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SUSTAINABLE INSTITUTIONS FOR AFRICAN AGRICULTURAL DEVELOPMENT

Carl K. EICHER

The logo for the International Service for National Agricultural Research (ISNAR). It features the word "ISNAR" in a bold, italicized, sans-serif font. The letters are black with a white, grainy texture, giving it a high-contrast, industrial appearance.

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Carl K. EICHER

February 1989

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International Service for National Agricultural Research

ISNAR WORKING PAPERS

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PREFACE

I would like to thank the Twentieth Century Fund, the Rockefeller Foundation, and the International Service for National Agricultural Research (ISNAR), for their generous support during my 1987-88 sabbatical leave from Michigan State University

The initial draft of this manuscript was prepared while I enjoyed the warm hospitality and efficient service of ISNAR as a visiting senior research fellow from March through August of 1989. I am grateful to Alexander von der Osten, Director General of ISNAR, for extending an invitation, for his critical comments on my manuscript, and for placing the services of the ISNAR staff at my disposal, especially Peter C. Ballantyne, Sandra Gardner, and Monique Hand.

I am grateful to the following ISNAR staff for sharing their ideas on developing sustainable national agricultural research systems and faculties of agriculture in Africa: N'Guetta Fosso, Rudolf Contant, Matthew Dagg, Howard Elliott, Krishan Jain, Emil Javier, Guy Rocheteau, Willem Stoop, and Ajibola Taylor. Finally, special thanks are extended to my dedicated research assistant, Carolyn J. Ngozi Eicher, and to Seth Beckerman for his editorial guidance.

SUSTAINABLE INSTITUTIONS FOR AFRICAN AGRICULTURAL DEVELOPMENT*

by

Carl K. Eicher**

The true measure of the success of a program of international and technical collaboration is not in its accomplishments during the period it is in force but rather in what happens after foreign aid has been withdrawn.

--George Harrar, 1967

I. Introduction

The theme of the Brundtland Commission is sustainable development, a message that has been greeted with applause in rich and poor countries. The sustainable message has spread like wildfire, and 40,000 copies of the English edition, Our Common Future,¹ were sold in the first year. But the report sheds little light on African agriculture and on the development of sustainable institutions. Neither does the report by TAC (1988), Sustainable Agricultural Production, shed much light on the critical question of developing sustainable institutions.

This paper presents some thoughts on the development of sustainable institutions for African agricultural development. The focus is on strengthening the three core institutions--research, training, and extension--that form the institutional base of African agriculture. Primary attention is devoted to strengthening national agricultural research systems (NARS), and secondary attention, to training and extension.

A sustainable NARS is defined as one in which domestic political support is mobilized to provide adequate domestic financing of all core salaries and operating expenses of the national agricultural research system. The performance and sustainability of agricultural institutions is examined over two 30-year periods: the colonial period from 1930 to 1959 and post-independence from 1960 to 1988. This historical assessment raises some longer-term issues to ponder on strengthening African institutions over the coming 30 years, 1990 to 2020. Finally, some of the implications are explored for African states, donors, the CGIAR, and ISNAR.

This is a slightly revised version of a paper that was presented at a seminar on "The Changing Dynamics of Global Agriculture: Research Policy Implications for National Agricultural Research Systems," sponsored by ISNAR, CTA, and DSE, at Feldafing, Federal Republic of Germany, 22-28 September 1988. The proceedings of this seminar have been published by the sponsors and are available from ISNAR. The views presented in this paper are those of the author and do not necessarily represent those of his employer or any associated agency.

The initial draft of this paper was prepared while the author was a visiting senior research fellow at ISNAR, The Hague, Netherlands. He is currently a professor in the Department of Agricultural Economics, Michigan State University, East Lansing, Michigan 48824-1039, USA.

The thesis of this paper is that after a third of a century of independence, many African states are several generations behind Asia and Latin America in terms of their stage of scientific, political, and institutional maturity. A few countries in Africa are probably one or two centuries behind Latin America and Asia. This is a sensitive topic that was shunned in the 1960s and 1970s and is only slowly starting to be discussed openly. For example, the respected Africanist, Colin Legum, recently observed that as colonial powers withdrew from the continent in 1960, they "left behind them a series of national states, but very few nation-states. The level of development of the continent's nation-state was still roughly equivalent to that of Europe or China in the fourteenth and fifteenth centuries--and certainly no later than the seventeenth century" (Legum, 1985: 24).

It is hypothesized that the stage of institutional maturity of individual African states will play a critical role in determining the type, amount, and sequence of foreign aid that can be absorbed with integrity. But most donors normally ignore the stage of institutional maturity of individual African states and prepare a continent-wide strategy to strengthen institutions such as a national agricultural research system or a national extension service.

The stage of institutional maturity of African countries relative to Asia and Latin America is beginning to receive attention from researchers. While much of the comparative scholarship on Africa and Asia centers on drawing insights from Asia's development experience for Africa, there are a few studies which deepen our knowledge base and eschew policy prescriptions. Two demographers studied the relationship between the stage of development and the speed at which family planning was adopted in Asia and Africa and concluded that the slowness to adopt family planning in Africa is "not explained by the African countries being at an earlier stage of socioeconomic development" (Caldwell and Caldwell, 1988: 19). The Caldwells contend that African family structures and economic and religious attitudes towards fertility severely limit the ability of African states to implement forceful family planning programs. But there are many puzzles about the dramatic differences between Asia, Latin America, and Africa in terms of life expectancy. For example, even though Sri Lanka and Sierra Leone both had per capita incomes of \$330 in 1983, the life expectancy was 69 years in Sri Lanka, compared to 38 years in Sierra Leone (Behrman and Deolalikar, 1988). A recent study of 25 World Bank-financed agricultural development projects in East Asia, Latin America, and Africa points to substantial differences in the sustainability of agricultural projects by continent. Instead of evaluating projects immediately after project completion (normally five to seven years after projects had started), the projects implemented between 1969 and 1980 were studied between 1980 and 1984. The surprising finding was that all of the 10 projects in Latin American and Asia were considered economically sustainable, while only two of the 15 projects in Africa were economically sustainable (Gernea, 1987: 4). The findings point to differential sustainability rates between Africa and Latin America and Asia and suggest that projects for Africa may have to be designed differently than those in Asia and Latin America.

II. The African Development Context

In 1957 Ghana, formerly the Gold Coast, attained its independence amid an outpouring of joy and high expectations. Three years later in 1960, 17 additional countries won their independence, thus explaining why 1960 is often referred to as the date of Africa's independence. Today 45 countries, totaling around 500 million people, make up sub-Saharan Africa (Figure 1). But despite the euphoria accompanying independence in the late 1950s and early 1960s, there has been a fundamental mismatch between the enormous potential for physical production in Africa and the capacity of Africans to achieve their economic aspirations. Table 1 shows that African states are poor and that life expectancy is low.

Africa's poverty is captured in a single statistic: the total GNP of the 45 countries in sub-Saharan Africa in 1985 was slightly less than the total GNP of Spain, a nation of 40 million (World Bank, 1987b). Sixteen of the 20 poorest countries in the world are African. Since 70% of the people in Africa live in rural areas, raising the income of rural people is a prerequisite for improving the African standard of living. Because poverty is the most central cause of hunger and malnutrition, it also follows that growth in per capita income is a primary way of helping families increase their access to food and reduce malnutrition.

African states are generally small in terms of population. Seventeen of the 40 countries in Table 1 have fewer than 5 million people, pointing up the need to examine how NARS in small countries can adopt what Emil Javier of ISNAR calls "intelligent borrowing" as the primary strategy for acquiring new technology. Intelligent and systematic borrowing of technology is the hallmark of the dynamic economic growth of Japan, Singapore, South Korea, and many other countries. Nevertheless, there is a widespread view in African scientific circles that Africa should develop its own technology rather than relying on borrowing technology as the primary source of acquiring new technology. For example, Professor Thomas Odhiambo, Director General of ICIPIE forcefully argues that "Africa must outgrow its concentration on technology transfer as the primary mechanism for achieving agro-industrial development" (Odhiambo, 1987: 4).

Africa's economic crisis of the 1980s is first and foremost agrarian. And since the agrarian crisis in almost all African states is a failure of the food and agricultural sector, rather than simply a food crisis per se, the challenge for African policymakers and donors is to discover how to raise rural productivity and rural incomes across the board (Eicher, 1982a). The government of Kenya adopted this strategy in 1986 when it identified seven "essential" commodities that formed the core of its food and agricultural policy: maize, wheat, milk, and meat for food security; horticultural crops for both export and home consumption; and coffee and tea for raising farm income and earning foreign exchange. Kenya's approach is refreshing because it moves beyond the narrow debate on food and cash crops--a favorite among many PVO/NGO (private voluntary organizations/nongovernmental organizations) groups, and decides which commodities should be promoted in order to achieve multiple objectives, including family and national food security, foreign exchange, government revenue, employment, and regional balance.



