RESEARCH REPORT 17

AGRICULTURAL RESEARCH POLICY IN NIGERIA

by
Francis Sulemanu Idachaba

August 1980

The International Food Policy Research Institute was established to identify and analyze alternative national and international strategies and policies for meeting food needs in the world, with particular emphasis on low-income countries and on the poorer groups in those countries. While the research effort is geared to the precise objective of contributing to the reduction of hunger and malnutrition, the factors involved are many and wide-ranging, requiring analysis of underlying processes and extending beyond a narrowly defined food sector. The Institute's research program reflects worldwide interaction with policymakers, administrators, and others concerned with increasing food production and with improving the equity of its distribution. Research results are published and distributed to officials and others concerned with national and international food and agricultural policy.

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Research Report 17
International Food Policy Research Institute
August 1980

Library of Congress Cataloging in Publication Data

Idachaba, Francis Sulemanu.
Agricultural Research Policy in Nigeria.

(Research report—International Food Policy Research Institute; 17)
Bibliography: p. 67
1. Agricultural Research—Nigeria. 2. Agriculture and state—Nigeria. I. Title. II. Series: International Food Policy Research Institute. Research report—International Food Policy Research Institute; 17.
S542.N513 630'720669 80-20791
ISBN 0-89629-018-2

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FOREWORD

Research reports and other work of the International Food Policy Research Institute (IFPRI) have emphasized the difficult food situation most African countries will face in the next few decades as their populations and cities grow faster than food production. Nigeria epitomizes these problems. If past trends continue, it will need to import up to 20 million tons of grain by 1990. But economic reasons make it unlikely that Nigeria will be able to import that much. It may even be physically impossible. The alternatives are to accelerate production growth rates or to severely stretch food supplies.

The core of the solution to the food problem in Africa, as elsewhere, is a larger and more effective agricultural research system. Nigeria has many agricultural research institutions, an organizational structure with experienced administrators and trained scientists, and many years of experience from which to learn. Recognizing the potential of this system, IFPRI asked Francis Idachaba to use his sabbatical leave from the Department of Agricultural Economics at the University of Ibadan to pull together data and other historical information on the agricultural research system of Nigeria in a manner that would enable policymakers to draw useful conclusions. On the basis of these data, widespread travel, and extensive discussions, he has gone further and made substantial and specific recommendations. Some of these follow directly from the data. Others are more broadly based and, in a sense, personal. We hope the effort will be helpful not only in Nigeria, but also in other countries wrestling with similar problems.

We are grateful to Francis Idachaba for making this effort and to the University of Ibadan for facilitating his sabbatical leave at IFPRI. This effort has benefited us at IFPRI directly and, even more, through interactions affecting many areas of research in which we are engaged.

John W. Mellor

Washington, D.C.
August 1980

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SUMMARY

Agricultural research in Nigeria first emphasized the export crops—oil palm, cotton, cocoa, groundnuts, and rubber—which were needed by the British economy. Most of the early research institutes were located in areas suitable for production of these crops. Emphasis on export crops increased with the outbreak of World War II when the United Kingdom lost its Far Eastern sources of raw materials.

Export crops continued to receive research emphasis after independence in 1954, largely because of their foreign exchange contribution and the revenues they provided regional governments through marketing board taxes. During the Second National Development Plan, 1970-74, 63 percent of the total allocations for agricultural research went to export crops, compared with 33 percent to food crops.

Before 1954 organized agricultural research in Nigeria consisted largely of research and experimental sections of the old Federal Department of Agriculture with headquarters at Moor Plantation and outstations at Samaru, Badeggi, Shika, and Umudike. During this period the private sector played a major role in export crop research, especially on cotton. Since the 1954 Constitution, agricultural research has been conducted concurrently by federal and state governments but has never been effectively coordinated.

Production and yield performances of most crops indicate that Nigerian agricultural research has not succeeded in raising crop yields and output over the years. From 1968/69 to 1974/75, land area, yield, and output of maize recorded significant declines. Slight gains in yield of sorghum barely offset declines in land area, whereas small gains in yield of cowpeas were more than offset by decreases in land area. Groundnuts recorded marginal increases in land area, yield, and output. On the other hand, rice and millet made impressive gains.

Crop output has fluctuated widely from year to year. Calculated indexes of variability show that, among the grains, sorghum and millet yields were the most unstable, whereas rice fluctuated the least. Soybeans were the most unstable of the oilseeds. Cotton and groundnuts, crops with a long history of agricultural research, were highly vulnerable to environmental stress. But outputs of cocoa, cotton, and groundnuts probably were higher than they would have been in the absence of research.

Reasons for ineffective agricultural research include:

Inadequate Research Funding. This has resulted in halfhearted research efforts, incomplete projects, a shortage of medium- to long-term research projects, and uncertainty for research staff.

Inadequacy of Research Staff. All institutes have listed an unrealistic number of projects per scientific man-year. This indicates that staffs were too thinly spread out for effective work, or that many of the listed projects were deadwood.

Research Staff Instability. For many institutes this may well be an even more serious problem than staff inadequacy. It has led to incomplete and abandoned projects, too much emphasis on short-term projects, poor coordination, and waste of resources. Indexes of research staff instability computed for this study reveal not only differential instability across departments and sections, but also across institutes and over time.

Lack of Materials and Equipment. For most institutes this problem was compounded by inadequate maintenance and servicing.

Lack of an Effective System for Delivering Research Results. The federal government has had varying degrees of responsibility for agricultural research throughout this century, but responsibility for agricultural extension has been left to the states. The result has been that agricultural research, training, and extension have remained largely uncoordinated within the national framework.

Another major weakness in Nigeria's agricultural research is the neglect of irrigation and the major farm inputs. None of the 18 institutes is charged with responsibility for input research.

Allocations to agricultural research dur-

ing the last two decades have declined in relation to government expenditures on agriculture, reflecting increased spending on nonresearch programs. Allocations to agricultural research, which includes crops, livestock, forestry, and fisheries, fell from 21 percent of all federal government expenditures on agriculture in 1953/54 to only 5.7 percent of planned expenditures on agriculture and irrigation during the 1975-80 Plan. During this period, however, research emphasis within the agricultural sector changed. Crops and fisheries received larger shares of the total research funds, and livestock and forestry received smaller shares. Among the food crops, research resource allocations for roots and tubers, cereals, seeds and nuts, cowpeas, and sugar have been relatively less than their contribution to the national supply of nutrients.

Allocations to agricultural research also have declined relative to overall government expenditures, accounting for only 3.3, 1.0, and 0.3 percent in the 1962-68, 1970-74, and 1975-80 Plans, respectively. Nevertheless, the agricultural sector continued to be of major importance in the national economy. It contributed an annual average of 58.1 percent of the gross domestic product (GDP) during the 1962-68 Plan, 28.8 percent during the 1970-74 Plan, and a projected 20.9 percent during the 1975-80 Plan.

Several proposals for changes in Nigeria's agricultural research program are developed in this study, many of which are relevant to other developing countries. These include joint federal and state responsibility for funding agricultural research; federal government responsibility for research on livestock, fisheries, forestry, and irrigation; new initiatives by the federal government for research in a systems context on farm labor, soils, agrometeorology, irrigation water, farm mechanization, and related fertilizer and pesticide problems; decentralization of the agricultural research system; integration of the research of the institutes and the faculties of agriculture and veterinary medicine in Nigerian universities through joint projects and the sharing of personnel and facilities; greatly increased funding by the federal government for agricultural research and training; increased allocations for research to increase farm production; new programs in crop processing and utilization; establishment of an agricultural economics section at each research institute to work jointly with the physical scientists; greatly increased federal funding of irrigated cotton research; adoption of a national approach to agricultural extension and delivery of research results; and increased research staff and training.

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INTRODUCTION

This study examines agricultural research priorities in Nigeria, a relatively large food-deficit country, and the ability of agriculture to meet the country's requirements in the next three decades. Specifically the study reviews the evolution and achievements of agricultural research; examines resource allocations to agricultural research for the various crops; and compares the amount of research resources allotted to export and food crops; crops, livestock, forestry, and fisheries; rainfed and irrigated agriculture; agricultural production, inputs, and multi-disciplinary systems; and the allocation of research facilities by region. It identifies major research needs in the light of available capabilities, indicates the Nigerian political and economic policies that affect the efficiency of the national agricultural research system, and makes policy recommendations for Nigeria that are relevant to other developing countries.

The Economic and Agricultural Setting

Nigeria has a land area of 924,000 square kilometers and an estimated 1978 population of more than 80 million. The rainy season ranges from 3 months in the far north to 11 in the south. Annual rainfall ranges from a high of 4,000 millimeters in parts of the south to 500 millimeters in parts of the far north.

Almost the whole of the northern half of the land area does not receive any rain until early May.[1] The heavy downpours of tropical storms during the short rainy season lead to severe leaching of the soils, rapid runoff, and soil erosion. This is especially harmful to crops that have to be planted with the first rains because nitrogen and other nutrients are leached out. Because of the distribution of rainfall in the northern half of the country, only one crop a year can be raised without irrigation. But in much of the southern half, two crops can be grown. Temperatures in Nigeria are high most of the year, especially in the south where there is little variability. However, the harmattan winds bring cool air from the Sahara to the northern half of the country during the dry season (November to March).

The bulk of Nigerian soils (41.7 percent of classified soils) are the ferruginous tropical types.[2] Found mainly in the northern states, they have low moisture-holding capacity and are prone to waterlogging and soil erosion.[3] The ferrasols (20.3 percent of all soil), found mainly in the south and the Niger basin valleys, are relatively favorable for food production. The remaining soil types are mainly lithosols, alluvial, semiarid brown, saline, and hydromorphic. According to the Food and Agriculture Organization of the United Nations (FAO) classification, 63 percent of Nigerian soils rate low or very low in productivity at current levels of technology.

There are eight main vegetation zones. The Sahel zone (20,812 square kilometers) lies in the extreme north, mostly in Borno State, and consists of open grassland and thorn trees with acacia and commiphora trees predominant. It supports limited production of millet and groundnuts and has

[1] Jan M. Kowal and Danuta T. Knabe, *An Agro-Climatological Atlas of the Northern States of Nigeria* (Zaria: Ahmadu Bello University Press, 1972).

[2] Food and Agriculture Organization of the United Nations, *Agricultural Development in Nigeria 1965-1980* (Rome: FAO, 1966).

