generated teaching materials and thus is causing a decline in the quality of academic education. Links to farming communities are limited and weakening; students, not farmers, have been the primary clientele. Agricultural faculties are isolated from new developments in agricultural sciences abroad and from the mainstream of agricultural activity in the home country. Faculties have limited experience with

problem-solving and multidisciplinary research relevant to local farming conditions (Hansen 1986, 1,2).

In summary, the report points out that "institutional capacity has been put in place. Now this capacity needs to be strategically positioned to perform more diversified education, research and outreach roles. In the absence of measures to accomplish this objective, the colleges, and previous long term A.I.D. [and African] investment therein, will likely wither" (Hansen 1986, 3).

Noting some of the accomplishments at Ahmadu Bello University, and the Hassan II Institute of Agriculture and Veterinary Medicine, as well as at other institutions outside Africa, Hansen sees the need to "move from institutional development to a systems development agenda." This systems approach would include an expansion of the college mission to include farmers as a major clientele, a linkage of colleges to rural development programs sponsored by the government or external donors, the development of exchange programs with other national and international institutions to help colleges stay informed of advances in the agricultural sciences, and a continuing evaluation of the agricultural environment to ensure the relevance of agricultural programs to future requirements (Hansen 1986, 3).

The Hansen report concludes that "the first phase on institution building for the six agricultural colleges is over -- colleges are in place, and in some cases more institution building efforts will be needed in the development of graduate programs. In any case, current capacities frequently remain poorly utilized because the colleges operate in isolation from what is usually a fragmented research, extension and agri-service system. Stronger coordinative linkages are needed in bringing these elements together in a system where resource allocations are driven by a common program agenda." The report warns that without such collaboration in the agricultural sector there will be further institutional duplication, overbuilding, and a severe shortage of funding for recurrent budgets (Hansen 1986, 4-6)

Agricultural Research

In a recent study of U.S. assistance and agricultural development in six African countries, Johnston et al. conclude that the U.S. efforts in building African research programs have clearly not been comparable to its contributions to the building of agricultural colleges. "Both A.I.D. and African governments have failed to take the necessary steps to develop effective national agricultural research systems.... Many of the research projects that were funded were short-term, fragmented efforts that could not be expected to make a significant contribution to the necessarily long-term work of building a national capability for research" (Johnston 1988, 158).

In the early years, research may have been neglected as a consequence of concentrating on educating African agricultural scientists and developing African agricultural educational institutions. Research was certainly a part of the college programs, but in most instances, its scale was too modest. Educating African agricultural scientists was the first task.

Also research has not been as politically attractive to African leaders, who were more interested in programs with early results and impact. As a result, shortages of resources and the lack of recognition for research inhibited faculty members from making greater contributions. In addition, domestic organizational issues, which keep agricultural education and research apart, have impeded collaboration between the best research talents in the universities and the ministries and other agencies with control over resources for research.

Similarly, U.S. assistance, which was influenced by the basic human needs drive of the 1970s, was not supportive of long-term research and related institution building. Also a "technological optimism" prevailed in the early years, manifested in a faith in the efficacy of existing technologies and a belief that new ones could be quickly identified. Western technology would suffice, with some adaptation (Johnston, 1988, 159).

Despite these adverse influences, by 1980 a majority of African countries were engaged in some form of agricultural research supported by U.S. assistance. Some of the research was a component of other agricultural production activities related to a particular problem such as dryland cropping research in Kenya or maize and rice production research in Nigeria. In other countries, like Malawi, Sudan, Cameroon, Chad, Zaire, Somalia, Sierra Leone, and Lesotho, research institution building received more direct attention. Also some significant research work is evident in several of the college programs. For example, the Hassan II Institute in Morocco has carried out some important work on date palm diseases, dryland agriculture, and dairy livestock. Ahmadu Bello Agricultural College in Nigeria and the affiliated Institute for Agricultural Research has undertaken some pioneering work on farming systems research.

In addition to these activities, A.I.D. is funding an abundance of research activity in Africa through several centrally funded programs. The Program in Science and Technology Cooperation (PSTC) and the U.S.-Israel Cooperative Development Research (ICDR) program support numerous research projects in Africa, such as studies on food contamination or use of agro-bacterium rhizogenes in Tunisia, tomato production in Somalia, and biochemical aspects unique to the parasite (striga)/host (sorghum) system in Sudan. The Board on Science and Technology for International Development of the NAS (BOSTID) has made grants to the University of Nairobi for research on the selection and introduction of grain amaranth for dryland and semiarid climates and to Bunda College in Malawi for research on fast-growing, nitrogen-fixing trees and their effect on crop yields and soil properties. The Historically Black Colleges and Universities (HBCU) are also involved in agricultural research in Africa, such as Lincoln University's project on nutrient analysis of vegetation in Burkino Faso. The A.I.D.-funded Collaborative Research Support Program of the American Land Grant Universities includes several subprojects in Africa, such as on small ruminants, sorghum and millet, peanuts, and tropical soils. These research activities help, to a limited extent, to overcome some of consequences of the shortages of funds available to African institutions for specific studies and may make a small contribution to institution building, although that is not their purpose.