Figure 1. Countries and capital cities in sub-Saharan Africa

Table 1. Economic Indicators for Forty Countries in Sub-Saharan Africa

	Population (millions) mid-1986	GNP per Capita Annual Average Growth Rate		Agriculture Annual Average Growth Rate (Percent)		Average Index of Food Production per capita (1979-81=100) 1984-86	Percentage of Labor Force in Agriculture		Life expectancy at birth (years) 1986
		Dollars 1986	(Percent) 1965-86	1965-80	1980-86		1965	1980	
Low Income									
1. Chad	5.1	..	..	..	..	100	92	83	45
2. Guinea	6.3	..	..	..	0.3	93	87	81	42
3. Ethiopia	43.5	120	0.0	1.2	-3.9	87	86	80	46
4. Burkina Faso	8.1	150	1.3	..	2.7	112	89	87	47
5. Malawi	7.4	160	1.5	..	2.5	90	92	83	45
6. Zaïre	31.7	160	-2.2	..	1.7	100	82	72	52
7. Guinea-Bissau	0.9	170	-2.0	..	0.3	..	..	..	39
8. Mali	7.6	180	1.1	2.8	-2.3	101	90	86	47
9. Mozambique	14.2	210	..	..	-15.9	85	87	85	48
10. Madagascar	10.6	230	-1.7	..	2.1	98	85	81	53
11. Uganda	15.2	230	-2.6	1.2	-0.1	111	91	86	48
12. Gambia, The	0.8	230	0.7	..	..	..	..	..	43
13. Burundi	4.8	240	1.8	3.3	1.3	98	94	93	48
14. Tanzania	23.0	250	-0.3	1.6	0.8	92	92	86	53
15. Togo	3.1	250	0.2	1.9	1.7	91	78	73	53
16. Niger	6.6	260	-2.2	-3.4	2.8	85	95	91	44
17. Benin	4.2	270	0.2	..	3.0	114	83	70	50
18. Somalia	5.5	280	-0.3	..	7.9	98	81	76	47
19. Central Afr. Rep.	2.7	290	-0.6	2.1	2.5	94	88	72	50
20. Rwanda	6.2	290	1.5	..	0.9	87	94	93	48
21. Kenya	21.2	300	1.9	4.9	2.8	87	86	81	57
22. Zambia	6.9	300	-1.7	2.2	2.8	96	79	73	53
23. Sierra Leone	3.8	310	0.2	2.3	0.5	97	78	70	41
24. São Tomé/Príncipe	0.1	340	0.7	..	..	..	..	..	65
25. Sudan	22.6	320	-0.2	2.9	0.4	96	82	71	49
26. Lesotho	1.6	370	5.6	..	1.6	82	92	86	55
27. Ghana	13.2	390	-1.7	1.6	-0.2	109	61	55	54
28. Mauritania	1.8	420	-0.3	-2.0	1.2	88	89	69	47
29. Senegal	6.8	420	-0.6	1.4	2.3	102	83	81	47
Lower-Middle Income									
30. Liberia	2.3	460	-1.4	5.5	1.2	99	79	74	54
31. Cape Verde	0.3	460	..	..	..	..	..	..	65
32. Zimbabwe	8.7	620	1.2	..	3.4	92	79	73	58
33. Nigeria	103.1	640	1.9	1.7	1.4	103	72	68	51
34. Swaziland	0.7	690	2.8	..	..	..	..	..	55
35. Côte d'Ivoire	10.7	730	1.2	3.3	0.9	105	81	65	52
36. Botswana	1.1	840	8.8	9.7	-9.8	76	89	70	59
37. Cameroon	10.5	910	3.9	4.2	2.0	94	86	70	56
38. Congo, People's Rep.	2.0	990	3.6	3.1	-0.6	93	66	62	58
39. Mauritius	1.0	1200	3.0	..	5.3	100	37	28	66
Upper-Middle Income									
40. Gabon	1.0	3080	1.9	..	..	98	83	75	52

SOURCE: World Development Report 1988, Tables 1,2,7, and 31 and Box A, p. 289.
Key: .. = Not available.

The NARS in Africa are slowly replacing their food-centered research agenda of the 1980s with a more balanced research agenda--an agenda that focuses on the generation of new technology for food, livestock, and export commodities. Under conditions of rapid population growth, new technology is essential to help raise rural incomes, provide rural jobs, and assist in "parking a generation" of people in rural areas until fertility rates slow down and/or industrial expansion generates more jobs.

To summarize, Africa's economic crisis is complex and it has been building for several decades. Neither simplistic statements about changing the international economic order nor calls for export-led growth are the answers. The problem is rooted in the political neglect of agriculture during the colonial period. This neglect has continued in the post-independence period. Stop-gap measures have been tried--crash production campaigns and mass infusion of foreign aid--but these have mostly failed. Therefore, to meet the crisis, one must turn to agricultural-led growth. But, based on historical experience, an agricultural-led strategy must be framed in no less than a 20-year horizon and must entail a combination of technological innovation, policy reform, and institutional restructuring because each, by itself, is limited.

III. Institutions and African Development

With the exception of the pioneering research on institutional innovation by Vernon Ruttan and Yujiro Hayami, agricultural development specialists have neglected institutional issues. This has been especially true in Africa where social scientists have been enthralled with farming systems research, social impact assessment, and more recently, sustainable production systems. This lack of attention to research on institutions, however, does not come as a surprise. The late Gunnar Myrdal reports that when he was carrying out research for Asian Drama in the 1960s, the most difficult issue was learning how "to deal with the political issues of changing institutions, which were then, as now, avoided by most ordinary economists in their writings on development" (Myrdal, 1984: 154).

But the study of institutions has recently been moved to center stage by economists in industrial countries, such as Douglass North, Oliver Williamson, Irma Adelman, and many others. In a major 20-year investigation of the economic development process in 23 countries over the 1850-1914 period, two scholars recently concluded that "institutions mattered most in distinguishing between country groups experiencing more successful and less successful economic development" (Morris and Adelman, 1988: 209).² The authors concluded that "diversity in growth, diversity in institutions and diversity in applicable theories were the hallmarks of the process of nineteenth century development." Prof. Glenn L. Johnson of Michigan State University contends that "institutional limitations are presently the most serious constraining factor" for the agriculture of developed and newly industrializing countries and that the less-developed countries "are now constrained more by existing institutions and human capital stocks than by technologies and stocks of biological and physical capital" (Johnson, 1988: 1).

But research on rural institutions in Africa is in its infancy (Van Reenen and Waisfisz, 1988). The hard-core knowledge base on how to strengthen institutions such as NARS, extension services, and faculties of agriculture in Africa is inadequate.³ Research is urgently needed on widespread institutional failure. But research is also needed on why some institutions are strikingly effective: the Kenya Tea Development Authority, serving 150,000 smallholders; the Zimbabwe smallholder Cotton Marketing Board; Botswana Meat Commission; West Cameroon Coffee Cooperative Union; and the Mali Sud Cotton Project that includes 50,000 smallholders (Abbott, 1987). These success stories should be carefully studied to draw lessons for institution building in the 1990s.

African states and donors are fumbling and confused about how to develop human capability and agricultural institutions at this early stage of African development. Many countries find it difficult to pursue long-term institution-building strategies because of civil unrest, political instability, and the ready availability of financial aid for overseas training and long-term advisors. In other countries, the real and imagined fear of political unrest constrains donors from pursuing the long-term institution-building models that were successful in Asia in the 1960s and 1970s. But the most fundamental issue is the inability of donors to come to grips with Africa's early stage of institutional and scientific maturity.

The longer one works in Africa, the more one is forced to conclude that the resource-transfer model of foreign assistance must be replaced by a human-capability/institution-building model of development. The shortcomings of the resource-transfer model are painfully apparent in Somalia. A recent joint UNDP/IBRD technical mission dug deeply into the mode of delivering foreign aid to Somalia, a country riven with clan wars and a century or two behind most Asian countries in terms of its level of scientific, institutional, and administrative maturity. The joint team reported that donors were collectively pumping US\$ 100 million into Somalia each year to support 1200 expatriates on technical assistance contracts and overseas training for Somali nationals (UNDP and IBRD, 1985).⁴ Nevertheless, this revolving-door model of foreign advisors and overseas training is not achieving the ultimate objective, "the development of national capacity through the permanent transfer of skills and know-how to Somali nationals and national institutions" (UNDP and IBRD, 1985: 2). Without question, the model is not addressing the long-term problem of developing sustainable Somali institutions.

Three decades of independence have produced a large knowledge base on why many foreign aid-financed agricultural and rural development projects are not performing well at this early stage of Africa's economic history and institutional fragility (Morss, 1984; Cernea, 1985, 1987; Zurek, 1985; World Bank 1987a, 1988d; Eicher, 1982b, 1984, 1988a, 1988b). There is consistent evidence that human capability and institutional barriers to development have been skirted in the drive to increase the flow of foreign aid to African agriculture--especially during the rapid build-up of aid for direct-action projects over 1973-83. Starting around 1983, the foreign aid pendulum shifted from project- to policy-based lending.

But regardless of whether the focus was on projects or policies, the end result has been the same: the long-run human capability, scientific and institutional and social organizational issues--the prime movers of agricultural development--are being seriously neglected by both African policymakers and donors.⁵ There is a need for a fundamental reexamination of the assumptions about Africa's stage of economic history, the differential levels of development of various African states, absorptive capacity, recurrent costs, and appropriate long-run strategies to strengthen national agricultural services such as research, extension, and training.