[3] Kowal and Knabe put it thus: "The soils are very weakly buffered and have a very small exchange capacity. ... Because of the high proportion of free metal oxides present in the soil, there is a pronounced tendency for phosphate to be immobilized, and crops respond well to phosphatic fertilizers. The total content of available soil nutrients in these soils is very small because of leaching, runoff, and soil erosion. In addition, there is a high loss of nitrogen and sulphur due to fires and removal of crop residues." Kowal and Knabe, *Agro-Climatological Atlas*, p. 10.

some potential for irrigated rice and wheat (Figure 1). The Sudan zone (241,800 square kilometers) is mainly grassland whose natural vegetation has largely disappeared as a result of continuous cropping. It covers most of the states of Sokoto, Kano, and Borno, and parts of Kaduna and Bauchi. Conditions here are most favorable for the production of cereals, legumes, and livestock (mainly millet, guinea corn, cowpeas, groundnuts, cattle, small livestock, and poultry). The Northern Guinea zone (231,000 square kilometers) consists mainly of short grasses and scattered trees (mainly isoberlinia). It covers the northwestern parts of Kwara and Niger States, most of the southern half of Kaduna State, and parts of Bauchi and Gongola States. This zone also supports grain and livestock production. The Southern Guinea zone, or transition woodland area (174,200 square kilometers), covers the nothern stretches of Oyo State, parts of Kwara State, most of Niger State, the northern parts of Benue State (minus Idah, Ankpa. Dekina, and Bassa local government areas), as well as the southern stretches of Gongola State. Primarily this zone produces yams, cassava, guinea corn, cotton, tobacco, locust beans, benniseed (sesame), soybeans, and cowpeas. Production of rice is significant in Niger State. The Derived Savannah zone covers the northern stretches of Ogun and Oyo States, a large segment of Kwara northeast of Ilorin, and the southern parts of Benue and Gongola States, as well as most of Anambra State. It is a mixture of tall grasses and trees that have replaced the natural vegetation of high forests. The Tropical High Forest zone covers most of the southern Ogun, Oyo, and Kwara States, almost all of Ondo and Cross River States, most of the southern half of Bendel State, and parts of Imo and Rivers States. This zone supplies most of the country's timber requirements and contains many forest reserves. The main perennial crops are also grown here—cocoa, oil palm, coffee, kola, cashew, and rubber. Roots and tubers (yam, cassava, cocoyam, and sweet potato), maize, rice, groundnuts, cowpeas, and beans are also grown. The Fresh Water Swamp and Mangrove Swamp zones are confined mainly to the delta and coastal areas. Swamp rice is grown in the mangrove swamps. Fishing and fiber making are the main agricultural activities in the fresh water swamps which lie north of the mangrove swamps.

Recent Economic Trends

At constant 1962/63 factor costs, Nigeria's GDP grew 6.9 percent from 1958/59 to 1973/74 and 7.8 percent from 1970/71 to 1973/74. Agriculture, forestry, and fishery increased 1.4 percent in the 1958/59 to 1973/74 period but declined 1.4 percent in the 1970/71 to 1973/74 period. Agriculture is also declining as a percentage of the GDP. Average annual percentage contributions of agriculture, forestry, and fishery to the GDP at 1961/63 factor costs were 60.3 percent in 1958/59 to 1966/67, 51.0 percent in 1967/68 to 1969/70, and 39.8 percent in 1970/71 to 1973/74. Agriculture's declining share reflects its slower growth and the phenomenal rise of the petroleum sector.

Imports for some important food items have increased (see Table 1). The country even imports products it used to export. Nigeria exported ₦25.648[4] million of groundnut oil in 1973 and imported ₦7.886 million in 1976. Main sources of supply were Senegal, the Ivory Coast, and Argentina.

Food shortages are likely to worsen if production is not accelerated. A recent IFPRI study indicates that, if present production trends continue, Nigeria's food deficit would be about 17 million metric tons by 1990 if income growth were low and about 21 million metric tons if income growth were high.[5] The study by Olayide, et al. also shows a gross deficit by 1985.[6] Among the grains only rice and acha are projected to have surpluses. Deficits are projected for all of the roots and tubers except yams, groundnuts, other oilseeds, nuts, and vegetable oils. The

[4] Nigeria's currency is the naira (₦). At the time of writing, one naira was worth US$ 1.62.

[5] International Food Policy Research Institute, *Food Needs of Developing Countries: Projections of Production and Consumption to 1990*, Research Report No. 3 (Washington, D.C.: IFPRI, 1977).

[6] Samson Olajuwon Olayide, comp., *A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria 1968-85* (Lagos: Federal Department of Agriculture, 1972).

Figure 1—Ecological zones and state boundaries

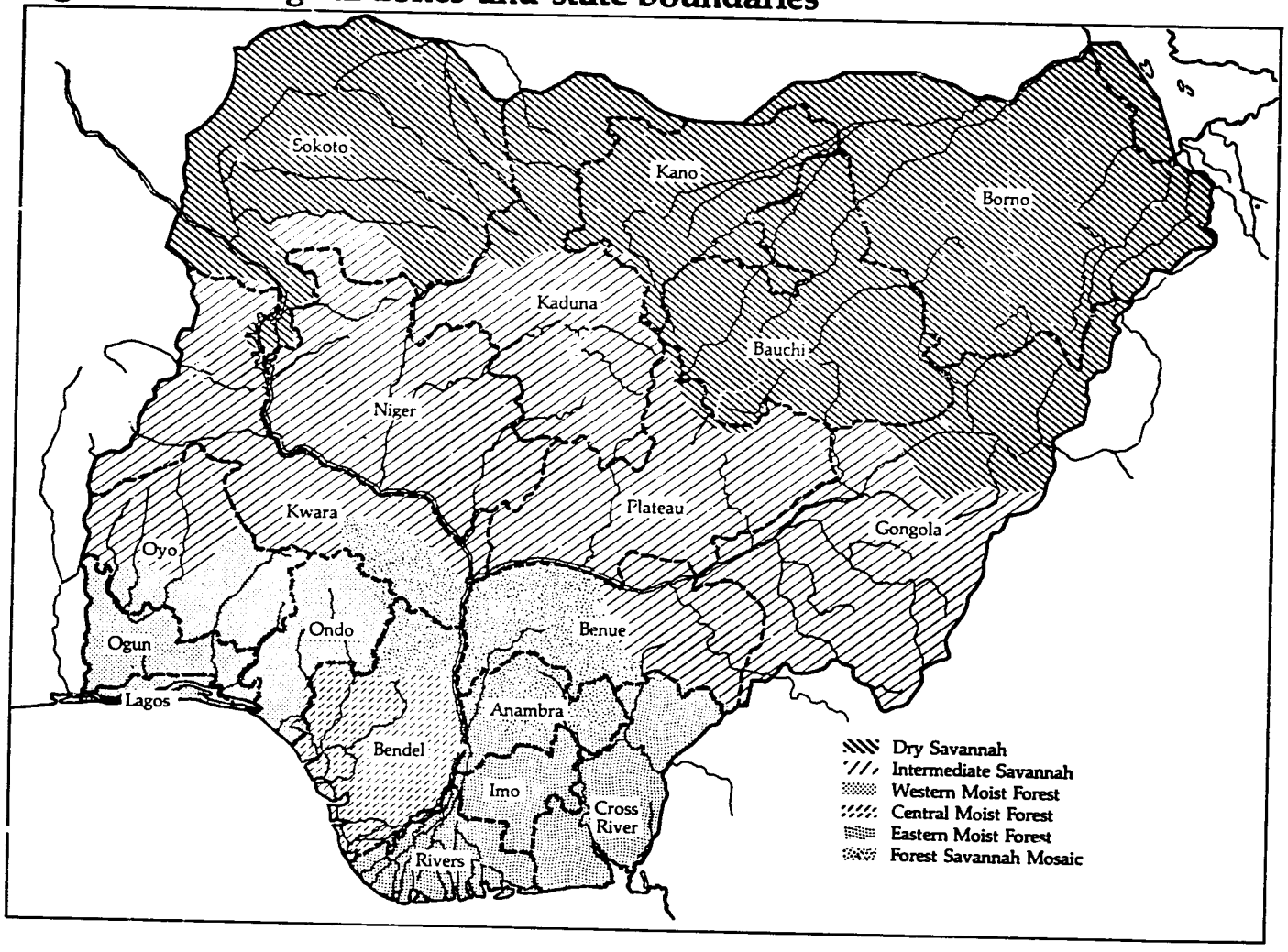


Table 1—Trends in selected food imports, 1970 to 1976

Year	Meat	Dairy Products	Fish	Wheat and Spelt (including meslin)	Rice	Maize	Vegetables
				(metric tons)			
1970	87	52,052	6,593	258,721	1,749	8,882	2,575
1971	103	65,320	7,696	358,948	255	3,853	9,209
1972	39	78,384	16,585	266,679	5,890	2,391	8,247
1973	47	63,578	13,158	1,088,347	1,069	1,722	4,460
1974	944	68,162	14,710	318,269	4,805	2,440	6,024
1975	5,636	87,456	39,997	407,309	6,652	2,211	10,595
1976	17,934	101,881	85,529	730,711	45,377	9,861	19,502
1970-76 mean	3,541	73,833	26,324	489,855	9,400	4,480	8,659
				(percent)			
1970-76 estimated growth rate	98.19	8.78	38.80	86.71	57.45	−2.77	21.57

Source: Basic data from Nigeria, Federal Office of Statistics, *Nigeria Trade Summary* (Lagos: Federal Office of Statistics, 1970-76).

phenomenal rise in wheat imports in recent years, as seen in Table 1, reflects the increasing use of bread as a convenience food. Recent estimates project wheat imports into Nigeria will reach 1.7 million metric tons in 1985 if present trends continue.[7]

The challenges facing agricultural research include: low yields of staple food crops in the face of population and income increases; protein deficiencies in the national diet; the need for complementary socio-economic research in health, home economics, transportation, and electricity; the need to reduce losses in food processing and marketing; and the need to improve the workings of rural institutions through which new research results are transmitted to farmers.

[7] Francis Sulemanu Idachaba, *Food Policy for Nigeria*, forthcoming.

3

HISTORICAL BACKGROUND

Government interest in agricultural research dates back to 1893 when a botanical station was established in Lagos. In 1899 a model farm was started at Moor Plantation, Ibadan, to propagate rubber trees and general agriculture.[8] The British Empire Cotton Growing Corporation (ECGC)[9] began research at the farm in 1905 but abandoned it five years later when the site was found unsuitable for cotton production. In 1910 Moor Plantation became the headquarters of the Department of Agriculture. Experimental work at the plantation increased in the early 1920s, and a chemistry laboratory was constructed in 1926.