As is evident from the Harrar Report, U.S. assistance to agricultural research in Africa has, from its outset, recognized the importance of national agricultural research systems and the need for significant institution building--at least in principle if not consistently in practice. For example, the concept of a network of ecologically based experiment stations was recognized in that report. A critically important beginning has been made in this area by the international agricultural research centers in Africa--IITA, ICLA, ILRAD, WARDA, and INCIPE--which receive major support from U.S. assistance.

Two milestones in the evolution of African research programs and U.S. assistance were the 1968 Abidjan Conference on Agricultural Research Priorities for Economic Development in Africa and the 1972 NAS Report on "African Agricultural Research Capabilities" sponsored jointly by the NAS and A.I.D.

The Abidjan Conference provided the first opportunity for African, U.S. and European scientists to meet and jointly consider the priorities for agricultural research. About 200 delegates from 32 countries participated in reviewing problems and assessing priorities in 11 technical and program areas: soil and water management, animal health, animal production, cereal crop production, industrial crop production in humid and savanna zones, economics of agricultural production and marketing, grain legumes and root crop production, education, crop protection and storage, and research institutions. It was at this meeting that The Association for the Advancement of Agricultural Sciences in Africa was formed.

In the discussion on agricultural research institutions, the conference focused on ways to "increase effective research." The participants were particularly interested in ways of deciding research priorities, performing the research, and ensuring that the results are applied. "Problem-solving research is not complete until results have been published... and reflected in the welfare of the people." They also stressed the importance of close associations of research organizations and universities--advice that has not been readily followed, as the Hansen report points out. The participants

concluded that for the purposes of economy and efficiency, the priorities should be (1) strengthening national programs, (2) developing national programs that have unique strengths and extending them to serve additional countries, and (3) strengthening existing regional programs to meet the needs of different ecological areas.

Some of the participants at the conference focused on the role of universities and schools of agriculture in research and manpower development. Their primary concern was the training in Africa and abroad of African scientists and technicians in programs that would build their capabilities to work on African agricultural research problems. Research should be "preponderantly such as to contribute to the needs of local agriculture." They also stressed the importance of close associations of university research with similar research in government institutions, other educational institutions, and independent (including commercial and industrial) research organizations. National research authorities "through financial support of research, could assist universities and other institutions to play a fuller part in the agreed program" - advice that continues to be important today (NAS 1968, 55-57).

Four years later the NAS, at the request of A.I.D., undertook a comprehensive review of African capabilities for agricultural research and laid out a broad range of recommendations for research priorities, including agricultural systems, soil and water management, cereals, grain legumes, roots, tubers and plantains, vegetables, fruits and nuts, sugar, beverages, fibers, oil plants, commercial crops, animal resources, pests and pathogen systems, science policy, communications, institutions for research, and manpower development. Again it pointed out the importance of strengthening existing national research stations and establishing close links with international programs. "Improving the quality of staff at research stations is of paramount importance. To accomplish this, governments will need to lift constraining civil service regulations, supply better laboratory and housing facilities and develop better communications with university faculties of agriculture and with field service units" (NAS 1972, 253).

The Harrar Report in 1959, the Abidjan Conference in 1968, the NAS study in 1972, and the Hansen summary in 1987 echo each other on the basic issues and themes of the effort to advance African agricultural sciences. Certainly much progress has been made in creating key institutions and educating highly competent African agricultural scientists. Yet the concerns persist about manpower and funding shortages, weak linkages, and limited impact. Our review of agricultural university and research programs in other countries outside Africa reflects to varying degrees a similar condition.

The opening comments on agricultural research point to some of the reasons for the slow growth of support for research in assistance programming and development priorities. Others more expert in the field will have richer insights, but some of the conclusions of A.I.D. impact evaluations on agricultural research and agricultural universities worldwide may point the way.

In the Fall of 1983, the Center for Development Information and Evaluation in A.I.D. completed its Program Evaluation Report, "Strengthening the Agricultural Research Capacity of the Less Developed Countries: Lessons From A.I.D. Experience." This report is a comprehensive analysis of existing evaluation documents concerning completed A.I.D. projects; eight projects in Africa, Asia, and Latin America were selected for in-depth field evaluations. Five conclusions stand out from these studies:

1. Host government commitment and support to research is essential. This commitment will determine the sustainability of the research project and the use of research findings. A continuous dialogue among politicians, administrators, and researchers is necessary, along with evidence of the potential benefits from research.