IV. Institutional Development during the Colonial Period: 1930-1959

A skeletal agricultural research infrastructure was established in most countries in Africa during the first two to three decades of this century.⁶ A few countries such as the Sudan launched research programs immediately following World War I (Idris, 1969). By 1930, a small group of researchers was at work in most countries. Most researchers focused on export commodities, but research on food crops included sorghum in Uganda, maize in Zimbabwe and Kenya, rice and cassava in Zaire, and rice in anglophone and francophone West Africa.

Without question, many national agricultural research systems (NARS) in Africa were effective producers of new technology during the colonial period. The creativity of NARS can be illustrated through historical sketches of research in Zaire, Zimbabwe, and Kenya over the 1930-59 period. In Zaire, formerly the Belgian Congo, about two-thirds of the budget of the Belgian-financed national agricultural research service--INEAC--was focused on export crops and one-third on food crops. Research on oil palms was launched in 1933 with the goal of developing a high-yielding palm to replace the tall, low-yielding, wild palm that grew in the bush in West and Central Africa.⁷ In 1939, after only six years of research at the INEAC station at Yangambi in northern Zaire, a small team of five researchers unlocked the genetics of the oil palm, leading to the development of hybrid varieties that out-yielded wild palms by several hundred percent under farm conditions (Bevinaert, 1940; Tollens, 1988).

The oil palm research at INEAC had large regional and international spillover effects which helped launch the modern oil palm industry in Cote d'Ivoire (formerly the Ivory Coast),⁸ Nigeria (Eicher, 1967), Malaysia (Hartley, 1970), and Indonesia.

INEAC's rice research also demonstrates the spillover effects of a technology-producing national agricultural research system (TP/NARS). In 1958, INEAC released an upland rice variety, O.S.6, after six years of breeding and testing while relying on one of the first mainframe computers in Africa to process the experimental data.⁹ Although O.S.6 is not grown in Zaire, it is one of the dominant upland rice varieties in West Africa some 30 years after its release. O.S.6 is grown under different local names in West Africa today and it accounts for about 90% of the upland rice grown in Nigeria. In summary, the INEAC research

program in Zaire illustrates the vast potential that national research services in Africa have for producing new technologies for food and export crops and for contributing to meeting the research needs of neighboring countries and the global agricultural research system.¹⁰

The NARS of Zimbabwe is the second example of the creativity of a national system in Africa. Hybrid maize development in Zimbabwe from 1932 to 1960 represents a textbook example of a NARS in Africa producing new technology without relying on imported germplasm.¹¹ In 1932, H.C. Arnold launched a maize improvement program in Zimbabwe (then Southern Rhodesia). In 1938, A.G.R. Rattray assumed the leadership of the program, and in 1949, 17 years after research was initiated, the first hybrid, SR-1, was developed by crossing two locally bred open-pollinated varieties, Southern Cross and Salisbury White. But SR-1 was not released to farmers because yields were low. Research continued from 1949 to 1960 in a search for higher-yielding hybrids.

In 1960, SR-52, a single-cross hybrid was released to commercial farmers after 28 years of research (1932-1960). Looking back over the past six decades of research on food crops in Africa, the SR-52 white maize hybrid is undoubtedly the Green Revolution food-crop success story in Africa (Eicher, 1984, 1986). Historically, the size of the maize research program in Zimbabwe has been small (two to four researchers), but the program is known for its continuity, its scientific and administrative leadership, and its productivity.¹² Zimbabwe's experience also illustrates the extensive spillover effects of a TP/NARS. SR-52 maize has been sold as far north as Ethiopia, as far west as Cameroon, and as far south as the Republic of South Africa.

In Kenya's national agricultural research system, it took Michael Harrison and his maize team only nine years (1955-1964) to develop a high-yielding hybrid maize variety by crossing a local variety with a variety imported from Ecuador. Kenya's experience illustrates the potential of importing germplasm and underscores the need for the NARS in Africa to develop a high level of technical capacity to pursue a strategy of "intelligent borrowing" of technology from neighboring countries and the global system.

Regional research institutions were introduced during the colonial period from 1930 to 1959 to deal with the problem of small countries and to stimulate the production of export crops for European markets. One of the most successful regional research and extension projects in Africa is the CFDT/IRTC network that supports smallholder cotton production in 10 countries in francophone West Africa. Cotton research is carried out by IRTC¹³ researchers in France, Cote d'Ivoire, and satellite countries in francophone West Africa. The CFDT¹⁴ is a private cotton management and extension organization with four decades of experience in West Africa. In nine of the 10 francophone countries where data are available, average cotton yields increased fourfold over the 20-year period, 1963-1982 (Dequecker, 1983). The World Bank recently evaluated the CFDT/IRTC cotton model in Burkina Faso, Cote d'Ivoire, and Togo and concluded that it is a "striking success" when compared with other agricultural development projects in Africa (World Bank, 1988b: 29). Lele and van de

Walle (1988) recently concluded that phasing out regional cotton programs in anglophone Africa in the 1970s explains the slow growth in cotton production in anglophone relative to francophone Africa over the past 15 years.

In anglophone West Africa, the colonial period from 1930 to 1959 was marked by constant experimentation with research models to deal with the small country problem (Kyomo, 1988). In 1930, Ghana was the world's largest cocoa producer, but the industry was plagued by insect and disease problems. To deal with these problems, a National Cocoa Research Institute was established at Tafo, Ghana, in 1938 by the British Colonial Service. The Institute carried out highly successful studies of controlling several cocoa diseases, including swollen shoot virus, capsid, and black pod. In 1946, spraying programs based on research findings were launched and they were instrumental in boosting Ghana's cocoa production to a peak output of 520,000 tons in 1965 (Martinson et al., 1987). In 1944, the Cocoa Research Institute was renamed the West African Cocoa Research Institute (WACRI) and given a mandate to serve both Ghana and Nigeria. But cocoa research in Ghana over the past 50 years is marked by constant organizational change and turmoil:

- 1938 Cocoa Research Station established at Tafo to serve Ghana.
- 1944 West Africa Cocoa Research Institute (WACRI) replaced the Cocoa Research Station with a mandate to serve Ghana and Nigeria.
- 1962 Five years after independence, the government of Ghana dissolved WACRI and set up the Cocoa Research Institute of Ghana (CRIG). The government of Nigeria then converted the WACRI station to the Cocoa Research Institute of Nigeria (CRIN).
- 1975 The mandate of CRIG was expanded in 1975 to include coffee, kola nuts, and shea nuts.

Cocoa research in Ghana has also been subjected to constant change in parent organizations. Since 1962, cocoa research in Ghana has been administered by the following six organizations in chronological order:

- * National Research Council;
- * Ghana Academy of Sciences;
- * Council for Scientific and Industrial Research (CSIR);
- * Ministry of Cocoa Affairs;
- * Ghana Cocoa Marketing Board;
- * Ghana Cocoa Board.

Three lessons have emerged from 50 years of cocoa research in anglophone West Africa. First, the colonies of Ghana and Nigeria were well served by a small team of British scientists in a highly productive regional research institute (WACRI) from 1944 to 1962. In 1944 WACRI was staffed with 15 British scientists. Second, the transition from a regional (WACRI) to a national research model (CRIG) in 1962 led to a breach in research continuity because 12 expatriate staff resigned, leaving seven professional staff and 25 vacancies at the Cocoa Research Institute of Ghana (CRIG).¹⁵ CRIG is now nationalized but it is starved for operating funds and it has poor linkages with the cocoa extension service.¹⁶ It is now negotiating with the Overseas Development Administration (ODA) of the United Kingdom for a US\$ 3.1 million grant for research support as part of a five-year multidonor cocoa rehabilitation project. The third lesson is that the research management of NARS suddenly emerged as a critical factors when the regional institutes were nationalized. For example, the management of cocoa research in Ghana has been in constant turmoil since CRIG was nationalized in 1962. No scientific organization can flourish as it passes from one ministry and agency to another on the average of once every three years as CRIG has done since 1962.

Just as Ghana was the world's largest cocoa producer during the colonial period, Nigeria was the leading producer of oil palm. In 1939 the British colonial government established an Oil Palm Research Station in Nigeria in order to meet the growing challenge of oil palm production on plantations in the Far East. In 1951, the British converted Nigeria's oil palm station into the West African Institute for Oil Palm Research (WAIFOR) at Benin City, Nigeria, with a mandate to serve the British West African territories of Nigeria, Ghana, Sierra Leone, and Cameroon. In the 1950s, WAIFOR had a scientific staff of only 16 senior officers (Table 2). Soon after Nigeria became independent in 1960, the new government decided to nationalize WAIFOR and rename it the Nigerian Institute for Oil Palm Research (NIFOR). During the 1962-64 transition period, 10 of the 15 research officers left the institute. When NIFOR was formally established in 1964, it had a staff of 10 senior officers (five of whom were on overseas training), and the number increased slowly to 15 by 1970. But Nigeria's oil boom of the 1970s provided funding to increase NIFOR's staff from 15 senior officers in 1970-71 to 283 in 1985.