Before independence British West Africa was served by a regional network of research institutes, the West African Research Organization. Two of these had their headquarters in Nigeria: the West African Institute for Oil Palm Research (WAIFOR) and the West African Institute for Trypanosomiasis Research (WAITR). The West African Research Organization was dissolved in 1962. The 1954 Constitution specified that "scientific and industrial research" was to be pursued by both the federal and regional governments. A department of agriculture was established in each region, and research facilities at Moor Plantation were shared by the federal and western regional governments. The new Federal Department of Agricultural Research (FDAR) was expanded in the 1950s with the construction of greenhouses and experimental plots for the West African Cocoa Research Institute (WACRI).

There are now 18 agricultural research institutes covering agriculture (crops), livestock, fisheries, and forestry. These are classified in Table 2 and illustrated in Figure 2.

The institutes have undergone various transformations over the years. The National Cereals Research Institute (NCRI), established

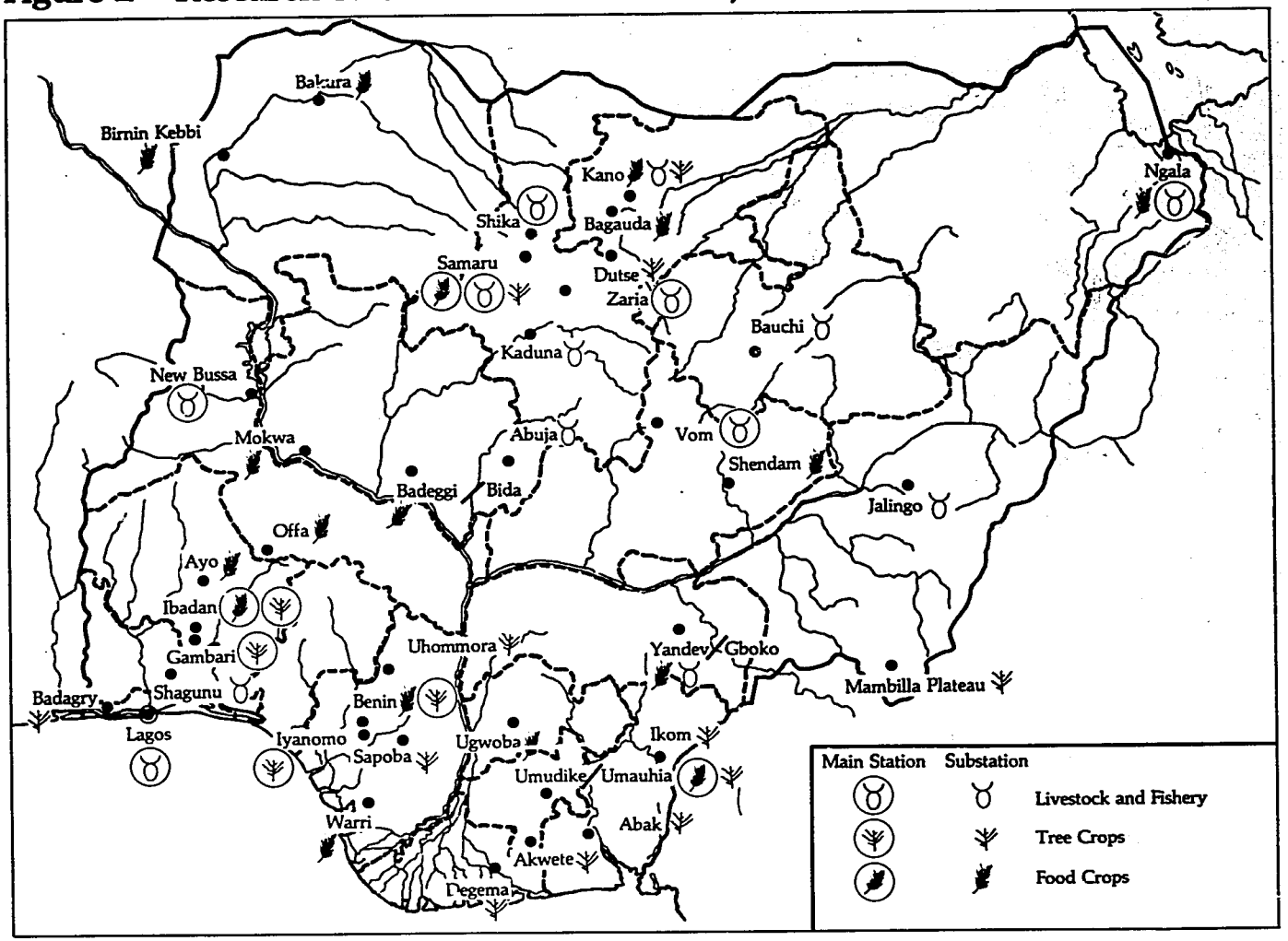
Table 2—Research area and location of agricultural research institutes

Institutes	Station Headquarters
Food Crops	
Institute for Agricultural Research (IAR)	Samaru, Kaduna State
National Cereals Research Institute (NCRI)	Ibadan, Oyo State
National Root Crops Research Institute (NRCRI)	Umudike, Imo State
National Institute for Horticultural Research (NIHORT)	Idi-Ishin, Oyo State
Institute of Agricultural Research and Training (IAR&T)	Ibadan, Oyo State
Tree Crops	
Cocoa Research Institute of Nigeria (CRIN)	Gambari, Oyo State
Nigerian Institute for Oil Palm Research (NIFOR)	Benin, Bendel State
Rubber Research Institute of Nigeria (RRIN)	Iyanomo, Bendel State
Forestry Research Institute of Nigeria (FRIN)	Ibadan, Oyo State
Livestock	
National Veterinary Research Institute (NVRI)	Vom, Plateau State
National Animal Production Research Institute (NAPRI)	Shika, Kaduna State
Nigerian Institute for Trypanosomiasis Research (NITR)	Kaduna, Kaduna State
Leather Research Institute of Nigeria (LRIN)	Zaria, Kaduna State
Fisheries	
Lake Chad Research Institute (LCRI)	Mechoun Fatori, Borno State
Kainji Lake Research Institute (KLRI)	New Bussa, Kwara State
Nigerian Institute for Oceanography and Marine Research (NIOMR)	Lagos, Federal Territory
General Services	
Agricultural Extension and Research Liaison Services (AERLS)	Samaru, Kaduna State
Nigerian Stored Products Research Institute (NSPRI)	Lagos, Federal Territory

[8] Robert E. Evenson and Yoav Kislev, *Agricultural Research and Productivity* (New Haven: Yale University Press, 1975).

[9] For a list of abbreviated terms, see Appendix 1.

Figure 2—Research stations and substations, 1978



in 1975, succeeded the FDAR. The National Root Crops Research Institute (NRCRI), established in Umudike in 1975 to conduct research into root crops and tubers, began as a provincial experimental farm in 1923. The present Institute for Agricultural Research (IAR) started out as a regional research station at Samaru in 1922 when it served as headquarters of the Department of Agriculture of the Northern Provinces. Actual research at Samaru began with the appointment of a botanist in 1924 and of a chemist in 1927.

The Institute of Agricultural Research and Training (IAR&T) dates back to 1956 when it was decided that the federal and western regional governments should share the research facilities at Moor Plantation. With the establishment of the University of Ife in 1962, IAR&T became part of the university. It is now under the funding control of the Federal Ministry of Science and Technology (FMST).

The National Horticultural Research Institute (NIHORT) was established at Idi-Ishin, Ibadan, in 1975. Research in horticultural crops was carried on but was not a coordinated effort.

The Nigerian Stored Products Research Institute (NSPRI) had its origins in the West African Stored Products Research Institute. Since 1977 it has been under the National Science and Technology Development Agency (NSTDA), now the FMST.

Research into the tree crop economy of the rain forest ecological zone was accorded priority, especially in the years just before and after World War II. WACRI was established at Tafo, Ghana, in 1944 to serve the cocoa economies of southern Ghana, Nigeria, and other British West African countries. But cocoa breeding in Nigeria dates back to 1912 when seeds from yellow and red pods were planted on a six-and-a-half hectare farm.[10] Cocoa research was carried out at Moor Plantation until 1965. The Cocoa Research Institute of Nigeria (CRIN) replaced the Nigerian substation of WACRI in 1964. Its mandate was broadened to include research on coffee, kola, and cashew. It is now under the aegis of the FMST.

The Nigerian Institute for Oil Palm Research (NIFOR) had its origins in the Oil Palm Research Station established in 1939. The Rubber Research Institute of Nigeria (RRIN) first started as a research station under the old Western Nigeria government in 1961. Its headquarters is at Iyanomo near Benin City. Research into forestry was originally part of the old Department of Forestry, but is now under the Forestry Research Institute of Nigeria (FRIN). Conservation of wild flora and fauna are also included in the research program.

The National Veterinary Research Institute (NVRI) was preceded by the Nigerian Veterinary Department established in Vom in 1924 to study the prevention and control of diseases in animals in Nigeria and the Cameroons. The National Animal Production Research Institute (NAPRI) traces its origins back to 1927 when a herd of cattle was established at the Shika Stock Farm. Actual research into cattle breeding began in 1928.[11] NAPRI is the only livestock research institute with formal links with a university.

The Nigerian Institute for Trypanosomiasis Research (NITR), created in 1964, had its origins in WAITR, which was established in 1947 to serve the needs of Nigeria, Ghana, Sierra Leone, and Gambia. Nigeria assumed full responsibility for this research in 1962. Onchocerciasis, a human disease, was added to NITR's research responsibilities in 1975.

The Leather Research Institute of Nigeria (LRIN) was established in 1975 and dates back to 1964 when FAO established the Hides and Skins Demonstration and Training Project in Zaria. When the FAO project was terminated in 1972, it was upgraded to a research institute.

The Lake Chad Research Institute (LCRI) dates back to about 1960 when the federal government maintained a fisheries substation at Malamfatori on the northwestern shore of Lake Chad. The Kainji Lake Research Institute (KLRI) started as a United Nations Development Program (UNDP)/FAO project to conduct research in the fields of agriculture, public health, fisheries, limnology, and socio-economics as these affect the people resettled around the lake. The project ended in 1974. It was formally transferred to the federal government in 1975 when the KLRI was established. The Nigerian Institute for Oceanography and Marine Research (NIOMR) was

[10] Cocoa Research Institute of Nigeria, *Progress in Tree Crop Research in Nigeria* (Ibadan: CRIN, 1971).