2. Technological solutions alone cannot solve problems which have political, economic, and social dimensions. Agricultural research programs should be selected within a much broader rural development policy and planning framework.

3. Research should be farmer-oriented. It will be essential to establish, maintain, and use a two-way information system among researchers, extension service agents, and the farmers.

4. Inadequate management of limited resources, especially a high rate of attrition among skilled staff, can undermine the effectiveness and sustainability of an otherwise satisfactory program. Training skilled researchers has been found to be the most successful component of many research projects, but the training provided should be adapted to the realistic needs and capabilities of the country, in choice of discipline, level of education, and timing of the training. Returning trainees should be assured of satisfactory material, professional incentives, and rewards comparable to those offered to other public servants.

5. Coordination among researchers and other development actors, from farmers to politicians, is the key to success. A research system will be most effective if the many actors who influence its success are involved in a network in which their needs are identified and through which the interaction between different sectors of development are as synergistic as possible (Murphy 1983, vi-viii).

Table 1 provides a summary picture of the conditions that were found to favor the development of the effective research systems reviewed in the evaluation. These conditions reflect many of the essential elements of institution building. Taken together and posed as questions, they provide a guide for assessing effective institution building in agricultural research in Africa.

Trends in U.S. Assistance to Agriculture and Current Policy

In a functional review of agricultural programs financed by A.I.D., the Africa Bureau reported on the trends in the allocation of U.S. assistance to agriculture and to various subactivities within the agricultural program. Overall, from fiscal years 1979 to 1987, the budget for agriculture has increased from \$218.7 million to \$317.1 million (it peaked at \$400.6 million in FY 1985). The agricultural program share of total U.S.

Table 1 Highlights of Conditions Found Favorable to Effective Research Systems¹

A. Host Government	B. AID Assistance
<ol style="list-style-type: none"> 1. The host government is committed to providing sufficient human and financial resources for research activities. 2. Pricing mechanisms and other government policies are conducive to expanding production of crops being researched. 3. Complementary services (such as extension, inputs, marketing, credit, roads, irrigation) will be functioning when needed for adoption of research results. The private sector is allowed to participate in the provision of such services. 4. Research priorities are established as part of a comprehensive development plan. 5. Coordination is encouraged among research, extension, services, and training institutions. 	<ol style="list-style-type: none"> 1. Assistance to agricultural research institutions is designed as a long-term activity, preferably 10 years, with option to redesign or extend on the basis of regular evaluations. 2. Assistance is integrated into the entire program of assistance to the country. 3. The AID in-country mission is capable of providing the required logistic support and problem-solving assistance to the project contractor and the host country, and includes staff members with knowledge and understanding of agricultural development and research issues. 4. AID assistance is implemented through a government entity which can coordinate its activities with those of related institutions and programs. 5. Training programs are adapted to future needs and scheduled to complement on-the-job training with foreign technical assistants.
C. Research Institution	D. Research Program
<ol style="list-style-type: none"> 1. The institution benefits from stability in its research staff (i.e., sufficient incentives to keep them) and from the presence of competent managers as well as knowledgeable researchers. 2. Funding and research priorities remain assured and stable over the duration of a research program. 3. The research staff forms a multidisciplinary team including social as well as technical expertise. 4. Linkages are established and maintained with other related in-country, regional, and international research institutions. 5. The research institution exchanges information with the extension services and agricultural training institutions. 	<ol style="list-style-type: none"> 1. The overall research takes into account existing farming conditions and the natural, economic, and social conditions that affect change. This does not mean that basic research may not also be necessary. 2. Base line data on actual farming practices and results are necessary both to establish research priorities and program design and to verify the results achieved. 3. The expected research results should clearly be worthwhile from the farming household's point of view. 4. The research program should include on-farm testing of results, possibly in coordination with the extension service. 5. Correct promotion of research results to the farmers should be assured.

Excerpt from ~~NAS~~ ^{AID} 1985

assistance, however, has dropped from 69 percent to 59 percent. From 1979 to 1987, the portion obligated for agricultural education declined from \$36.3 million to \$19.6 million, or from 16.6 percent to 6.8 percent of the agricultural budget. For agricultural research (called technology development in the report), the levels increased from \$31 million to \$46 million, or about 14 percent of the agricultural budget each year. While there has been some growth in dollar terms for research, the share of total assistance for these two key dimensions of African development is a matter of concern. The primary factor causing these shifts has been the rapid increase in program and sector assistance, addressing short-term policy and balance of payment issues, which has accounted for about 25-35 percent of the agricultural budget (USAID, 1987c, 14-15).

In 1985, the Africa Bureau adopted a "Plan for Supporting Agricultural Research and Faculties of Agriculture in Africa." The two-prong program provided for "the strengthening of national agricultural research systems in approximately eight core countries and building strong applied research capacities in neighboring countries to enable local scientists to screen and borrow technologies and adapt them to local environments." In addition, "long term assistance will be provided initially to four to six faculties of agriculture and other research institutions and programs" (USAID, 1987c, i).