Table 2. Number of Senior and Junior Officers at the West African Institute for Oil Palm Research (WAIFOR) and the Nigerian Institute for Oil Palm Research (NIFOR), 1955 to 1988

<u>Type of Staff</u>	<u>WAIFOR</u> <u>1955</u>	<u>WAIFOR</u> <u>1963</u>	<u>NIFOR¹</u> <u>1964</u>	<u>NIFOR</u> <u>1970</u>	<u>NIFOR</u> <u>1985</u>	<u>NIFOR</u> <u>1988</u>
Senior Officers	16	15	10 ²	16	283	289
Junior Officers and (Technicians)	<u>153</u>	<u>151</u>	<u>204</u>	<u>357</u>	<u>1,487</u>	<u>1,471</u>
Total Regular Staff ³	169	166	214	373	1,770	1,760

SOURCE: West African Institute for Oil Palm Research (1955/56, 1963), Nigerian Institute for Oil Palm Research (1965-65, 1969-70, 1970-71, 1985) and personal interviews, January 1988.

1. In 1964 WAIFOR was nationalized and became known as NIFOR.

2. Five of the 10 officers were on overseas training.

3. Excludes unskilled seasonal laborers.

Today, the Nigerian Institute of Oil Palm Research (NIFOR) is not performing well. A very substantial part of NIFOR's budget is used to pay the salaries of its vast administrative, scientific, and support staff. Only about one-third of its regular staff are directly engaged in research while the other two-thirds are in administration, support services, social services, and revenue generating activities. For example, in 1985, 48 scientists were working on the key crop--oil palm--while 64 out of the 283 senior officers were administering the institute. NIFOR is also starved for foreign exchange to purchase equipment and supplies. Its research mandate has been broadened beyond oil palm to include date palm, raphia, coconut, and other palms. In summary, NIFOR is top-heavy with administrative staff, and it is less productive today with 289 senior officers than it was when it had only 15 during 1955-1970. The sobering lesson that flows from cocoa and oil palm research in West Africa is that there is no guarantee that simply increasing agricultural research expenditures and the number of scientific staff will lead to greater research productivity. This is an important message for African politicians, research managers, and donors. But most donors have a strictly ahistorical view of development and they lack an institutional memory.

The rise and decline of cocoa and oil palm research in Ghana and Nigeria stands in sharp contrast to the experience of Malaysia and Indonesia. In 1925 Malaysia established the Rubber Research Institute of Malaysia (RRIM) and concentrated its national research effort on rubber for four decades. Malaysia became independent in 1957, the same year as Ghana, but today Ghana's per capita GDP of \$390 stands in sharp contrast to \$1,830 in Malaysia. In the late 1960s, Malaysia embarked on a massive agricultural diversification program away from rubber, with the goal of increasing rural incomes. Policymakers assumed that Malaysia had a long-term comparative advantage in producing a wide range of export crops such as oil palm and cocoa and that foreign exchange earnings from these crops could be used to finance food imports such as rice. To further its diversification of export crops, in 1969 the government decided to broaden its national research effort beyond rubber and it established the Malaysian Agricultural Research and Development Institute (MARDI), which began operations in 1971. Malaysia drew on Zaire's research on hybrid palms (Beirnaert, 1940) and over time developed hybrids for Malaysian conditions. In 1978, oil palm research was spun off from MARDI into a new institute, the Palm Oil Research Institute of Malaysia (PORIM) (PORIM, 1985). Malaysia is also planning to spin off cocoa research from MARDI and set up a separate cocoa research institute with the goal of around 100 scientists and technicians. It has increased its agricultural research staff from 100 officers at independence in 1957 to 1,000 today. Its research system is highly productive and it has helped Malaysia increase export crop production and world market shares.¹⁷

But West Africa--especially Nigeria--has dissipated its research base for oil palm and cocoa, and lost world market shares to Malaysia and Indonesia. For example, oil palm production is booming in Malaysia and Indonesia and planners in these countries no longer take West Africa as a serious competitor in the world oil palm trade. The dominance of Indonesia and Malaysia in world oil palm production is shown in 1986 production data:

Cote d'Ivoire	195,000 MT
Nigeria	550,000 MT
Indonesia	1,274,000 MT
Malaysia	4,500,000 MT

But restoring West Africa's competitive position in oil palm and cocoa research will require more than financial assistance from donors. Many basic political, organizational, managerial, and scientific questions are plaguing export-crop research in West Africa. These problems must be addressed first and foremost by Africans at both the political and scientific levels.

Five lessons for agricultural research policy in Africa flow from the colonial research experience:

1. Creativity of Technology-Producing NARS (TP/NARS)

During the colonial period, numerous countries demonstrated that national agricultural research systems could produce new technology and contribute to the global research system, rather than simply borrowing technology along the lines of the international technology-transfer model. A strategy to strengthen NARS in Africa in the 1990s should start with the premise that TP/NARS are a fact of life. Donors should agree on making strategic investments in eight to 10 TP/NARS over the next 30 years. But this does not mean pumping \$20 million to \$30 million into a TP/NARS over the next five to seven years. Rather, the challenge will be in spreading \$20 million to \$30 million in a NARS over the next 20 to 30 years with the aim of strengthening the quality of the research programs, improving financial management, and developing political and financial support from national sources.

2. Small Commodity-Research Teams

In most cases, three to four scientists, and in a few cases, no more than half a dozen scientists, formed the commodity teams of TP/NARS that produced hybrid maize in Zimbabwe and Kenya, rust-resistant wheat in Kenya, improved tea clones in East Africa, cotton in Uganda, and soybean and cotton varieties in Zimbabwe. But this "focus-and-concentrate" strategy was not heeded in the first 30 years of Africa's independence. Instead, the overarching goal of most NARS has been a) to expand the number of commodity research programs, b) to expand downstream research (e.g., farming systems research), c) to increase the number of scientists, technicians, and total staff, often at the expense of the overall quality of the NARS research program, and d) to expand the number of nonresearch activities such as managing plantations and processing plants and selling seedlings. For example, even though Nigeria has 1,000 agricultural scientists in 1988, its NARS is weaker today than when it had 100 scientists at the time of independence in 1960.

3. Research Spillovers: Regional, Pan-African, and International

Research spillovers from TP/NARS and regional institutes are illustrated by hybrid oil palm, hybrid maize, cotton, and many other commodities. For example, Cote d'Ivoire, Nigeria, Malaysia, and Indonesia borrowed the

research on oil palm genetics from Zaire. Because spillover effects are common features of national, regional, and international research centers, donor projects to strengthen NARS in Africa should explicitly address this issue in project documentation and implementation.

4. Technology-Borrowing NARS (TB/NARS)

The colonial experience is documented with success stories of borrowing technology. For most countries in Africa today--especially the 22 countries with less than five million people--intelligent borrowing of technology will be the primary strategy for acquiring new agricultural technology for the foreseeable future. But it will be necessary to convince African scientists that borrowing technology is not a second-rate, demeaning activity, and that it takes a high level of technical competence to develop an efficient national capacity to borrow, test, screen, and adapt technology to micro environments.

5. Regional Research: Efficient but Unsustainable

Regional research in anglophone Africa during the colonial period was highly efficient because it concentrated on a few commodities, had assured overseas funding, and was endowed with outstanding administrative and scientific leadership. Examples of successful regional research include the East African Agricultural and Forestry Research Organization (EAAFRRO) in East Africa; the Federation of Northern Rhodesia (now Zambia), Southern Rhodesia (now Zimbabwe), and Nyasaland (now Malawi); and the West African commodity research institutes (cocoa, oil palm, rubber, rice). But with the coming of independence in the late 1950s and early 1960s, the regional centers were converted into national institutes which came under political pressure to absorb staff, especially recent university graduates.

In francophone West Africa, several impressive regional research networks are still in operation, such as the IRCT/CFDT cotton research and extension network (World Bank, 1988b). Nevertheless, although regional research institutes represent an efficient research model, they are generally not financially sustainable from African sources. The Tea Research Foundation of Central Africa is one of the few examples of an African-financed regional institute but it has a small staff and it has turned to donors for support over the past decade (Ellis, 1988).

V. Institutional Development during the Post-Independence Period: 1960-1988

The collective experience of restructuring and strengthening rural institutions in the first three decades of independence can be analyzed under five topics:

1. The Colonial Legacy

At independence, African states inherited a strong bias for extension and international technology transfer to accelerate agricultural growth. This bias was based on the colonial premise that culture-bound, small

farmers needed to be educated and motivated, and that foreign assistance could be used to rapidly expand the number of low-paid extension agents relative to more highly paid agricultural researchers. With some rare exceptions, at independence the institutional base--training, extension, and research--for African agriculture was geared to supporting export agriculture, large farms, plantations, and ranches. This was a fact of life in 1960 when 17 countries won their independence, in 1975 when Mozambique and Angola won their independence, and in 1980 when Zimbabwe won its independence with a government to serve the rural majority--700,000 black smallholders, as well as 5000 commercial farmers.

Over the past 30 years, only modest progress has been achieved in converting the land-tenure, training, and research institutions to support the majority of rural people. For example, the government of Senegal waited until 19 years after independence to set up a BSc-level training program in agriculture in 1979 (Eicher, 1982a). Tanzania and Ethiopia have only recently established state agricultural universities. Zimbabwe's land-settlement program is stalled after settling about 40,000 families between 1980 and 1988 (instead of the planned 162,000 families between 1982 and 1985). In summary, the basic restructuring of agrarian institutions to serve the majority of rural people is proceeding at a snail's pace in most African countries. It comes as no surprise that project aid and structural adjustment lending all but ignore these festering institutional realities.