[11] Institute for Agricultural Research, *Annual Report 1962/63* (Samaru: IAR, 1964).

also created in 1975 to handle all aspects of oceanographic and marine research in Nigeria.

Laws and Decrees Establishing Institutes

The Nigerian Research Institutes Act of 1964 established four research institutes: CRIN, NIFOR, RRIN, and NITR. Subsequent actions included the following:

- 1971—A decree established the Agricultural Research Council of Nigeria (ARCN) and made it responsible for coordinating all agricultural research.
- 1973—The Agricultural Research Institutes Decree of 1973 empowered the Commissioner of Agriculture and Rural Development, in consultation with the ARCN and the Nigerian Council for Science and Technology, to establish institutes to conduct research and training in any field of agriculture, veterinary science, fisheries, forestry, agrometeorology, and water resources. The decree empowered the federal government to take over any existing state research stations. This marks an important departure. The 1963 Constitution said that "regions and states as well as the federal government" could engage in agricultural research. In actuality the federal departments have concentrated on basic agricultural research, whereas regional research departments have emphasized application of the results of basic research since the time of the 1954 Constitution.[12]

The effect of the 1973 decree on state governments is not yet clear. However, no state government has established an agricultural research station since 1973.[13]

- 1975—The Research Institutes (Establishment) Order established 14 research institutes: three for food crops (NCRI, NRCRI, and NIHORT); four for tree crops (CRIN, RRIN, NIFOR, and FRIN); four for livestock (NVRI, NAPRI, NITR, and LRIN); and three for fisheries (LCRI, KLRI, and NIOMR). (See Table 2.) The order specified the fields of research of each institute, the constitution of the governing boards, and their relationships with universities and other outside bodies. Four of the institutes (CRIN, NIFOR, NITR, and RRIN) had been created by the Research Institutes Act of 1964; four were converted from federal research departments (NCRI, NRCRI, FRIN, and NVRI); three from research units of federal departments (LRIN, LCRI, and NIOMR); and one from a research arm of a university (NAPRI).
- 1977—the National Science and Technology Development Agency Decree set up an executive agency (NSTDA) to coordinate all research in Nigeria, agricultural and nonagricultural. In effect it repealed the decree establishing the ARCN.

The 1979 Constitution included "scientific and technological research" on the "concurrent legislative list." This implies that both federal and state governments can conduct agricultural research.[14] Optimal division of responsibilities between state and federal governments will be taken up later.

One general defect of the early research institutes was that the ordinances and acts establishing them did not provide specific guidelines. Consequently research was not always consistent with national objectives. This frequently led to poor phasing and sequencing of programs. For example, new plant varieties were sometimes imported and tested before the agrobotanical characteristics of local varieties were determined.

The first clear attempt to specify the functions of the institutes came in the Research Institutes (Establishment) Order of 1975. It directed the crop research institutes to engage in breeding, agronomic and entomological research, and crop utilization. But even this general statement of purpose

[12] The International Bank for Reconstruction and Development recommended in its 1955 Report on Nigeria "that all basic research on livestock, crops, fisheries, and forestry should be done by the federal government, while the regions should concentrate on applied research or the experimental application of research findings." The basic/applied research distinction is misleading in practice since only an insignificant proportion of research done within the agricultural research establishment is basic in the UNESCO sense of a fund of scientific knowledge without any clear applied objective.

[13] There have been many instances (especially in education) when states were only too willing to surrender their institutions to the federal government. Such states set themselves up to be bailed out of their financial difficulties. They found this to be a good way to attract federal funds.

[14] The Constitution of the Federal Republic of Nigeria, 1979, Second Schedule, Part II, Item I.

had some drawbacks. First, the Order generally failed to set priorities for the institutes. Listing the same functions for all institutes implies that all crops are at the same level of varietal development and improvement. This, of course, is not the case. In rice research, for example, improved crop processing and utilization now have assumed a higher priority than plant breeding; in cowpea research the converse is the case. What the Order lacked was a means to transmit changes in priorities from the political and agricultural establishment to the agricultural research leadership. Unless priorities are set, many research institutes will continue to list irrelevant projects.

Second, the Order failed to recognize that a major objective of agricultural research is to help to raise the living standards of rural people. Without this recognition there is a danger of too much concentration on pure commodity research, which may leave the rural majority still in poverty if they cannot apply it. Third, the functions assigned to the institutes were largely production oriented. There was no specific reference to research on the problems of marketing increased output. Fourth, the Order listed mechanization of farming operations as a major objective, though research into alternative new technologies that are consistent with the country's factor endowments would have been more appropriate. It may well be that relative factor prices, even after adjusting for overvalued exchange rates and public subsidies, would still lead to the mechanization of Nigerian farms. But this is a conclusion that should await the results of research rather than be determined beforehand. The problem is that the institutes may come to accept the mechanization of Nigerian agriculture as a fait accompli, which could result in large misallocations of scarce research resources—a not uncommon situation in Nigeria's recent agricultural history.

Fifth, except for mechanization, none of the crop institutes was charged to do any input research. In fact, one has to go to the provisions for NAPRI to find a specific direction to study inputs for pastures, rangeland, and so forth. Because of a lack of appreciation for the crucial place of the derived demand for agricultural inputs, the Order failed to assign these institutes their proper roles in input research. Research into the use of new inputs such as fertilizers and pesticides is too important to be overlooked for lack of a national directive.

Furthermore, the Order provided no specific guidelines at all for LRIN or NRCRI. The broad mandate, "conduct research into all aspects of the production and products," does not provide an adequate guide for setting priorities.

4

AGRICULTURAL RESEARCH EFFECTIVENESS

Measures of Effectiveness

There are enormous difficulties in obtaining data to quantitatively assess the effectiveness of agricultural research.[15] First, only a few research institutes, for example NIFOR, keep any consistent set of time-series data on seeds produced and distributed. Second, research results may not make the desired impact because there is no effective system for passing on research results to farmers. The indexes chosen to assess the contribution of research are the growth in output, especially yields of crops; the stability of domestic output of crops from year to year around the trend; and research publications. Table 3 shows recent trends in the production of main food crops.

NCRI has no comprehensive records of the amount of rice and maize seed that has been distributed over the years, but there is a long list of varieties that have been recommended and released. For example, NCRI recommended FARZ 27 or FARZ 24, white varieties of early maize used mainly for human consumption, and the yellow varieties FARZ 7 or FARZ 23 in Ogun, Ondo, Bendel, and Oyo States. In the northern states joint research by IAR and NCRI lead to a long-standing recommendation for the NS-1 variety. But maize research does not seem to have had much impact on national output (see Tables 3 and 4). National maize output declined 14.2 percent per annum from 1968/69 to 1974/75, with growth of area and yield decreasing. Major producing states such as Oyo, Ogun, and Ondo recorded large declines.

An equally long list of rice varieties has been recommended by NCRI (see Appendix 2, Table 30). The data in Table 4 support claims of successful rice research at NCRI. Nevertheless, Sokoto, Niger, Oyo, Ondo, and Ogun still recorded large declines. The poor growth performance in these states was due mainly to declining area. In other states (for example, Bendel), declining land area was compensated for by gains in yields that could be attributed to research.

Although output performance of rice has been superior to that of maize, allocative questions still remain. The country has imported large quantities of rice in recent years when local producers were complaining of depressed market conditions. Urban consumers prefer imported rice because locally produced rice is poorly processed and has broken grains and foreign matter. With opportunity costs of time rising—especially for the urban housewife—many consumers are willing to pay a premium for imported rice. This suggests that research to improve rice processing has been largely ineffective.

Roots and tubers research was nominally

Table 3—Trends in mean annual production of main food crops, 1961/62 to 1966/67 and 1970/71 to 1974/75

Crop	1961/62–1966/67	1970/71–1974/75
	(metric tons)	
Millet	2,464.67	3,538.40
Guinea corn	4,034.33	3,604.80
Goundnuts	1,128.00	1,428.60
Beans	563.83	745.00
Yams	13,138.83	8,640.80
Maize	1,089.17	939.40
Cassava	5,911.50	3,765.60
Benniseed	29.50	10.40
Rice	193.50	404.40
Melons	93.17	94.60
Cocoyams	1,302.85	1,041.80

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys 1965/66-1974/75* (Lagos: Federal Office of Statistics, 1972, 1976).

[15] One approach used in other studies is to estimate the productivity of agricultural research using a production function. Unfortunately, the data do not exist to permit such a study for Nigeria.

Table 4—Estimated annual growth rates of maize and rice by state, 1968/69 to 1974/75

State	Maize			Rice		
	Area	Yield	Output	Area	Yield	Output
			(percent)			
Kaduna	-7.06	-35.31	-28.46	15.69	-5.69	10.97
Borno, Bauchi, Gongola	-9.94	-27.70	-37.26	19.54	-6.72	18.35
Sokoto, Niger	-41.59	1.33	-40.49	-29.89	-4.42	-34.85
Kano	-5.12	7.93	2.80	39.59	9.60	49.80
Benue, Plateau	3.39	1.10	4.38	5.88	6.47	11.97
Kwara	-10.59	9.28	-1.52	29.19	-6.46	21.91
Oyo, Ogun, Ondo	-29.14	-0.35	-29.65	-19.47	7.41	-12.40
Lagos	-38.35	-2.79	-40.21	-18.50	-2.35	16.16
Bendel	-0.73	6.80	5.93	-51.81	73.81	21.25
Rivers	11.74	8.63	20.18[a]	...	...	...
Cross River	-23.73	-13.24	-35.86[a]	...	...	...
Anambra, Imo	-6.61	-19.23	12.22[b]	-46.22	21.60	35.44[c]
All Nigeria	-9.02	-5.06	-14.20	6.40	6.26	17.38

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

[a] This rate is for the period from 1969/70 to 1974/75.

[b] This rate is for the period from 1970/71 to 1974/75.

[c] This rate is for the period from 1972/73 to 1974/75.