Drawing on experience with past programs, the plan identified nine guiding considerations for the implementation of the expanded program. These include a concern for more explicit objectives for research; an emphasis on selected countries, commodities and problems; more support for commodity research; more concentration on food crop research to support income and export growth; improvements in the complementarity among A.I.D.'s various mechanisms for investment in research and faculties; improvements in management capabilities; finance for recurrent costs; closer cooperation with other donors in planning and carrying out these investments; and the need to make a long-term commitment toward the development of agricultural research and higher education (USAID, 1985, 8).

A.I.D.'s "U.S. Assistance Strategy for Africa - 1987-1990", points out that Africa "faces a serious development crisis. Many African nations are experiencing continuous economic disequilibrium and decline. The recent drought and resulting food emergency have been the most dramatic manifestations of these disturbing trends." The strategy statement also points out that "over the past two decades per capita food production has declined by 16%." At the same time, it notes that the medium-term prospects for food security on a continent-wide basis is better than for individual countries. While food production has grown at a very slow rate (1.8 percent a year on average over the past decade), "the 85/86 bumper harvests estimated at about 54 million metric tons of food grain illustrate the point when compared to estimated total demand of about 57 million metric tons for this year." Yet "meeting the growing demand for food implies a growth in food production of about 4 percent a year. Achieving and sustaining this rate of growth will likely be very difficult, requiring substantial investment in agriculture and making the most of physical potential" (USAID, 1987c, 2-5).

What this prognosis suggests is that Africa's leadership and the donor community must demonstrate a resurgence of support for agricultural development, focused on improving rural incomes and production through structural reforms that create better incentives, new learning from research and education, and high-quality institutions to sustain the effort.

The agricultural crises of the last 10 years have introduced a renewed motivation for strengthening Africa's science and technological development. In the 1950s, the mission and the political commitment were clear. Now, in a more complex setting, is the motivation as strong? Are the missions and overall purposes of Africa's agricultural institutions well defined? Are these institutions capable of the dynamic changes and growth required to keep pace with their environments? Are they joining in a coordinated attack on priority problems? Or are we seeing a destructive competition for financial and human resources that will undercut effective performance? Are African leaders as committed to the growth and involvement of agricultural institutions as they were to their creation in the 1950s and 1960s?

U.S. ASSISTANCE AND AFRICAN HEALTH SCIENCES AND TECHNOLOGY

Health Sciences

The pattern of U.S. assistance to institution building in public health in Africa has been somewhat ambiguous. The U.S. commitment to health in the early decades responded to an uncertain trumpet. The importance of health to economic development was heatedly debated by economists and public health specialists, by advocates of capital investment for growth and advocates of investment in social services, and by advocates of clinic-based services and hospitals and advocates of rural health services. Throughout the past 30 years, there has also been a shifting in emphasis between categorical, vertically structured health campaigns and multifaceted, primary health care systems. The impetus for categorical programs was frequently the opportunity, through direct action, to eradicate or reduce the incidence of specific diseases such as malaria, smallpox, measles, and onchocerciasis. Multifaceted primary health care programs emphasized institution building and long-term results over a wide range of health services.

In the 1950s, as evident in the Harrar Report, public health was recognized as one of the priorities for U.S. assistance. And in those early years, U.S. assistance supported some significant programs. One of the most notable was support for the Public Health College at Gondar, Ethiopia, which is now a medical school in the Ethiopian university system.

In the 1960s, however, U.S. assistance to African health programs was not encouraged. In Nigeria, during a major program buildup from 1960 to 1965, A.I.D. leadership categorically excluded health from its priorities of institution building in education and agriculture. And as late as the early 1970s A.I.D. resisted new health program initiatives in Africa. The notable exception was the successful smallpox campaign. The opportunity to eradicate a specific disease caught public attention. Motivated by the technological possibility of eradicating smallpox--an objective of

worldwide significance to developing and developed countries alike--the mission was clear. Institution building was not an important consideration of the campaign, although many African scientists and technicians participated in and learned from this unique experience.

When the smallpox program came to an end in 1977 with the last case in Somalia, it was assumed that there would be no further assistance of this kind. However, a residual concern about the need for some longer term institutional development and training and the recognition that measles was a continuing problem led to the creation of the Strengthening Health Delivery Services project which began in 1971. This project which concentrated on West Africa, improved regional disease surveillance and health data systems, national health planning, regional health training centers, and institutional linkages. This was also the time when primary health care programs, spurred by the 1978 Alma Ata Conference, encouraged greater attention to the creation of primary health care systems. Major primary health care projects were initiated in Niger, Zaire, Lesotho, Liberia, Kenya, Tanzania, Cameroon, Botswana, and Sudan.