In many parts of Africa, the case can be made that the vast outpouring of foreign aid has helped maintain the status quo and postponed the inevitable restructuring of agrarian institutions and the domestic financing of basic agricultural services, such as NARS and training institutions. For example, donors are paying for a large share of the national research budget in a number of African countries, including Senegal. John Lewis of Princeton University reports that Senegal's annual, official, development assistance of over US\$ 50 per capita is four or five times higher than per capita levels for Asian aid recipients. In macro terms, Lewis reports that "foreign aid paid for all of Senegal's investments and 6% of its consumption in 1981" (Lewis, 1987: 285). With this level of generosity, why should administrators of Senegal's national agricultural research, extension, and training institutions allocate their energy to generating political and financial support from Senegalese clientele groups?

Table 3 presents data on the stock of human capital--Africans and expatriates in NARS and universities in sub-Saharan Africa--that has been patiently compiled by ISNAR researchers, Phil Pardey, Han Roseboom, Howard Elliott, and many others (Pardey et al., in press). The table shows that anglophone countries such as Nigeria, Kenya, and Ghana have achieved substantially greater progress in the nationalization of their NARS, relative to francophone countries. For example, Cote d'Ivoire and Nigeria have been independent for the same length of time. But after 28 years of independence, Cote d'Ivoire has 73% of its research and teaching posts filled by expatriates, compared with 6% in Ghana and none in Nigeria. This is a puzzle that warrants further analysis and debate at the political and technical levels.

Table 3. Sub-Saharan Africa: Total Number of Agricultural Researchers in NARS (National Agricultural Research Services) and Universities and Qualification Indices, 1980-86 average

	Number of Agricultural Researchers				Qualification ¹ Index: Total (percent)	Qualification ¹ Index: Nationals Only (percent)
	Total	Local	Expat.	Expat.(%)		
WESTERN AFRICA						
Benin	45	42	3	(7)	73	71
Burkina Faso	114	59	55	(48)		
Cameroon	187	126	61	(33)		
Cape Verde	16	13	3	(19)	57	45
Chad	28	20	8	(29)		
Cote d'Ivoire	201	54	147	(73)		
Gambia	62	45	17	(27)		
Ghana	138	130	8	(6)	74	69
Guinea	177	NA	NA			
Guinea-Bissau	8	7	1	(13)	75	71
Liberia	33	24	9	(27)	69	57
Mali	275	246	29	(11)	29	20
Mauritania	12	NA	NA		92	
Niger	57	25	32	(56)		
Nigeria	1005	NA	NA			
Senegal	174	123	51	(29)		
Sierra Leone	46	NA	NA			
Togo	49	37	12	(24)		
Subtotal	2626			(31) ²	50 ²	29
CENTRAL AFRICA						
Burundi	53	30	23	(43)	85	73
Central African Rep.	NA	NA	NA			
Congo	68	37	31	(46)		
Gabon	24	10	14	(58)	71	30
Rwanda	34	24	10	(28)		
Sao Tome & Principe	3	NA	NA			
Zaire	43	NA	NA		23	
Subtotal	225			(43)	60	59
SOUTHERN AFRICA						
Angola	28	15	13	(46)	46	0
Botswana	50	22	28	(56)	73	38
Lesotho	18	9	9	(50)	67	33
Madagascar	83	73	10	(12)	48	40
Malawi	80	75	5	(6)	30	26
Mauritius	99	NA	NA		36	
Mozambique	77	13	64	(83)	83	0
Swaziland	11	7	4	(36)	44	17
Zambia	111	57	54	(49)	61	24
Zimbabwe	153	NA	NA		45	
Subtotal	710			(41)	52	24
EASTERN AFRICA						
Comoros	14	7	7	(50)	50	0
Ethiopia	142	134	8	(6)	43	40
Kenya	483	408	75	(16)	45	
Seychelles	7	4	3	(38)	38	0
Somalia	31	27	4	(13)	9	
Sudan	206	NA	NA		81	
Tanzania	276	214	62	(22)	61	49
Uganda	185	NA	NA			
Subtotal	1343			(17)	54	44
TOTAL SUB-SAHARAN AFRICA	4905			29%	53%	38%

SOURCE: Pardey and Roseboom (in press).

1. Calculated as (number of PhD + MSc)/(number of researchers). For the Qualification Index based on the total (national + expatriate) number of researchers the expatriate researchers were assumed to hold either a PhD or MSc (or equivalent) qualification.
2. Subtotal figures are weighted group averages where the weights represent the proportion of total agricultural researchers for each regional group accounted for by each country.

2. Destruction of Regional, National, and Local Institutions

The 1960s and 1970s were marked by intense destruction of many of the regional and national institutions inherited from colonial governments. For example, most of the regional research institutes in anglophone Africa, such as the West African Cocoa Research Institute and EAAFRO, were converted into national institutions soon after independence (Dagg, 1986). At the national level, many colonial institutions were abolished. Guinea and Madagascar terminated the services of French researchers soon after independence, and in 1962, Nkrumah abolished Ghana's national extension service. The government of Tanzania abolished local government and farm cooperatives in the mid-1970s. Numerous training institutions, such as Makerere University in Uganda, were devastated during internal political upheavals. Many of the state institutions that were set up to serve farmers, such as marketing boards, have in fact "turned against them" (Arhin et al., 1985).

The influential Berg Report of 1981 recommended a shift to market liberalization and a reduction in public-sector employment (World Bank, 1981b). Because of the economic crisis in the early 1980s, African governments were belatedly forced to reexamine the role of public institutions and state control over agriculture. This is now a time of reflection and reexamination in Africa. Former President Nyerere of Tanzania recently reported that "there are certain things I would not do if I were to start again. One of them is the abolition of local government and the other is the disbanding of cooperatives. We were impatient and ignorant" (Nyerere, 1984). Tanzania has recently reintroduced local government and cooperatives.

Without question, one of the underreported events limiting African agriculture is the cycle of destruction of human capital because of coups, civil wars, and civil unrest. At least a half dozen countries have been stripped of high-level human capital through outmigration over the past three decades. Ghana, Ethiopia, Uganda, Somalia, Tanzania, and Zambia are prominent examples. Emil Rado recently reflected on the international brain drain in Ghana: "Ghana does not lack people of the highest capability. But the flower of them is abroad, in self-imposed exile. The PNDC (ruling party) has yet to face squarely the task of so broadening its constituency that it can attract them back" (Rado, 1986).

3. The Quantity-Quality Trade-off

Thirty years of independence have been dominated by an unbridled growth in the size of the civil service, national agricultural research and extension services, and parastatals. Most nations (with substantial donor encouragement) opted to increase the size of key institutions such as NARS and extension services. The following figures display the quantum jump in the size of the state machinery:

- * Sub-Saharan Africa started independence with a profound extension bias (21,200 extension agents and 1,329 researchers), and this bias was intensified by hiring an additional 36,000 extension agents over the next 20 years (Judd et al. 1987: 11-13).

- * The Congo increased the size of its extension staff 10-fold from 1960 to 1972 (Young, 1988: 26).
- * The Senegalese government employed 10,000 persons at independence in 1960 and 61,000 in 1978 (Young, 1988: 27).
- * In Ghana, the Cocoa Marketing Board employed 105,000 persons in the early 1980s to handle a crop half as large as that which 50,000 employees had managed in 1965 (Young, 1988: 27).
- * In Nigeria, the national agricultural research service expanded from 100 researchers in 1960 to around 1000 today (Table 2).

But in most cases, there was a clear trade-off in quantity versus quality and the expansion of size was accompanied by a reduction in the quality of the enterprise--whether it was the civil service or a NARS (Lipton, 1988). The major lesson for most NARS in the 1990s is to freeze and/or reduce the total number of employees and concentrate on improving the quality of scientists and their research programs and replacing expatriates in the process.

4. The Green Revolution Footprint

The Green Revolution has achieved the impact of a small footprint on Africa's rural landscape. Dalrymple (1986a, 1986b) reports that the total area of modern wheat and rice varieties under cultivation in sub-Saharan Africa in 1983 was about 800,000 ha (wheat 556,000 ha and rice 242,000 ha), which amounts to roughly one-quarter of the annual cropped area in Zimbabwe, one of the 45 countries in Africa.

5. The Imperative to Strengthen NARS

Since the Green Revolution has barely touched Africa, African leaders and the donor community must face up to the reality that the CGIAR and French research networks have not delivered the volume of new food crop technology that many experts had implicitly promised when the first CGIAR center--IITA--was established in Ibadan some 20 years ago. Therefore, African states, agricultural scientists, and donors are compelled to face up to the question: what can be done to strengthen NARS in a cost-effective and sustainable manner so that they can become more productive partners in producing new technology and complementing the CGIAR and French research systems?

In summary, the post-independence experience from 1960 to 1988 displays consistent evidence that the dominant institutional and technical assistance models of donors¹⁸ are not producing the expected increase in agricultural output in Africa, except in a few middle-income countries such as Zimbabwe. For example, donors are pumping US\$ 100 million a year into Somalia to finance 1,200 long-term expatriates and overseas training through a foreign-assistance model that postpones the tough issues surrounding the development of Somali institutions. Turning to the

Sahel, the former director of the Club du Sahel, Anne de Lattre, recently reported that the targets for the recovery of the Sahel are not being achieved despite the receipt of US\$ 15 billion of foreign assistance over the past 13 years for the 36 million people in the Sahel (de Lattre, 1988).