Table 5—Estimated annual growth rates of cassava, yams, and cocoyams by state, 1968/69 to 1974/75

State	Cassava			Yams			Cocoyams		
	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output
					(percent)				
Kaduna	-5.82	11.71	-3.84	-0.31	-0.40	-0.95	-20.18	-28.11	-49.30[a]
Borno, Bauchi, Gongola	1.19	-18.43	-17.27	-3.75	-17.26	24.15	-17.98	-1.66	18.17
Sokoto, Niger	-40.59	2.83	-37.92	-28.59	4.65	-24.16	...	...	...
Kano	10.64	-19.04	-5.93	...	...	...	...	...	...
Benue, Plateau	25.89	-14.44	11.23	-23.75	1.82	-11.16	-8.89	-9.86	-11.50
Kwara	-8.13	7.65	-0.74	-16.38	0.74	-16.74	-23.72	0.32	-23.45
Oyo, Ogun, Ondo	-26.13	1.74	-26.16	-20.82	1.24	-19.77	-1.03	-4.55	-4.60
Lagos	-19.35	-3.41	-22.89	-13.92	7.14	-6.87	-25.13	-16.96	-41.97
Bendel	5.78	-2.99	1.28	3.73	4.64	8.16	3.04	-2.90	n.a.
Rivers	-13.98	2.25	-12.20[a]	24.93	16.99	41.90[a]	10.96	-11.44	-2.83[a]
Cross River	-7.61	-19.45	-29.94	-12.35	-3.22	-14.78	-12.60	-14.36	-27.24
Anambra, Imo	4.50	6.59	10.69[b]	-2.00	3.43	1.69[b]	4.21	3.76	7.43[b]
All Nigeria	-1.03	-5.17	-6.70	-7.88	2.16	-5.95	9.28	-0.24	10.53

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

[a] This rate is for the period from 1969/70 to 1974/75.

[b] This rate is for the period from 1970/71 to 1974/75.

conducted under NCRI until 1975 when NRCRI was created. Very little progress has been made in this research area, even by official account. Only cocoyam has a rising growth rate of national output (see Table 5). Yield gains in yams were not sufficient to offset declines in cropped area.

The research results from IAR on food crops as measured by growth performance of output show mixed results (see Table 6). National output of sorghum grew less than 1 percent per year as gains in yields offset reductions in cropped area. Millet recorded an impressive 6.4 percent growth rate with yields increasing sharply and land area slowly. National groundnut output grew only 1.2 percent per year from 1968/69 to 1974/75, as shown in Table 7. The national growth rate of cowpeas decreased slightly during the period because modest gains in yields were not sufficient to offset declines in cropped area. National output of melons grew 9.5 percent per year with rates by states ranging widely. The cropped area of melons declined 8.5 percent a year, falling in all states except Rivers, but yields rose sharply. Cotton output has not performed well in recent years. Although yields increased 4.4 percent, cropped area fell at an annual rate of 20.1 percent.

The effectiveness of research in stabilizing production from year to year also has not been very impressive. Crops remain vulnerable to moisture stress, pests, diseases, and other environmental hazards (see Tables 8 to 12). Although the index of variability in maize production ranges widely, in the major producing states such as Oyo, Ogun, and Ondo output fluctuated only moderately. States with wide swings in output, such as Rivers and Cross River, had relatively small shares of total output. The experience for rice was similar. Fluctuations in output were moderate in states with significant shares of total production but were wide in other states. When all states are considered, agricultural research has not succeeded in reducing susceptibility of maize and rice to the vagaries of weather, pests, and diseases. Yields fluctuated much more than area cropped for both maize and rice.

Fluctuations in sorghum and millet output around the trend from year to year were relatively low in the main producing states of Sokoto, Niger, Kaduna, Borno, Kano, Bauchi, and Gongola. Yields varied much more than cropped area. Fluctuations in groundnut production were more pronounced in Kwara, Ogun, Oyo, and Ondo States where rainfall and pest distributions are unfavorable. Fortunately in Kano, the major groundnut-producing state, fluctuation was moderate. Groundnuts, a crop with a long history of research, still remain highly sensitive to environmental stress. Yields have been quite unstable, even in Kano.

Table 6—Estimated annual growth rates of sorghum and millet, 1968/69 to 1974/75

State	Sorghum			Millet		
	Area	Yield	Output	Area	Yield	Output
			(percent)			
Kaduna	−6.48	−2.72	−9.48	−2.19	4.91	2.54
Borno, Bauchi, Gongola	−1.50	1.75	2.67	5.21	3.86	8.87
Sokoto, Niger	−4.87	8.85	3.89	−1.90	10.26	6.77
Kano	−1.22	−0.80	−1.92	1.67	−0.21	1.49
Benue, Plateau	−3.40	12.90	8.36	−38.72	11.81	−27.20
Kwara	−6.83	47.20	7.26	−22.56	21.98	−0.50
Oyo, Ogun, Ondo	−30.87	−7.80	−39.18	...	...	...
Lagos	−18.34	...	...	...	...	...
Bendel	...	...	...	...	...	...
Rivers	...	...	...	...	...	...
Cross River	...	...	...	...	...	...
Anambra, Imo	...	...	...	...	...	...
All Nigeria	−2.55	2.77	0.07	0.79	9.03	6.36

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

Table 7—Estimated annual growth rates of cowpeas, groundnuts, and melons, 1968/69 to 1974/75

State	Cowpeas			Groundnuts			Melons		
	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output
					(percent)				
Kaduna	−7.72	12.22	4.57	−3.68	3.03	−1.07	...	...	...
Borno, Bauchi, Gongola	−2.32	9.54	7.14	1.63	10.84	12.50	...	...	...
Sokoto, Niger	12.88	8.71	−4.50	−0.62	−13.57	−14.11	−55.95	1.36	−41.27
Kano	5.83	−23.73	−20.29	1.97	−11.63	−9.89	...	...	...
Benue, Plateau	−13.70	32.02	17.45	−23.62	2.01	−21.79	−9.28	−2.36	−0.79
Kwara	−21.42	9.70	−12.43	−10.00	16.03	1.75	−5.81	11.79	5.76
Oyo, Ogun, Ondo	−34.04	12.64	−22.36	23.65	5.15	70.52	−45.94	28.12	1.50
Lagos	...	...	...	...	...	...	−13.80	41.76	...
Bendel	- 20.45	14.15	−6.40	28.45	26.04	53.63	−1.15	10.37	9.43
Rivers[a]	...	...	...	...	...	...	34.30	−33.25	...
Cross River[a]	−16.74	−8.02	−35.88	−13.44	−11.83	−33.38	−6.52	−0.56	5.07
Anambra, Imo[b]	17.40	19.53	−6.16	19.08	43.79	11.35	−4.61	23.67	16.58
All Nigeria	−4.42	2.41	−0.58	0.47	1.02	1.15	−8.52	17.80	9.53

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

[a] These rates are for the period from 1969/70 to 1974/75.

[b] These rates are for the period from 1970/71 to 1974/75.

Table 8—Normalized coefficients of variation for production of maize and rice by state, 1968/69 to 1974/75

State	Maize			Rice		
	Area	Yield	Output	Area	Yield	Output
			(percent)			
Kaduna	0.39	118.23	21.32	2.36	33.89	14.37
Borno, Bauchi, Gongola	0.74	74.59	18.52	2.04	24.12	17.55
Sokoto, Niger	1.85	70.64	18.43	5.54	46.94	45.93
Kano	1.88	20.73	22.99	5.99	330.50	217.52
Benue, Plateau	0.19	54.41	7.05	0.44	22.43	5.59
Kwara	0.30	60.06	10.45	16.33	25.91	47.81
Oyo, Ogun, Ondo	0.20	9.84	7.63	0.90	21.30	16.88
Lagos	5.04	15.22	22.16	3.35	7.06	7.38
Bendel	0.37	11.49	8.99	0.26	12.18	13.59[c]
Rivers	7.18	37.36	41.72[a]	...	...	...
Cross River	1.76	58.63	32.37[a]	...	...	...
Anambra, Imo	0.73	86.16	19.07[b]	0.56	3.69	6.31[c]
All Nigeria	0.02	23.65	0.03	0.07	12.87	0.06

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

[a] This figure is for the period from 1969/70 to 1974/75.

[b] This figure is for the period from 1970/71 to 1974/75.

[c] This figure is for the period from 1972/73 to 1974/75.

Table 9—Normalized coefficients of variation for production of sorghum and millet by state, 1968/69 to 1974/75

State	Sorghum			Millet		
	Area	Yield	Output	Area	Yield	Output
			(percent)			
Kaduna	0.09	31.24	3.87	0.02	16.53	3.70
Borno, Bauchi, Gongola	0.04	64.56	5.46	0.01	16.88	3.69
Sokoto, Niger	0.04	19.47	5.47	0.04	21.98	6.62
Kano	0.01	71.94	5.67	0.01	52.91	2.81
Benue, Plateau	0.03	39.11	4.29	0.60	36.05	21.27
Kwara	0.36	113.62	4.75	1.78	96.11	22.36
Oyo, Ogun, Ondo	2.57	23.03	26.85	...	...	...
Lagos	...	...	...	...	...	...
Bendel	2.11	38.81	38.00	...	...	...
Rivers	...	...	...	...	...	...
Cross River	...	...	...	...	...	...
Anambra, Imo	...	...	...	...	...	...
All Nigeria	0.003	31.31	0.08	0.003	29.34	...

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

Most of the fluctuations in cotton output are due to changes in yields. Again, cotton is an export crop that has received consistent research attention over the years but remains highly vulnerable to environmental stress.

In cassava production both cropped area and yield fluctuated considerably. In contrast, yields of yam and cocoyam varied more than cropped area.

Production lags compounded the difficulty of assessing the impact of research on tree crop output. In oil palm the problem was exacerbated by the disruption of rehabilitation and plantation schemes during the

Table 10—Normalized coefficients of variation for production of melons, cowpeas, and soybeans by state, 1968/69 to 1974/75

State	Melons			Cowpeas			Soybeans		
	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output
					(percent)				
Kaduna	...	...	...	0.12	200.76	...	...	...	...
Borno, Bauchi, Gongola	...	...	...	...	205.62	...	...	...	...
Sokoto, Niger	8.53	312.07	39.74	0.04	88.67	..	...	..	...
Kano	...	...	...	0.04	583.53	...	...	...	...
Benue, Plateau	7.35	564.35	96.38	0.29	250.29	...	75.01	177.12	...
Kwara	5.93	22.92	82.51	0.36	163.48	...	...	...	...
Oyo, Ogun, Ondo	2.96	421.11	10.34	3.43	56.15	...	...	...	...
Lagos	109.58	506.50	...	...	...	...	...	...	...
Bendel	0.67	132.05	19.94	10.62	115.54	...	...	...	...
Rivers	89.61	436.07	...	...	...	...	...	...	...
Cross River	8.00	176.91	105.63	36.18	167.00	...	...	...	...
Anambra, Imo	1.65	790.64	92.42	16.44	169.83	...	...	...	...
All Nigeria	0.19	118.95	0.64	0.01	0.05	...	13.08	70.26	..