By the 1980s a compelling international interest in addressing basic health needs brought about a shift in focus to childhood diseases. The Africa Bureau in A.I.D., anticipating this interest, initiated in 1979 the \$49 million Combatting Childhood Communicable Disease (CCCD) program. The program's goal was to reduce the incidence of morbidity and mortality resulting from malaria, measles, DPT, and diarrheal diseases in 15 to 20 countries. Reinforced by the extraordinary increase of funding for child survival programs worldwide beginning in 1985, the Africa CCCD program is being extended to other countries.

Over the past 30 years, A.I.D. health programs in Africa have reflected the swings between institutional and manpower development and campaign-type programs. These shifts were, of course, never absolute and there were elements of both orientations in the active health programs. In Ethiopia, the health program evolved from support to the Public Health College to a major malaria eradication program. In Ghana, the shift was from smallpox/measles campaigns to family health care research, health care

planning, and the introduction of courses on community health in the medical school curriculum. In Liberia, the shift was from the construction and operation of the JFK Hospital to outreach health services. And in Zaire, the initial programs for combatting measles and childhood diseases have evolved into a broader program of health care services through private religious organizations and the formation of a public health college.

The question of institution building in the health sciences has been an underlying concern during these decades. In some ways, the period might be characterized as a search for a sustainable approach. The swings from direct campaigns, in which institution building was a subordinate objective, to primary health care systems development, in which it was the dominant goal, reflected the tension between those pressing for immediate attention to critical diseases and those wanting to build permanent capacities to address a wide spectrum of curative and preventive health issues. The perceived urgency of the goal of smallpox eradication or, more recently, onchocerciasis control and of the need for rapid immunization for childhood diseases minimized attention to creating capabilities to carry forward these and similar programs without external assistance. This does not detract from their extraordinary accomplishments but does raise issues of preserving the progress made and building on it. Yet some important achievements were made during this period in building African capabilities in health care service delivery, from both a medical and a management perspective. The primary health care programs started in the 1970s in several African countries laid a basis for health care delivery.

But it is interesting to observe that in the same year that the World Health Organization (WHO) and the international health community were promoting the organization of integrated primary health care and health for all by year 2000, a NAS committee cautioned that there was no "strong evidence that this approach has been demonstrated to be clearly cost-effective and ready for widespread and relatively rapid replication ... [T]he development of a system directed toward multiple objectives vastly increases the complexity of the task while sharply reducing its probable successful implementation.... In the [NAS] committee's judgment, it may make sense in some situations to develop an operative structure for the execution of one

or two functions, gain experience and the trust of the recipients, then add an additional function, and later yet another" (quoted in Buzzard 1987, 45). The NAS committee pushed for categorical programs. Some of those involved in health care programs also argued that established health care systems resist the extra burdens of add-on programs, as was evident when attempts were made to add family planning services to the responsibilities of rural health post staffs.

A.I.D. support for primary health care programs weakened in the face of field experience, which appeared to reflect the NAS committee's conclusions, and the overwhelming attractions of child survival initiatives. A.I.D.'s current major interest is almost exclusively with child survival programs. As the program has developed, however, there has been a growing concern about its sustainability. Unlike the case of smallpox, eradication of childhood disease is not a feasible objective for assistance programs; permanent national capacities in personnel, organization, and finance must be established. The search for a sound approach to institutional development in African health sciences and services continues.

Health Research

Research on African health problems, and particularly support of health research institutions, has not been a major concern of U.S. assistance programs. Nonetheless, a number of activities have been supported in both basic and operational research. For example, A.I.D. has for many years supported research activities on schistosomiasis in Cameroon and Sudan on schistosomiasis and cancer research in Tanzania, and is continuing its support to the development of a malaria vaccine in its worldwide research program. A major research program in health and family planning services was carried out in Ghana.

The more significant research, however, has been that performed in conjunction with disease control programs. For example, the Onchocerciasis Control Program has included research on larvicide development, drug development, a test for detection of early infection, and

other technical and socioeconomic studies related to the black fly vector (USAID 1986, 5). In the CCCD program, U.S. Centers for Disease Control epidemiologists have carried out numerous operational research activities, such as on the spread of resistance to chloroquine treatments for malaria and studies on the dosage and uses of oral rehydration solutions for treatment of childhood diarrhea. Many African medical and health specialists received training in these research endeavors. But the creation or strengthening of research organizations has not been a principal goal.