Although many donors are reluctant to publish the results of their evaluations, it is well known that the failure rate of rural projects is high.¹⁹ For example, the World Bank's Operations Evaluation Department recently evaluated the Bank's experience with financing rural development (RD) projects from 1965-1986 and noted that although "RD lending targets were met, . . . half of the RD projects in sub-Saharan Africa failed" (World Bank, 1988d: xvi). The training and visit extension system (T & V) is being aggressively promoted by the World Bank in Africa. Preliminary evidence suggests that the T & V model may be sustainable in high-potential farming areas such as the central highlands of Kenya, but not in sparsely populated semi-arid areas. Because of the Bank's zealous promotion of the T & V approach,²⁰ continuing independent assessments of on-going T & V programs would be in Africa's self-interest.

Most African states do not currently have the institutional, managerial, or financial capacity to absorb present levels of project aid "with integrity" and to sustain the projects after foreign aid is phased out.²¹ In some subregions, such as the Sahel, foreign aid officials no longer discuss the "recurrent cost problem" because it is assumed that donors will be paying some of the operating costs of Sahelian governments for the indefinite future--perhaps for another generation or longer.²²

VI. Longer-Term Issues to Ponder: 1990-2020

Drawing on Africa's research experience over the past 60 years, six strategic issues emerge for debate on strengthening the institutional base for African agriculture over the next 30 years.

1. Restoring the Primacy of Commodity-Based Research

During the colonial period, long-term, highly focused research on a single crop such as cotton, groundnuts, cocoa, oil palm, or maize was successful in producing new technology that was relevant to African conditions.²³ But many NARS and donors have ignored this experience and have spread their support for research over too many commodities, too many discrete projects, and too broad a geographical area. For example, until 1985, USAID was supporting research on 28 commodities in Africa, but it has subsequently reduced the number to eight (USAID, 1985). A World Bank-financed project in Rwanda endorsed research on 17 commodities. In some countries over the past decade, farming systems research (FSR) has been given priority over commodity research. But FSR is now in decline as African research administrators seek to find a better balance between commodity and farming systems research. The key questions are striking the proper balance between the number of commodity and FSR scientists, budget allocation to commodity and FSR programs, and sequencing. FSR should serve as a handmaiden (servant) to commodity-research teams (Eicher, 1987). A strategic priority in the 1990s is strengthening national commodity-research teams on a few priority commodities. In some countries this will be only one staple food, while in others it may be three or four commodities.

2. Agricultural Research Investment Norms and Priorities

The second issue concerns how much African states should spend on agricultural research? Presently, most donors follow the guideline that a desirable agricultural research investment target would be in the range of 0.5% to 2.0% of the total national value of agricultural GDP. The World Bank has argued that a desirable investment target for research for many countries would be an annual expenditure (recurrent, plus capital) "equivalent to about 2 percent of agricultural gross domestic product" (World Bank, 1981a: 8). But this norm is derived from industrial countries with a century or more of experience in mobilizing political and financial support from farm organizations, commodity groups, private firms, and state and federal organizations. Foreign aid metered out to NARS in Africa according to the 1% to 2% investment norm will most likely inflate the size of the NARS (staff, buildings, and equipment) beyond the capacity to mobilize domestic political and economic support to maintain NARS over time.

When donor funds are transferred to a NARS in Africa according to the 1% to 2% formula from industrial countries, the missing elements in this resource transfer are the "political will and political support" from agricultural interest groups that have been nurtured by research managers and scientists over generations in industrial countries. Prof. Vernon Ruttan (1987) has repeatedly stressed the need to tie incremental donor funding for NARS to matching funds from the recipient government. The failure to follow some variant of matching funding increases the likelihood that donor funds may increase the size of NARS beyond the political will to maintain the system. The spectre of Mali's 275 agricultural scientists is a case in point.

In summary, the agricultural research investment norms derived from the experience of advanced countries, either capitalist or socialist, are almost certain to be inappropriate short-term policy guides for donors and for African states. Despite 60 years of organized agricultural research in Africa, there is little solid information on the economics of research in Africa. No published studies are available on the economic returns on investment in any commodity or in any NARS in Africa.²⁴ A series of case studies is needed on the economics of investment in agricultural research in Africa.

3. Size, Quality, and Productivity of NARS

There is little solid empirical information from Africa on the relationship between the size (number of scientists), quality of scientific staff, and productivity of a NARS. There is, however, enough historical and anecdotal evidence to conclude that some of the pronouncements on the level of investment and the size of NARS in Africa should be taken with a grain of salt. For example, Jha (1987) recently studied national agricultural research systems in Africa and concluded that there is "substantial underinvestment" in agricultural research because 14 countries were spending less than 0.5% of their agricultural GDP on research (Jha, 1987: 267). Instead of coming to Jha's conclusion, one can make a convincing case that there is overinvestment in research

in some countries relative to their current stage of institutional maturity, absorptive capacity, scientific leadership, political support for research, and projected government revenues.

Three examples reinforce this point: First, most African countries have ignored the colonial experience of high payoffs to small research teams and have expanded the size of their NARS in terms of the number of scientists, technicians, buildings, equipment, and operating budgets. In many cases this expansion has outstripped the capacity to manage the national research enterprise, pay staff on time, plant experiments on schedule, and mobilize political support to finance and sustain the system after foreign aid is phased out. Under the current levels of foreign aid in Africa, it is often easier for the director general of a NARS to mobilize an additional million dollars of research support from foreign donors than it is from domestic funds. This illustrates how foreign aid can increase the dependency on foreign donors and postpone the day of reckoning.

Second, donors are part and parcel of the drive to increase the size of NARS. For example, donors are currently paying a substantial share of the recurrent budget of the national agricultural research systems in Mali, Ghana, Senegal, Niger, Zambia, Rwanda, and many other countries. It is almost impossible to cite a feasibility study that recommends reducing the size of a NARS and concentrating on upgrading the quality of the present research staff and the relevance of the research programs.

Third, many NARS have been under political pressure to absorb new university graduates and expand the size of the institution at the expense of quality. For example, Nigeria has invested at a brisk pace in expanding its National Agricultural Research Service from around 100 scientists at independence in 1960 to 1000 in 1988 (Table 2). But Prof. Francis Idachaba, Vice-Chancellor of the University of Agriculture, Makurdi, Nigeria, recently reported that "research management probably constitutes the most important constraint on Nigeria's National Agricultural Research System" (Idachaba, 1987: 351).

In summary, many African countries are making some of the same mistakes that Asian and Latin American countries made in the 1970s when the emphasis was placed on expanding the size of NARS to the point where there were too many research facilities and researchers "without" programs (Ruttan, 1987: 78). There is need for a study of the size, productivity, and sustainability of NARS and the economics of agricultural research.

4. The Training Fallacy

Many African states, donors, and members of the university community maintain that more training is needed to solve Africa's shortage of skilled manpower. But this standard prescription has been overtaken by events in many countries where the human resource problem has shifted from the supply to the demand side as recent agricultural graduates at the certificate, diploma, and higher levels have found it increasingly difficult to find jobs. In addition, many NARS and universities in Africa are hemorrhaging and losing scientists and teachers as fast as

they are trained. For example, the average loss of NARS research officers with a university degree is estimated to be about 7% per year (World Bank, 1988c: 18), a rate that would require a NARS to replace its entire cadre of researchers every 13 years. Another serious problem is the loss of productive scientists and teachers over 40 years of age. Four guidelines for training in the 1990s are as follows:

- * NARS and faculties of agriculture should utilize a systems approach in developing a human resource strategy that includes recruitment, training, promotion, and retention of researchers and teachers.
- * The number of researchers and teachers released for training should be tailored to the ability of the country to finance and sustain them over the long pull.
- * Training should concentrate on
 - a) upgrading present staff and
 - b) replacing expatriates rather than training to fill new posts and increase the size of the organization.
- * Faculty of agriculture expansion projects should be designed within a subregional perspective (e.g., the Sahel) to avoid duplication of training facilities.

5. The Need for Rolling Subregional Research Maps

Africa's immensity and diversity rule out any meaningful discussion of Africa-wide research priorities and guidelines for strengthening NARS. There is a compelling need for African research managers and donors to adopt a subregional geographical area such as the Sahel or Eastern Africa as the operational unit for developing research strategies and a framework for considering investments in NARS, regional institutes (e.g., WARDA), and regional research networks. The present method of preparing feasibility studies for NARS on a country-by-country basis ignores research spillovers from NARS to neighboring states and regional and international centers. By ignoring these spillovers, there is a high probability that donors will overinvest in NARS and contribute to the inflation of NARS in terms of size.

The practical message that flows from this discussion is the need for an organization such as ISNAR to develop rolling regional research maps to guide teams that are preparing feasibility studies for donor investment in NARS. Subregional research maps should contain a vision of the long-term dynamic comparative advantage of agriculture in a sub-region, identification of present research institutions and donor activities (present and projected) and research priorities to help change the comparative advantage of agriculture in a subregion over time. It is important that the preparation of research maps should not lead to research inventories that count all the research projects in a region such as the Sahel (Devres, 1984) or Southern Africa (Devres, 1985).