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/76 (Lagos: Federal Office of Statistics, 1972, 1976).

Table 11—Normalized coefficients of variation for production of groundnuts and cotton by state, 1968/69 to 1974/75

State	Groundnuts			Cotton		
	Area	Yield	Output	Area	Yield	Output
			(percent)			
Kaduna	0.07	68.82	4.54	0.33	44.66	...
Borno, Bauchi, Gongola	0.03	56.98	7.60	1.02	84.21	...
Sokoto, Niger	0.41	109.34	7.49	0.55	48.02	...
Kano	0.01	53.28	5.43	4.57	48.55	...
Benue, Plateau	1.86	17.73	18.14	...	...	...
Kwara	9.92	71.84	91.40	12.49	402.91	...
Oyo, Ogun, Ondo	11.45	35.53	19.71	1.61	32.17	...
Lagos	...	...	...	...	...	...
Bendel	20.24	271.96	640.98	53.09	283.36	...
Rivers	...	...	...	...	...	...
Cross River[a]	10.55	366.75	36.93	...	...	...
Anambra, Imo[b]	1.48	168.34	55.01	...	...	...
All Nigeria	0.004	44.77	0.02	0.14	45.80	...

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys*, 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

Civil War. The average annual distribution of seed by NIFOR was as follows: 1952-56—1.0 million; 1957-61—2.0 million; 1962-66—7.4 million; 1967-71—3.7 million; 1972-77—3.0 million. The 50 percent drop between 1967 and 1971 illustrates the impact of the Civil War.

Measures of the effect of cocoa research include seedling distribution, on-farm consumption of cocoa pesticides, trends in production, and cocoa quality. The distribution of F3 Amazon seedlings has increased sharply since the early 1950s, as shown below:

Table 12—Normalized coefficients of variation for production of cassava, yams, and cocoyams by state, 1968/69 to 1974/75

State	Cassava			Yams			Cocoyams		
	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output
					(percent)				
Kaduna	26.69	6.09	22.73	5.41	14.66	10.21	29.44	12.41	49.68
Borno, Bauchi, Gongola	5.29	6.21	15.93	4.46	17.08	18.89	6.45	26.47	1.80
Sokoto, Niger	26.81	9.20	46.65	1.13	26.95	6.15	...	...	...
Kano	2.87	9.00	10.06	n.a.	n.a.	...	...	...	...
Benue, Plateau	1.25	4.25	6.69	0.07	7.60	2.57	8.88	9.46	6.93
Kwara	4.26	1.67	12.58	0.14	5.65	3.08	50.33	17.99	32.02
Oyo, Ogun, Ondo	0.60	2.98	11.23	0.3'	4.34	6.86	3.65	10.15	27.65
Lagos	3.20	2.52	12.40	60.3	12.70	48.90	54.14	18.48	65.09
Bendel	0.45	2.58	8.18	0.12	8.78	3.66	4.70	16.39	8.18
Rivers[a]	15.00	0.92	8.69	2.16	15.75	7.82	4.77	2.52	11.43
Cross River[a]	0.79	2.70	21.52	0.29	7.68	11.89	1.11	1.88	14.53
Anambra, Imo[b]	0.43	5.97	4.17	0.14	21.32	2.94	0.84	5.67	16.84
All Nigeria	0.02	1.73	0.006	0.002	5.90	0.002	0.40	4.58	0.098

Source: Basic data from Nigeria, Federal Office of Statistics, Agricultural Statistics Unit, *Rural Economic Survey of Nigeria: Consolidated Results of Crop Estimation Surveys* 1965/66-1974/75 (Lagos: Federal Office of Statistics, 1972, 1976).

Note: "n.a." means not available.

Year	Seedlings Distributed (million)	Estimated Area Planted (hectares)
1954/55—1958/59	1.40	1,338.5
1959/60—1963/64	4.91	4,568.4
1964/65—1969/70	3.82	3,094.2

CRIN has developed new strains that mature in seven to eight years and are more tolerant of difficult environmental conditions. New techniques have helped to rehabilitate an estimated 50,000 hectares in western Nigeria and 1,000 hectares in Bendel.

The increase in the use of pesticides in the cocoa belt has been phenomenal (see Table 13). Earlier studies showed that input subsidies have helped greatly in boosting pesticide use.[16] The experience with cocoa pesticides is an excellent example of cooperation between policymakers in agriculture, the private sector, a commodity research institute, and farmers.

Table 13—Trends in pesticide use on cocoa farms in Oyo, Ogun, and Ondo states

Pesticide	Average Annual On-farm Demand	Estimated Annual Growth Rate
	(liters)	(percent)
	1957/58 to 1973/74	
Gamma 20	939,876	13.18
	1968/69 to 1972/73	
Kokotine	298,885	12.88
	1956/57 to 1973/74	
	(tons)	
Copper sulphate	2,694	19.45
	1961/62 to 1971/72	
Cuprocobre sandoz	551	12.71
Perenox	789	14.60

Source: Basic data from Francis Sulemanu Idachaba and Samson Olajuwon Olayide, *The Economics of Pesticide Use in Nigerian Agriculture* (Lagos: Federal Department of Agriculture, 1976).

Cocoa exports grew from 198,283 metric tons between 1948 and 1952 to 217,200 metric tons between 1970 and 1974. Research has also focused on improving cocoa quality to meet world market standards.

An examination of the research published shows that IAR had 150 articles cited in *Abstracts on Tropical Agriculture* between 1972 and 1977. This represented 51.2 percent of all articles by Nigerian research institutions cited. CRIN was second with 70 abstracted articles, whereas NCRI and its predecessors produced only 24 articles. The least productive were RRIN and FRIN.[17]

The impact of research on crop output depends heavily on the kind of research being conducted and the extent to which scientific man-years are allocated to areas with potential for major breakthroughs. Almost one third of the articles in *Abstracts on Tropical Agriculture* concerned biology, mainly developmental research, whereas about one fifth dealt with crop damage and crop protection, mainly maintenance research (see Appendix 2, Tables 31 and 32). Only 5 percent of the articles were on animal husbandry topics, despite the urgent need to increase the share of animal protein in the national diet.

Factors Limiting Effectiveness

A number of factors account for the limited effectiveness of agricultural research in Nigeria.

Level of Research Funding. Resources allocated to agricultural research during the current 1975-80 Plan are only about 0.3 percent of all federal government expenditures. In contrast, the average annual contribution of the agricultural sector to the GDP is projected at about 21 percent. Virtually all research institutes listed inadequate financing as their major obstacle in their reports to

[16] Francis Sulemanu Idachaba, "Econometric Estimation of Input Demand Functions in Developing Agriculture: The Case of Pesticides in Ondo, Oyo and Ogun States of Nigeria," *Indian Journal of Agricultural Economics* 21 (October-December 1976): pp. 22-33; and Francis Sulemanu Idachaba and Samson Olajuwon Olayide, *The Economics of Pesticide Use in Nigerian Agriculture* (Lagos: Federal Department of Agriculture, 1976).

[17] Though universities are not covered in this study because of their teaching obligations, it is useful to note their research output as cited in *Abstracts on Tropical Agriculture*. These were: University of Ibadan, 103; University of Ife, 67; University of Nigeria, Nsukka, 19; and Ahmadu Bello University (excluding IAR), 23. This gives a total of 212 for the four universities that combine teaching and research.

the research institutes review panel.

Stability in Research Funding. Research is rendered ineffective by erratic and unpredictable fluctuations in funding. The uncertainty resulting from such fluctuations is compounded by the fact that research results cannot be predicted in advance. All research institutes in Nigeria have had unexpected instability in funding, especially in the last few years. Many projects [illegible] completed because of cuts in support. Related to this problem is the arbitrary manner in which funds are allocated among various kinds of agricultural research.

Inadequate Staff. Virtually all research institutes are inadequately staffed. This has partly resulted from the loss of expatriate researchers when the country attained independence, losses following the outbreak of civil war in 1967, and transfers to the universities. Other reasons for this cumulative loss include unsatisfactory working conditions and the application of civil service rules and criteria to research institutes. Some indication of the workload for IAR and NCRI is given in Appendix 2, Tables 33 and 34.[18]

Research Staff Instability. For most research institutes, the problem of not enough research staff is compounded by high turnover. According to an index of research staff instability calculated for this study, the most stable section at IAR from 1962/63 to 1967/68 was cotton breeding and the most unstable were crop physiology, animal husbandry and grassland, and agricultural engineering (see Appendix 2, Table 35). Patterns of research staff stability fluctuated over the years at IAR. In comparison the instability indexes for FDAR/NCRI were relatively low. Staff instability may be a more serious problem for many institutes than staff inadequacy. Staff instability hampers sustained effort and results in incomplete projects or badly conducted research. Organizations with a long history of staff instability are unlikely to make the desired research breakthroughs.

Research Materials and Equipment. Most research institutes lack the materials and equipment they need. This is related to the problem of inadequate funding. Another perennial problem is inadequate maintenance and servicing of equipment and machines. Institutes usually do not have engineers and technologists to handle breakdowns. After-sale service of most firms is reputed to be very poor. In addition, shipments of equipment and raw materials often arrive late.

Factors in the Sociopolitical Environment. Agricultural research has been conducted within the institutional framework defined by the political leadership. From 1899 to 1954 almost all agricultural research was conducted by federal agencies and institutions. The 1954-73 period witnessed the parallel development of both federal and regional institutes. This development was due to two factors: first, as noted earlier, scientific and industrial research was on the concurrent legislative list in the 1954 Constitution; second, agriculture was a residual item for which the regions were responsible. The development of regional institutes was facilitated by large grants from the regional marketing boards, especially for export crops. Thus IAR was liberally funded by the then regional government, whereas CRIN received liberal grants from the Marketing Board. With the Research Institutes Decree of 1973, and the provisions for agricultural research in the Constitution, it remains to be seen how federal/state responsibilities for agricultural research will work out.

The research community is greatly handicapped by the failure of the political leadership to provide sufficient support. On the other hand, the political leadership, faced with falling petroleum revenues, has had to cut funding for virtually all projects. The cuts have been on a flat percentage basis, not related to agricultural policy objectives and research priorities. No account has been taken of the fact that, as officials of IAR put it, "Some programs are more sensitive to cuts than others." The research leadership has been given no guidelines for absorbing the cuts, except rule-of-thumb criteria in some cases. Because the Federal Ministry of Finance is unwilling or unable to determine agricultural research priorities in the face of severe budget cuts, the research leadership is left to decide on its own how to allocate reduced resources. This procedure favors programs that are already started and those that already have substantial sums committed to them. One result is that the research

[18] The data in these tables should be treated with caution: tasks in agronomy are usually short term, whereas those in botany often involve long-term breeding.

leadership may continue projects that are inconsistent with new national economic and social goals.