U.S. ASSISTANCE AND AFRICAN PROFESSIONAL EDUCATION IN THE UNITED STATES

U.S.-funded participant training programs have been the clearest embodiment of the theme of helping to develop African capabilities in science and technology through African institution building. The term "participant training" reflects the aim of preparing African professionals to carry on the programs initiated jointly with African governments. The term "scholarship program" was rarely applied to overseas education because it emphasizes personal gain rather than program capacity building. Participant training has been a standard feature of almost every project A.I.D. has undertaken. In all cases, it was understood by everyone involved that the individuals selected for education in the United States would return to the program and, in most instances, replace the U.S. specialist. Over the years, the evidence shows that well over 90 percent of those who received project related overseas education returned to the project--at least for a short time.

But in the early years of U.S. assistance, there was also the view that a much more extensive effort was necessary to accelerate the development of African professionals in fields of importance to African development. The numbers of Africans attending U.S. universities and the opportunities in African universities were considered too limited. At the same time, there was concern among some American university leaders, prompted by a few African leaders who had been educated in the United States that Africans did not consider U.S. higher education to be comparable to a European education. Members of the African establishment, particularly those in

education in the 1950s and 1960s, were still heavily influenced by their colonial heritage and believed in the superiority of the European university system. Thus Africans with undergraduate and graduate degrees from U.S. universities had difficulty competing for positions in government and educational institutions after returning home.

Together, these two concerns led to the establishment of several major programs for African professional education in the United States. One of the most significant was the African Scholarship Program of the American Universities (ASPAU), which began in 1961 and ended in 1975. This was followed in 1963 by the African Graduate Education Program (AFGRAD). Under the ASPAU program, some 1,600 Africans, many of Africa's best students, received their undergraduate education in leading U.S. universities. Unfortunately, only a small percentage--about 35 percent--of them have returned. Under the AFGRAD program, more than 200 Africans have received advanced degrees from over 200 participating universities; about 90 percent of AFGRAD students have been returned to their home country. (In 1985, the AFGRAD program began to offer 50 short postgraduate fellowships intended primarily for policy makers, researchers and scientists.)

As African universities were established, African leaders began to object to the ASPAU program because it competed with the local universities for students. In its place, the INTERAF program was established to provide scholarships for Africans to attend African universities outside their home country in order to pursue degree programs not available in their home country. From 1975 to 1984, a special program combining the features of ASPAU, AFGRAD, and INTERAF offered Africans from Portuguese-speaking countries the opportunity to pursue studies in agriculture, education, health, rural development, public administration, and economic planning. About 430 Africans participated in this program.

In a few instances, individual A.I.D. country programs had special projects for specifically targeted groups of Africans. One of the most interesting was the Future Agricultural Leaders program in Nigeria, which sent over 300 Nigerians to U.S. agricultural universities. This program was intended

to complement the work of establishing faculties of agriculture within Nigeria. A similar project was undertaken in Southern Africa. In some instances, these country projects focused on specific African institutions. The University General Support project in Ethiopia from 1969 to 1980 was tied to the faculties of agriculture, public health, education, and, to a lesser extent, arts and sciences and to university administration. An even more focused project was carried out between 1978 and 1983 for the National Agronomy Institute of Tunisia to prepare PhD-level faculty in animal, plant, and soil sciences.

Statistics on the number of Africans who have received advanced education in the United States financed by A.I.D. are scarce, particularly for the years prior to 1980. But rough estimates suggest that between 1950 and 1986, 25,000-30,000 Africans received undergraduate or graduate education in the United States. A roughly equal number participated in short term (less than one year) programs. Between 1980 and 1987, the number of participants in academic degree programs of 1 year or longer averaged 2,000 each year (2,179 in 1987). Also during this period, the number of students in graduate programs increased by 66 percent, while the number in undergraduate programs declined. A.I.D.-assisted African students in agriculture, education, and health increased by 15 percent. About two-thirds of these students were in graduate programs; one third were in engineering, mathematics, computer science, and physical science programs. Based on the statistics for Africans attending U.S. institutions of higher education funded by all sources--public, private, individual--it appears that without the U.S. assistance program, very few Africans would be attending U.S. universities in agriculture, education, and health.

Unquestionably, participant training programs have added markedly to African institutional capabilities. Examples abound of individuals in African institutions who obtained their advanced education in science and technology in the United States. But beyond anecdotal evidence, how does one measure the impact of these programs on African institution building?

First, one has to subtract from the total number trained those who have not returned to Africa (e.g, the 65 percent of the undergraduates in the ASPAU

program) or who have left their countries for positions in international organizations or private business in other countries. Certainly the lack of suitable well-supported positions in African institutions has diverted many, as have periods of political instability and civil strife. For some countries, like Ethiopia or Uganda, domestic crises have resulted in major setbacks in expanding the institutional capacities that existed in important areas of development activity. Countries like Nigeria and Zimbabwe, however, have conscientiously and successfully worked to induce their professional compatriots to return from abroad after periods of domestic crisis.