6. Sustainability of NARS

A sustainable NARS has been defined as one that has the ability to mobilize domestic political support to pay the salaries and required operating costs of the core scientific staff from national sources. Presently, the complex issues surrounding the sustainability of NARS are not being systematically addressed by any major donor or international institution working in Africa.

VII. Reflections on the World Bank's Strategy to Strengthen NARS in Africa

Donors are an integral part of Africa's agricultural research dilemma. For example, the development of sustainable African institutions is being undermined by the decision of donors to use lower standards of performance in evaluating investments in Africa. Edward Jaycox, Vice-President of the Africa Department of the World Bank recently pointed out that:

Donors have continued to prefer new investments long after it became clear that budget revenues would be inadequate even to maintain past investments. The design of projects has too often ignored the fragility of African institutions and the scarcity of skilled manpower. And, perhaps most important of all, African countries have not been held to the standard of performance common elsewhere in the world, including other low-income countries (Jaycox, 1985: 11).

By committing about US\$ 4 billion a year for agricultural loans, the World Bank is the undisputed leader in setting the policy direction for agricultural lending in the Third World. Over the past decade, the Bank committed about US\$ 33 billion--one-third of its lending portfolio--for agriculture. When cofinancing with other donors is taken into account, the total outlay for agriculture is US\$ 90 billion over the past 10 years (Jaycox, 1988: 15). Moreover, the Bank recently announced that it plans to invest \$6 billion to \$7 billion in agriculture in Africa over the coming five years (World Bank, 1988e). The Bank's high-profile role in African agriculture underscores the political significance of a new Bank initiative in a complex area such as agricultural research.

But the Bank is a relative newcomer to agricultural research. It made its first agricultural research loan to Spain in 1970. It threw its weight behind agricultural research in Africa in 1979 with a loan to the Sudan. It is now supporting or planning to support research projects in 16 countries in sub-Saharan Africa (World Bank, 1988c: 22). The Bank committed US\$ 1.3 billion to agricultural research worldwide during the six-year period, 1981-1986, including US\$ 314 million for Africa (Pritchard, 1988).²⁵

In March 1988, the World Bank unveiled a strategic framework to guide its support of agricultural research in Africa--Strengthening Agricultural Research in Sub-Saharan Africa: A Proposed Strategy (World Bank, 1988c). The report reflects a "consensus" that emerged after a three-year study and a period of consultations and meetings, including a high-level meeting of African policymakers, researchers, and donor representatives in Feldafing in 1987 to review the draft report (Pickering, 1988). The central question that can be raised about the Bank's proposed strategy for Africa is the following:

Will the implementation of the strategy lead to productive, cost-effective, and sustainable NARS or will it possibly increase the dependency of some NARS on the international donor community, the CGIAR, and the French research establishment for decades to come?

This overarching question will be explored by examining five issues related to the Bank's strategy for Africa:

1. Africa's Early Stage of Institutional Development

The Bank's strategy is based on the implicit assumption that all African countries are at a fairly similar stage of political and institutional maturity and that the limiting factor of NARS is financing for buildings, equipment, vehicles, and operating costs. Over the past decade, the Bank has a demonstrated record of designing fairly large (\$15 to \$50 million) projects with other donors as cofinancers, and disbursing these funds through short-term (five- to seven-year) projects. By contrast, USAID's strategy to strengthen NARS in Africa is based on the implicit assumption that African countries are at different stages of institutional maturity and that strategies of foreign assistance must be tailored to a nation's stage of development and absorptive capacity (USAID, 1985). For example, USAID's strategy breaks new ground by dividing the 45 NARS in Africa into eight to 10 TP/NARS and the balance into technology-adapting (borrowing) NARS (TA/NARS).

2. Resource-Transfer Model

The Bank carried out extensive background studies over a three-year period to aid in the preparation of its new strategy. But these studies did not include the collection of original data on the economics of investment in research in any commodity or in any NARS in Africa. Nevertheless, the Bank's strategy assumes that African states should spend 1% to 2% of agricultural GDP on agricultural research--the same level that many industrial countries are spending. The Bank's strategy presents a consensus view (of donors and African planners and research managers) that large transfers of financial resources are needed to strengthen NARS in Africa. Since the Bank's strategy is partially designed to mobilize donor support to cofinance research projects, it will be warmly endorsed by political leaders and the directors of NARS in Africa. But the challenge is to move beyond the resource-transfer model

of building buildings and purchasing equipment and vehicles, and to develop a human-capability/institution-building model that is geared to the realities of Africa in the 1990s. The three hallmarks of the human-capability model are 1) the slow, step-by-step process of improving the quality of the scientific, managerial, and financial capacity of a NARS, 2) upgrading the quality and relevance of research programs, and 3) developing support from clientele groups to finance and sustain the research system from domestic sources.

3. Tapping Africa's Research Experience

The Bank's strategy does not explicitly draw on Africa's research experience over the past six to seven decades in developing a strategy for the coming 30 years. For example, why were small teams of scientists (two to six) so productive during the colonial period? What does this experience suggest for the current proposals to finance the expansion of NARS in Tanzania, Niger (Niger and ISNAR, 1988), Mali (Mali and ISNAR, 1988), and other countries? The Bank's proposed strategy also fails to draw insights from some of the contemporary African success stories in agricultural research. For example, what was the role of public and private research in helping to triple smallholder maize production in Zimbabwe from independence in 1980 to 1987 (Rohrbach, 1988)? What can Africa learn from Malaysia's pioneering research in biotechnology (National Council for Scientific Research, 1985)? Zimbabwe is planning to set up a private biotechnology research institute. Should African countries set up private or public biotechnology institutes or rely on industrial countries for biotechnology?

4. The Puzzle of Francophone West Africa

The Bank's research strategy for Africa does not analyze why francophone countries are so heavily dependent upon expatriates relative to anglophone countries. For example, after three decades of independence, why are 73% of the agricultural researchers and teachers in Cote d'Ivoire still expatriates (Table 2)? Is this desirable? The Bank's proposal studiously avoids this issue. How do NARS maintain research quality (e.g., cotton research) in francophone West Africa while progressively developing a cadre of national scientists and reducing the dependency on expatriates? This is a puzzle that requires attention at the political and technical levels.

5. Sustainability--The Neglected Issue

Over the next five years, the Bank plans to help mobilize \$US 3 billion of resources for agricultural research in Africa (\$1.5 billion into NARS and 1.5 billion into the CGIAR system) (World Bank, 1988e: 3). There is a high probability that transferring an average of \$300 million a year into the NARS over the next five years will overload the NARS with buildings, equipment, and increased recurrent costs under the banner of conforming to the 1% to 2% investment target. The end result may make African NARS more dependent on the CGIAR and French research institutes and international donors, and postpone the day of reckoning--i.e., developing local political support to finance the core costs of NARS from domestic sources as the key to sustainability of NARS. In short, the Bank's strategy has dodged the critical question of how to increase the financial sustainability of NARS.

I am convinced that the five issues flagged about the Bank's approach to strengthening agricultural research in Africa will slowly emerge as the critical issues under public debate in the 1990s. In fact, some of the reservations that I have raised about the Bank's resource-transfer model were recently echoed by a World Bank official at the Bank's 1988 Agriculture Symposium:

Is it reasonable, as has been seen in many cases, in particular in Africa, to promote--not to say to force--the creation of bureaucratic, civil service systems in places where there is no commitment, political or otherwise, and where there are serious doubts as to the ability of governments to finance such systems from budgetary resources (Lafourcade, 1988: 65).

In summary, the World Bank is providing financial but not intellectual leadership in strengthening the institutional base of African agriculture. Despite the unlimited resources at its disposal, the World Bank does not have a cadre of core staff and consultants who have the time to study and reflect, and the freedom to design long-term projects that slowly and progressively strengthen the human capability of national agricultural research systems over a period of decades.²⁶

VIII. Implications for African States, Donors, the CGIAR, and ISNAR

The thesis of this paper is that many African countries are generations, and a few are several centuries, behind Asian and Latin American countries in terms of their stage of human capability and institutional and political maturity. What flows from Africa's agricultural research history over the past 60 years is the simple but powerful proposition that current institution-building strategies and lending approaches that are effective in Asia and Latin America will have to be sharply modified to fit the earlier stage of development of many countries in Africa. In addition, because of the differential stages of development between African countries, institution-building approaches in middle-income countries in Africa, such as Zimbabwe and Cameroon, are likely to fail in Guinea, Chad, Burundi, Somalia, Uganda, and Ethiopia.

Institution-building strategies should be tailored to the stage of a nation's institutional, scientific, and political maturity. The World Bank's proposed Africa-wide strategy for strengthening NARS is almost certain to be ineffective. Instead, a subregional strategy should be prepared to strengthen the three core national agricultural services--research, training, and extension--for each of the five major agroecologies: Sahel, coastal West Africa, Central Africa, Eastern Africa and the Horn, and Southern Africa. Each strategy should include the basic concept of TP/NARS and TA/NARS, and research networks to link researchers in NARS with regional and international institutes.