Research Management Related to the preceding point is the problem of management. A major part of the agricultural research problem stems from the failure of political and research leaders to provide proper management. At the political level this has been manifested by appointments of unqualified research leaders and failure to promptly dismiss those known to be professionally or administratively incompetent. The research leaders, in some instances, have become so engrossed in administrative details that they have failed to provide direction in undertaking new approaches or in monitoring ongoing projects. Many institute directors have not provided the environment to ensure stability of staff, nor have they been innovative in devising measures of staff performance. Consequently promotions at some institutes have been based on longevity rather than merit, thus encouraging mediocrity.

Lack of Effective Delivery of Research Results Many researchers claim that the apparent ineffectiveness of agricultural research is really due to the lack of an effective system for delivering results to farmers. There is some truth in this position. Agricultural extension has always been a "residual item" claimed by the regional governments. The policy duality in this area needs urgent reexamination. The federal government has had responsibility for agricultural research for decades, but agricultural extension has remained a regional/state responsibility.[19] The lack of a formal link between research and extension has often resulted in ignorance on both sides. Researchers are not aware of field problems developing from the applications of research findings, whereas extension officials are not fully aware of research results.

The lack of qualified personnel in research reflects the general scarcity of skilled manpower in the agricultural sector. The following shows estimated agricultural personnel in the public sector in 1975:[20]

Professionals	2,369
Senior technical	3,105
Junior technical	7,521
Vocational	10,005
Estimated Nigerian population, 1975	77 million
Estimated rural population, 1975	57 million

There are only 41 professionals and 404 public employees per 1 million of the farming population.

Researchers as a percentage of all staff in the agricultural research institutes range from nearly 17 percent for NAPRI to 1.7 percent for NIFOR (see Table 14). The data below present the number of researchers and senior technical staff as a percent of staff in all institutes, by commodity groups, 1977/78:[21]

	Number	Percent
Cereals and grain (IAR, NCRI, IAR&T)	498	35.24
Roots and tubers (NRCRI)	130	9.20
Tree crops (CRIN, RRIN, FRIN, NIFOR)	378	26.75
Livestock (NAPRI, NITR, NVRI, LRIN)	238	16.84
Fishery (KLRI, LCRI)	69	4.88

The greatest concentration of research manpower is in cereals and grain legumes, the smallest in roots and tubers. A breakdown by discipline shows that the plant sciences have almost two thirds of all research staff with Bachelor of Science degrees and above and nearly half of all staff with Masters degrees and above (see Table 15). The staffing situation in animal science is grossly inadequate for a country with severe shortages in livestock products. There are few re-

[19] Two new approaches allowing the federal government to take on responsibility for agricultural extension—through the back door as it were—are the National Accelerated Food Production Program (NAFPP) and the World Bank Rural Development Projects.

[20] The data on staffing are from NSTDA; the population data are from Samson Olajuwon Olayide, ed., *Economic Survey of Nigeria 1960-75* (Ibadan: Caxton Press, 1976).

[21] These figures were derived from data of the NSTDA.

Table 14—Manpower resources of agricultural research institutes, 1977/78

Institute	Researchers[a]		Technical Staff[b]		Others[c]	Total
			Senior	Junior		
		(percent)				
NIFOR	48	1.72[a]	79	1,161	1,502	2,790
NAPRI	30	16.95	6	40	101	177
RRIN	24	7.02	5	16	298	343
FRIN	85	10.08	47	183	528	843
CRIN	43	2.66	47	1,094	432	1,616
NRCRI	30	2.47	100	233	851	1,214
IAR&T	37	5.18	89	221	367	714
LCRI	20	10.15	2	68	107	197
NIOMR	33	8.73	14	166	165	378
NVRI	57	10.00	39	80	394	570
NSPRI	11	5.56	7	41	139	198
LRIN	7	3.32	23	77	104	211
NITR	23	3.15	53	n.a.	654	730
IAR	104	6.55	53	n.a.	1,378	1,535
NCRI	159	8.13	56	n.a.	1,731	1,946

Source: Figures provided by the National Science and Technology Development Agency.

Note: The full names of the institutes listed in the table are the following: Nigerian Institute for Oil Palm Research (NIFOR), National Animal Production Research Institute (NAPRI), Rubber Research Institute of Nigeria (RRIN), Forestry Research Institute of Nigeria (FRIN), Cocoa Research Institute of Nigeria (CRIN), National Root Crops Research Institute (NRCRI), Institute of Agricultural Research and Training (IAR&T), Lake Chad Research Institute (LCRI), Nigerian Institute for Oceanography and Marine Research (NIOMR), National Veterinary Research Institute (NVRI), Nigerian Stored Products Research Institute (NSPRI), Leather Research Institute of Nigeria (LRIN), Nigerian Institute for Trypanosomiasis Research (NITR), Institute for Agricultural Research (IAR), and National Cereals Research Institute (NCRI).

[a] These are researchers on or above Grade Level 7. The percentages are the proportion they make up of staff of the research institutes.

[b] "Senior" means on or above Grade Level 7. "Junior" means on or below Grade Level 6.

[c] This includes the senior administrative staff, the clerical staff, and other supporting personnel.

searchers in agricultural engineering sciences despite a policy of substituting machines for human labor. Very few economists, statisticians, and social scientists work in the agricultural research institutes.

In addition to poor distribution of research personnel by discipline, many established posts are not filled (Table 16), and large numbers of researchers have no research training. There is a need to train personnel, build up research capability, utilize equipment, and manage research resources. Foreign exchange costs could be reduced considerably by doing most of the training in Nigerian universities. However, this would require an improved relationship between the institutes and the universities. Researchers-in-training should be able to work on topics that university staff find professionally interesting and that also help to further policy objectives.

Table 15—Distribution and highest degree of agricultural research personnel by discipline, 1977/78

Discipline	Number of Researchers with Degrees at Highest Level		
	B.Sc.	M.Sc.	Ph.D.
Plant Sciences			
Agronomy	68	35	31
Plant pathology	24	9	25
Plant physiology	1	3	4
Soil science	25	23	22
Entomology	22	15	14
Forest products research	7	1	1
Subtotal	147	86	97
Animal Sciences			
Livestock and veterinary	...	4	31
Others	2	5	4
Subtotal	2	9	35
Engineering			
Food technology	16	...	4
Others	7	6	...
Subtotal	23	6	4
Economics/Sociology			
Economics and statistics	22	14	3
Rural sociology	2	3	3
Subtotal	24	17	6
Other Sciences			
Chemistry, including biochemistry	11	3	4
Others	8	4	5
Subtotal	19	7	9
Total	215	125	151

Source: Figures supplied by the National Science and Technology Development Agency.

Table 16—Vacancy rates in selected agricultural research institutes, 1977/78

Institute	Researchers	Technical Staff		Others
		Senior	Junior	
		(percent)		
NRCRI	19.11	7.02	n.a.	n.a.
IAR	55.55	33.77	26.03	7.20
CRIN	20.37	47.78	10.03	13.43
IAR&T	36.21	33.08	10.16	10.92
LCRI	23.08	33.33	10.53	12.30
NIOMR	47.62	39.13	35.41	15.82
NVRI	56.82	62.50	41.18	38.91
NSPRI	57.69	46.15	51.19	19.19

Source: The calculations are based on data from the National Science and Technology Development Agency.

Note: The full names of the institutes listed in the table are the following: National Root Crops Research Institute (NRCRI), Institute for Agricultural Research (IAR), Cocoa Research Institute of Nigeria (CRIN), Institute of Agricultural Research and Training (IAR&T), Lake Chad Research Institute (LCRI), Nigerian Institute for Oceanography and Marine Research (NIOMR), National Veterinary Research Institute (NVRI), and Nigerian Stored Products Research Institute (NSPRI).

5

RESOURCE ALLOCATIONS TO AGRICULTURAL RESEARCH

Allocations of research resources to crops, livestock, fisheries, and forestry should reflect national economic objectives. For most of the first half of this century, however, there was no formal articulation of such objectives. The lack of clear guidelines is reflected in the budget allocations by the federal government to research in the three national development plans (see Table 17).

Allocations to crop, livestock, fishery, and forestry research rose sharply between 1953/54 and the 1975-80 Plan. But the adequacy of these allocations must be evaluated in terms of future farm production needs as well as the importance of each sector in the national economy.

The 1950s and 1960s were largely characterized by extensive agriculture. The soil-plant-water balance was such that rotational bush fallowing provided much of the incremental production needed at reasonable prices. However, continuous cultivation has seriously, in some places irreversibly, depleted soil nutrients so that incremental farm pro-

Table 17—Federal allocations to agricultural research and to total agriculture, by subsector, various years

Year	Crop		Veterinary and Livestock		Fishery		Forestry		Total		
	Research	Total[a]	Research	Total[a]	Research	Total	Research	Total	Research	Agriculture	Public Sector
					(₦ million)						
1953/54[b]	0.2	0.8	0.2	0.9	0.1	0.1	0.1	1.1	0.6	2.9	
1954/55[b]	0.3	1.0	0.2	1.1	0.1	0.1	0.1	1.1	0.7	3.4	
1955/56–1959/60[c]	3.2	4.2	1.1	6.4	0.3	1.1	0.6	8.6	5.1	20.3	
1962/68 Plan[c]	2.9	22.9	0.6	0.6	1.4	1.8	1.0	1.0	6.0	26.3	180.6
1970/74 Plan	6.9	61.7	1.8	2.4	1.4	1.6	0.8	2.3	11.0	68.1	1,110.2
1975/80 Plan	49.1	750.8	20.7	173.2	7.8	58.6	3.1	30.1	80.6	1,012.6	26,165.1
1975/80 Revised Plan	55.1	1,300.1[d]	26.1	284.0	10.3	54.6	4.5	36.1	96.1	1,674.8[d]	33,921.1

Sources: The data for 1953/54-1959/60 are from the International Bank for Reconstruction and Development, *Economic Development of Nigeria* (Baltimore, Md.: Johns Hopkins University Press, 1955). The data for 1962-68 are from Nigeria, Federal Ministry of Economic Development, *National Development Plan 1962-68* (Lagos: Federal Government Printer, 1963); for 1970-74 from Nigeria, Federal Ministry of Information, *Second National Development Plan 1970-74* (Lagos: Federal Government Printer, 1970); for 1975-80 from Nigeria, Federal Ministry of Economic Development and Reconstruction, Central Planning Office, *Third National Development Plan 1975-80*, vol. 1 and revised vol. 2 (Lagos: Federal Government Printer, 1975).