For those who have returned and stayed, what have been the opportunities to apply their advanced learning and knowledge of development problems and skills? How have they been able to contribute to their country's economic and social progress? Evaluations of the impact of participant training have generally been limited to attempts to determine what has happened to individual participants and how they have benefited from their participation. We are now experimenting, through our participant training impact studies in Kenya, Nepal, and Indonesia, with an approach that attempts to determine in greater depth what have been the effects of these programs. Since we do not yet have the results of these studies, however, we continue with the rarely challenged view that the returned participant is playing an important part in African institution building and national development.

INSTITUTION BUILDING AND THE SUSTAINABILITY OF U.S. INVESTMENTS IN AFRICAN SCIENCE AND TECHNOLOGY

What can we conclude from this broad look at U.S. assistance to African science and technology? How has this assistance affected the ability of African institutions to advance African development? What are the factors that have influenced the accomplishments?

In recent reviews of sustainability in development, several categories of factors have repeatedly been associated with the sustainability of

investments in development. Although there is no agreed hierarchy of the importance of these factors, they all are evident in varying degrees in each of the programs discussed in this review. These categories are management and organization, host government policies, finance, technology, socio-cultural setting, environment and ecology, external political and economic circumstances, and program design and evaluation (DAC, 1988). One study of sustainability as part of the development process focused on three conditions that encourage sustainability: policy incentives to reinforce long-term results, institutions to mobilize continuing support, and management systems to set priorities and adapt activities (U.S.AID 1987d).

A careful analysis of African programs in agriculture and health would demonstrate the importance of all of these factors to varying degrees. But without attempting a category-by-category review of A.I.D.'s assistance in agriculture and public health, what are some of the most significant conditions among those cited above that characterized and affected the development of African scientific and technological achievements? I suggest that there are three broad considerations that stand out: commitment and continuity, time dimensions, and leadership.

The commitment and continuity of the political and professional leadership in Africa and the United States stand out as a vital feature of programs in the agricultural and health sciences. The commitment was not maintained consistently over the 30 years and varied by project and across the board. In the early years, African and U.S. leadership shared a common sense of mission in approaching the challenge that lay before them. The aim of developing African professional and institutional capacities was a highly motivating interest that was shared broadly and in specific projects. A sustained commitment was evident, for instance, in the development of several of the agricultural colleges and faculties, perhaps most distinctively at the Hassan II Institute of Agriculture and Veterinary Medicine in Morocco, where a close collaboration continues after 25 years. While less significant in terms of institution building, an outstanding commitment was evident in the smallpox eradication program and the current Onchocerciasis Control Program. In these instances, a willingness

to maintain an effective program for an extended period of years overrode counterinterests, pressures, and external events.

However, the commitment to institution building in science and technology, evident in the drive of the initial period was not consistently maintained throughout the 30 years. Several considerations have affected a sustained interest. For one, U.S. interests in development made a fundamental shift in the 1970s, when the concern for addressing basic human needs in programs with direct and relatively immediate impact became the dominant criterion for resource allocations. In the first years of this view of development assistance, the relevance of long-term institution building and even professional graduate education programs for Africans was challenged. As a consequence, assistance programs were shifted to rural development schemes directed to specific poor communities and away from building institutional capacities. This shift was evident in most African countries receiving U.S. assistance. For example, in Tanzania, regional development programs were given precedence over the continuation of assistance to the Agricultural College at Morogoro (now called the Sokoine Agricultural University). The current focus on policy reform and program assistance--while certainly important--may be having a similarly adverse effect on institutional development.

Second, instability in Africa's political and economic systems has had a profound effect. Internal civil unrest and conflict have deterred long-term development activity and have discouraged the return of Africans who are pursuing a professional education abroad. Economic and financial crises and major periods of drought and famine have diverted attention and resources to short-term relief and stabilization programs. The common driving interest in the Sahel Development Program was the desire to avoid the repetition of the famine of 1974/75; programs to promote rapid increases in food production took priority over institution building efforts.

Third, and perhaps most fundamental, the original consensus on the primary mission of institution building and professional education became less clear and decisive. The Hansen analysis on agricultural higher education raises this issue and points out the need for a redefinition of and a new

commitment to the role of agricultural education, research, and extension in African agricultural development--a commitment that must rise above the institutional compartmentalization that plagues effective development activity. Donor programs, which can provide the critical margins for continued growth, can either exacerbate this compartmentalization and the proliferation of institutions to which it leads or promote the effective use and linkage of the institutional capabilities already in place.

Perhaps one benefit of the period of drought and financial crisis--if one can speak of benefits in such a context--has been that it has laid bare some of the fundamental weaknesses in the African condition. There is now a better appreciation of the policy, institutional, and technological circumstances that impinge on Africa's development. The complexity of the ecological environment, the significance of incentive policies, and the need for institutional growth and adaptation all combine to call for a renewal of the shared sense of mission and commitment by assistance programs and Africa's leadership. Recent developments in the views of African and U.S. leaders suggest movement in this direction as reflected in the 1986 UN Special Session on African Development and in the reformation by the U.S. Congress of the African assistance program. Yet will the preoccupation with the immediate concerns of policy reform again undercut assistance to institution building just as the basic human needs mandate did in the 1970s?