Now is the time to start fresh and examine the causes of differential stages of institutional maturity in Africa and the incremental nature of building scientific capability. The starting point should be a thorough review of what has been learned about Africa's agricultural research history over the past 60 years (Carr, 1982; Anderson et al., 1988). The second step is to improve our understanding of the payoff to investment in agricultural research by undertaking a set of comparative studies of the economic rate of return on past investments in research (Echeverria, 1988). ISNAR is the logical institution to undertake studies of the payoff to investment in food, export crops, and livestock because it has generated a global data base for agricultural research (Pardey and Roseboom, in press; Pardey et al., 1988). Although studies of past investments in research offer limited guidance on how much to invest in research in the future, they will help Africa gain a better understanding of its agrarian heritage. The results of these rate-of-return studies will also serve as a bridge to ex ante studies of potential future returns on investment in public and private research in Africa.

Feasibility teams preparing donor projects to assist NARS should discontinue using rate-of-return coefficients from other continents to justify investments in NARS in Africa. Moreover, the use of the 1% to 2% of agriculture GDP as the guideline for investment in NARS in Africa (World Bank, 1981a) should be discontinued because there is no empirical foundation from Africa to support the use of the norm. In practice, the 1% to 2% guideline allows donors to sidestep thorny issues such as recurrent costs and financial sustainability.

Donors should come to grips with the immensity of Africa and the diversity of its colonial heritage and uneven prospects for development. Investment in research, training, and extension should be conceptualized as part of an interactive investment package on a subregional basis, such as the Sahel or Southern Africa, in a 20- to 30-year time frame. The present project-by-project and country-by-country approach to strengthening national agricultural services is a politically safe but technically flawed approach to institution building. The subregional approach to research planning has the potential of capturing research spillovers. But to implement such an approach, African states and donors must deal with some complex political issues limiting the development of sustainable institutions. For example, because of the different nature of the international political interests in francophone West Africa and Southern Africa, the approach to strengthening NARS in these two subregions will be radically different.

Subregional research investments should be conceptualized as part of an interactive package where regional spillovers are a fact of life. The TP/NARS concept in the USAID (1985) strategy is one that should be factored into the preparation of subregional plans to strengthen NARS. WARDA (1988) and IITA (1988) recently prepared brief sketches on how they propose to strengthen NARS in West Africa. The sketches reflect the lack of a clear mandate to deal with the complex political, technical, and financial issues in strengthening indigenous scientific capacity in West Africa. But the WARDA and IITA sketches are a beginning. They need to be placed side by side with the plans of NARS, SPAAR, and CGIAR, as well

as with plans by bilateral and multilateral donors. There is an urgent need to set up a SACCAR type of organization for the Sahel with a full-time African director to guide donor investments in agricultural research and promote research cooperation among scientists in the region. A similar type of organization is needed for coastal West African countries.

ISNAR has a special responsibility and opportunity to work with NARS, donors, the CGIAR, and French research networks to develop subregional plans to strengthen NARS. There is need for the CGIAR to supplement the counting of hectares as a measure of the production impact of a CGIAR center with new measures of the performance of research institutions over time. For example, how does one measure the performance of the SADCC/ICRISAT sorghum and millet center based in Zimbabwe in terms of its progress in helping strengthen NARS in Southern Africa?

The mission of the CGIAR system and the approach that it uses in dealing with NARS in Africa should be reexamined. When George Harrar, F.F. Hill, and others were laying out the CGIAR system in the early 1960s, they had a limited time horizon of 15 to 20 years in mind for the system. F.F. Hill, an agricultural economist and then vice-president of the Ford Foundation reported that whereas every state in the US, for example, had a college of agriculture and a system of experiment stations, a "half-dozen leading colleges of agriculture produced the bulk of the new technology" (Hill, 1964). Hill observed that this concept of technology-producing states could be used to set up "regional research organizations"--International Agricultural Research Centers (IARCs)--in less-developed regions. Hill contended that these new IARCs in the Third World should have continuity of funding from public and private sources for a "sufficiently long period of time to enable them to carry out their assigned missions. This will usually require fifteen to twenty years, sometimes longer" (Hill, 1964: 152).

In the early 1960s there was a general perception that the Ford and Rockefeller Foundations could withdraw and transfer the management and support of the early IARCs (CIMMYT and IRRI) to the host countries over a period of several decades (Ruttan, 1987). But one CGIAR center has celebrated its 25th anniversary, another its 20th, and both are planning programs for the year 2000. In short, the CGIAR system is firmly entrenched, and a few scholars such as Prof. Ruttan have argued that the CGIAR system should be given permanent status in the global research system.

Nevertheless, after 20 years of CGIAR activities in Africa, the CGIAR system does not have a feasible plan of action to strengthen Africa's NARS. Before the CG system brings more centers under its control, four hard questions about the CGIAR's role in Africa should be addressed:

- * What constitutes a successful international effort in agricultural research in a subregion of Africa such as the Sahel? Should donor assistance to the CGIAR system be evaluated on the basis of the volume of new technology produced, or on the dual objectives of producing technology and strengthening NARS?

- * Is the CGIAR prepared to modify its technology-generating focus in Africa and develop a dual strategy of generating new technology and strengthening NARS?
- * Is the CGIAR prepared to rebudget human and financial resources to help improve the capacity and increase the sustainability of NARS?
- * Are the French research institutes prepared to develop and implement a strategy (in cooperation with the CGIAR) to strengthen NARS in francophone West Africa?

To address these and other questions, ISNAR should map out a 10-year research program on "Sustainable NARS in Africa."

Notes

1. World Commission on Environment and Development (1987).
2. No countries in sub-Saharan Africa were included in the 23 studied.
3. Historical studies of agricultural research policy include a study of 60 years of agricultural research history in Uganda (Carr, 1982) and Idachaba's (1987) study of agricultural research policy in Nigeria.
4. About US\$ 90 million was spent on the 1200 long-term advisors, and about \$10 million, on overseas training in 1985.
5. For an extended discussion of the five prime movers, see Eicher (1983a, 1988b). The prime movers are favorable economic environment, human capability, new technology, rural capital formation, and rural institutions.
6. The 1900-1929 period in anglophone countries is admirably chronicled by McKelvey (1965), Jeffries (1964), and Masefield (1972). I am not aware of a definitive history of agricultural research in francophone Africa.
7. The INEAC oil palm research team visited Indonesia in 1933.
8. In 1947, the French established the Institut de recherche pour les huiles et oleagineux (IRHO) to carry out research on oil palm. Cooperation between INEAC and IRHO scientists played a critical role in developing the modern oil palm industry in Cote d'Ivoire.
9. Processing of the rice research results was greatly aided by the arrival of a large IBM mainframe computer at the Yangambi station in 1956 (Tollens, 1988).
10. At independence in 1960, there were 420 European (mostly Belgian) scientists and technicians, of which more than half were university graduates. In addition, there was a Congolese labor force of 12,000 to support 17 research stations, 14 experimental plantations, and a veterinary laboratory (Drachoussoff, 1965: 188). But Guy Rocheteau of ISNAR reports that in 1988, there are only 43 national scientists in Zaire's NARS (see Table 2), supplemented by 56 national and 11 expatriate scientists in a separate research and extension project in the Ministry of Agriculture.
11. See Eicher (1984) and Rohrbach (1988) for more information on Zimbabwe's maize industry.
12. A.G. Rattray served as director of maize research from 1938 to 1968, at which time he retired from government service. Zimbabwe's maize research program has been directed by only four scientists over the past six decades (1932-1988), a record of continuity that is unmatched almost anywhere in the world.

13. Institut de recherche du coton et des textiles exotiques (IRTC).
14. Compagnie Francaise pour le developpement de fibres textiles (CFDT).
15. The last expatriate scientist left CRIG in 1962. For more details see Martinson et al. (1987).
16. The number of Ghanaian scientific staff increased to 11 (of 17 total) in 1970 and to 25 by 1985.
17. See Malaysia (1986) and PORIM (1985) for a discussion of the aggressive steps taken by Malaysia to become the dominant world oil palm producer and a leading generator of biotechnology (National Council for Scientific Research, 1985).
18. Institutional models include integrated rural development (IRD), agricultural (area) development, T & V extension, farming systems, discrete agricultural research projects, and research components in area development projects. Technical-assistance models include short-term consultants, long-term resident expatriate advisors, counterparts, and overseas training.
19. See Cernea (1985 and 1987), Dyson-Hudson (1985), Zurck (1985), and Birgegard (1987).
20. For an upbeat assessment by a World Bank official, see "A Successful Managerial Approach: The Training and Visit System of Agricultural Extension" (Israel, 1987: Chap. 10).
21. Invariably, loan, credit, and grant agreements are vague on the source of the extra government budget resources expected to take up the slack after the loan or grant is disbursed. Because extra revenue is not forthcoming in most cases, the project activities are terminated or dramatically scaled back when foreign assistance is over. In some cases, the project is "repackaged" and another donor takes over.
22. For a discussion of the recurrent cost problem, see Heller (1979), CILLS/Club du Sahel (1979), USAID (1982), Howell (1986), and Morss (1984).
23. Idris (1969) summarizes 50 years of cotton research in Sudan from 1918 to 1968, and Martinson et al. (1987) review 48 years of cocoa research in Ghana.
24. Prof. Eric Tollens is carrying out a study of the returns to Belgian investment in agricultural research in Zaire (formerly the Belgian Congo) from 1933 to 1959.
25. These figures include allocations for free-standing agricultural research projects, and agricultural and regional development projects with research components.
26. For valuable perspectives on this complex process see Odhiambo (1967, 1987) and Rocheteau et al. (1988)

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