Views on the time dimensions of assistance programs have been an important determinant of African institutional development. First, the perception of the time it takes to create sustainable institutions--even in the best of circumstances--is commonly underestimated. U.S. assistance has often been cut short for a variety of reasons and often just when institutional maturation was beginning. Ten years is rarely long enough to be confident about the sustainability of a program that is making a significant impact; yet at the outset, it is difficult for the participants to commit themselves to such an extended relationship. One major exception was the Onchocerciasis Control Program which was planned from the outset as a 20-year endeavor. Yet even in this program it is only in the last year or so that attention has been given to the devolution to national

ministries of health responsibilities for maintaining surveillance and residual control. The characteristics and style of the assistance should change over the years, but continued external support for an extended period is important to maintain vital, dynamic institutional growth.

Second, there is an inherent conflict between the need to demonstrate short-term results and the need to establish longer term institutional growth. In some instances, such as in health campaigns institutional growth has not been considered important. Thus, if institutional and management capacity does not exist at the outset of a health campaign program, it is unlikely to be developed during the life of the program and the expertise and organizational capabilities will be largely imported. A clearly formulated strategic plan is required to permit a shift in focus from immediate results and operational issues to organizational development and constituency building.

A third feature of the time dimension is the importance of recognizing when "times have changed" and of making appropriate adjustments. As programs evolve and institutions become established, their long-run sustainability is more and more a matter of maintaining relevance. Constant attention to the surrounding environment, whether political, economic, ecological, technological, or cultural is required in order to adapt institutions to changing circumstances and new opportunities. Concern about program impact and an interest in influencing the program's environment as well as reacting to it are signs of institutional vitality. This is a key issue for the agricultural colleges and research establishments.

Time and again, reports on successful institution building in science and technology, as in all fields of endeavor, stress the importance of managerial leadership. It is the blend of technical management skills with the talents of leadership that appears to be so essential yet relatively scarce. Competence in organizational development and internal administration is a necessary but not sufficient condition for institutional development--no matter how helpful it may be in the short run. Similarly, pure charisma cannot build or sustain an organization for long. What stands

out for successful institutions is a leadership capable of instilling a sense of mission and purpose; and of mobilizing the support and collaboration of political leaders, complementary organizations, and beneficiaries; and then following through on a program. Constituency building is an essential dimension of the institutional development process.

The characteristics of managerial leadership, demonstrated in some of Africa's best institutions and programs and necessary for the complex and challenging tasks ahead, have been summarized by John W. Gardner, a leader and thinker in U.S. public service. In a recent speech he pointed out what he believes distinguishes the leader/manager from the "general run of managers":

1. They think longer term--beyond the day's crises, beyond the quarterly report, beyond the horizon.
2. They look beyond the unit they are heading and grasp its relationship to larger realities--the larger organization of which they are part, conditions external to the organization, global trends.
3. They reach and influence constituents beyond their jurisdictions, beyond boundaries. Thomas Jefferson influenced people all over Europe. Gandhi influenced people all over the world. In an organization, leaders overflow bureaucratic boundaries--often a distinct advantage in a world too complex and tumultuous to be handled "through channels."
4. They put heavy emphasis on the intangibles of vision, values and motivation and understand intuitively the non-rational and unconscious elements in the leader-constituent interaction.
5. They have the political skill to cope with the conflicting requirements of multiple constituencies.

6. They think in terms of renewal. The routine manager tends to accept the structure and processes as they exist. The leader of leader/manager seeks the revisions of process and structure required by ever-changing reality (Gardner 1987, 6).

Such characteristics of leadership and management are generally recognized as an important part of development programs; yet there is rarely a conscious effort to identify and develop them. Where they are evident among leaders of African institutions, they are having a profound effect on the creation of sustainable institutions and programs.

CONCLUSION

In this brief review of U.S. assistance to African science and technology over the past 30 years, I have attempted to highlight some of the more significant contributions of U.S. assistance and identify some of the issues that have affected their accomplishments. What seems evident from this experience in collaboration in institution building is the need for a constancy of commitment and a continuing reassessment of progress and problems to enable African and donor leadership alike to adjust program direction. The crises of the moment, no matter how serious, should not deflect attention from the development and adaptation of the basic institutions and their knowledge of the African environment that are required for growth. For it is these institutions which over time will mitigate the crises and guide the continent's development.

In sum, the test of success in institutional development is a capacity to continue a flow of beneficial impacts on development after major external assistance is terminated; that is, to sustain the "valued results of development activities."

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