[a] Research is included in these totals.

[b] The figures for 1953/54 and 1954/55 are approved estimates for crop research. They cover both recurrent and capital expenditures for research and administration. The figures for the years between 1955/56 and 1959/60 are projections by the International Bank for Reconstruction and Development. The veterinary research and fishery research figures for 1953/54 are approved estimates, but for 1954/55 are preliminary estimates. The 1953/54 and 1954/55 figures for forestry research are approved estimates.

[c] The figures for 1962-68, 1970-74, and 1975-80 cover total capital costs for the entire plan as given in the plan document for that period (see the list of sources).

[d] This includes ₦535.1 million for irrigation.

duction in the 1970s and 1980s must come from reduced rotational fallow periods and intensive continuous agriculture. In addition, various policies over the years have reduced the availability of farm labor. These include an urban bias in the provision of infrastructural facilities, the effects of universal free primary education, urban minimum wages, and so forth, which have drawn workers to the cities, leaving an aging farm labor force that cannot meet the challenges of extensive agriculture. The need to obtain most of the increase in crop production from higher yields implies that the share of crop research in total federal government expenditures in the crops subsector should have risen. However, it actually dropped sharply (see Table 18).

Because there was no institutional federal responsibility for agriculture before 1965, there were no agricultural sector objectives. Agricultural research policy could not be derived from a national agricultural policy. In the 1962-68 National Development Plan, the traditional federal presence in agricultural research was simply reaffirmed with minor modifications. Areas of emphasis were food crops, tree crops, and research on fertilizers, pesticides, improved seeds, improved farm practices, and soil fertility. Areas of emphasis were chosen according to the needs of the moment.

The 1970-74 Plan included a comprehensive set of national economic objectives that provided a basis for agricultural sector objectives. But the share of research allocation for crops in total federal government expenditures on crops still fell slightly. It appears that planners are not using shares of subsectors and sectors in the national economy as criteria for allocating research resources. Crop production averaged nearly 50 percent of the GDP in the four years preceding the 1962-68 Plan, but the crop research allocation during the Plan was only 1.6 percent of the total federal public sector budget. Thus in terms of the importance of crops in the national economy, federal allocations for crop research in the 1962-68 Plan were grossly inadequate. Allocation to crop research in the 1970-74 Plan was also inconsistent with the relative importance of the crops subsector.

Allocations for research on crops, livestock, fishery, and forestry fell from almost 21 percent of all federal expenditure on these subsectors in 1953/54 to only 5.7 percent in the 1975-80 Plan. The relative decline in support for research also is revealed by the decline in value of research allocation per naira generated in the agricultural sector from 1962 to 1980 (₦0.0006 in the 1962-68 Plan, ₦0.0015 in the 1970-74 Plan, and ₦0.0042 in the 1975-80 Plan).[22] These allocations are clearly inconsistent with the contributions of agriculture, livestock, fishery, and forestry to the economy and with a developmental strategy that emphasizes small-scale farming.

Agriculture averaged nearly 40 percent of GDP at current factor costs between 1968/69 and 1969/70 and 34.7 percent between 1970/71 and 1972/73. Therefore, at a time when increased allocations were needed, the nation experienced instead a drastic reduction in the relative allocations to crop research to counter the declining growth rate of the agricultural sector.

The situation in livestock and fishery research is similar. Increasing income and population have boosted demand for livestock products. But livestock research fell from 26.1 percent in 1953/54 to 9.2 percent in the 1975-80 Plan period. The share of fishery research in federal expenditures on fishery fell from 59.3 percent in 1953/54 to 18.8 percent in the 1975-80 Plan. On the other hand, the share for forestry research rose from 7.2 to 12.5 percent.

Recurrent expenditures on crop, livestock, forestry, and fishery research have shown relative declines in recent budgets. Allocations for all institutes were 1.5 percent of total federal government recurrent expenditures in 1976/77 and only 0.4 percent in 1977/78.

Judged on the basis of its past and prospective role in the national economy and in nutrition and food policy, crop research should receive top priority among

[22] The figure for the 1962-68 Plan was obtained by dividing the average annual planned expenditure on all agricultural research during the Plan period by the average annual value added in the agricultural sector. The figures for the 1970-74 and 1975-80 Plans were obtained by dividing the planned average annual total research by each Plan's projected value added in the agricultural sector during the Plan period.

Table 18—Subsector shares of federal allocations to agricultural research and to total agriculture, various years

Year	Crop		Veterinary and Livestock		Forestry		Fishery		Research as Percent of Total Allocation to Agriculture	Research as percent of Total Public Sector Expenditure
	Percent of Total Research Allocation	Research as Percent of Total Allocation	Percent of Total Research Allocation	Research as Percent of Total Allocation	Percent of Total Research Allocation	Research as Percent of Total Allocation	Percent of Total Research Allocation	Research as Percent of Total Allocation		
1953/54	37.42	28.18	39.40	26.10	12.58	7.18	10.60	59.26	20.97	n.a.
1954/55	39.02	24.85	37.80	22.75	11.59	6.85	11.59	61.29	19.56	n.a.
1955/56–1959/60	63.08	77.14	20.36	16.28	11.68	6.99	4.87	23.36	25.33	n.a.
1962/68 Plan	49.04	12.76	10.79	0.00	16.69	n.a.	23.47	56.27	22.66	3.30
1970/74 Plan	63.07	11.23	16.71	75.66	12.61	36.07	7.62	84.70	16.13	0.99
1975/80 Plan	60.89	6.54	25.70	11.96	3.79	10.18	9.61	13.23	7.96	0.31
1975/80 Revised Plan	57.34	4.24	27.29	9.23	5.02	12.51	11.38	18.79	5.74	0.28

Sources: The data for 1953/54-1959/60 are from International Bank for Reconstruction and Development, *Economic Development of Nigeria* (Baltimore, Md.: Johns Hopkins University Press, 1955). The data for 1962-68 are from Nigeria, Federal Ministry of Economic Development, *National Development Plan 1962-68* (Lagos: Federal Government Printer, 1963); for 1970-74 from Nigeria, Federal Ministry of Information, *Second National Development Plan 1970-74* (Lagos: Federal Government Printer, 1970); for 1975-80 from Nigeria, Federal Ministry of Economic Development and Reconstruction, Central Planning Office, *Third National Development Plan 1975-80*, vol. 1 and revised vol. 2 (Lagos: Federal Government Printer, 1975).

Table 19—Subsector shares of GDP and shares of federal allocations to agricultural research, various years

Year	Crop		Veterinary and Livestock		Forestry		Fishery	
	Percent of GDP	Research Allocation as Percent of Total Research	Percent of GDP	Research Allocation as Percent of Total Research	Percent of GDP	Research Allocation as Percent of Total Research	Percent of GDP	Research Allocation as Percent of Total Research
1953/54[a]	54.85	37.42	6.44	39.40	1.55	12.58	0.95	10.60
1954/55[a]	55.21	39.02	6.29	37.80	1.47	11.59	0.81	11.59
1962/68[a]	45.58	49.04	4.99	10.79	4.44	16.69	2.59	23.47
1970/74[a,b]	33.60	63.07	n.a.	16.71	2.52	12.61	5.11	7.62
1975/80	20.78[c]	57.34	n.a.	27.29	n.a.	5.02	n.a.	11.38

Sources: The data for 1953/54 and 1954/55 are from International Bank for Reconstruction and Development, *Economic Development of Nigeria* (Baltimore, Md.: Johns Hopkins University Press, 1955). The data for 1962-68 are from Nigeria, Federal Ministry of Economic Development, *National Development Plan 1962-68* (Lagos: Federal Government Printer, 1963); for 1970-74 from Nigeria, Federal Ministry of Information, *Second National Development Plan 1970-74* (Lagos: Federal Government Printer, 1970); for 1975-80 from Nigeria, Federal Ministry of Economic Development and Reconstruction, Central Planning Office, *Third National Development Plan 1975-80*, vol. 1 and revised vol. 2 (Lagos: Federal Government Printer, 1975).

Notes: The gross domestic product (GDP) is in current factor prices. "n.a." stands for not available.

[a] The GDP figures in this column are from Nigeria, Federal Office of Statistics, *Annual Abstract of Statistics* (Lagos: Federal Government Printer, 1960-73).

[b] In this column, the GDP figures for crops and livestock are combined.

[c] This figure combines the GDPs of agriculture, livestock, fishery, and forestry.

the subsectors (see Table 19). In the years before comprehensive development planning, livestock, fishery, and forestry research were emphasized more than was warranted by their contributions to GDP. With the 1962-68 Plan, crop research was accorded relative priority, rising to 63.1 percent of total research during the 1970-74 Plan.

The emphasis on livestock and fishery research in the early 1950s reflects the attention given to solving the protein deficiency problem. The earliest available estimate of per capita calorie intake of the Nigerian population was 2,250 calories per day in 1952/53. Protein availability per capita in that year was estimated at 50 grams per day, made up of 45 grams of vegetable protein and 5 of animal protein. These estimates led to special stress on veterinary research (animal disease control), expanded fisheries production, and the gradual substitution of cereal crops for roots and tubers in the South. Even though fishery and livestock are not sectorally as important as crops, relatively high research allocations are justified by the need to correct nutritional deficiencies.

The lack of a national food or nutrition policy for much of Nigeria's history largely accounts for the lack of a national policy on food crop research.[23] The greater the awareness of the political leadership of the nutrition problem, the greater the proportion of revenues devoted to food crop research. The 1962-68 Plan made no distinction between food crops and export crops in providing for research. But the 1970-74 Plan, which contained an eloquent statement on both the food problem and agricultural sector objectives, specifically provided for food crop

[23] A framework for food policy analysis, especially within a developmental context, can be found in Idachaba, *Food Policy for Nigeria*.

Table 20—Federal allocations to agricultural research institutes, 1976/77 and 1977/78

Research Institute	Commodity	1976/77 Allocation	Percent of Allocation to all Research Institutes	1977/78	Percent of Allocation to all Research Institutes
		(₦)		(₦)	
Food Crops					
NCRI	maize, rice, grain, legumes, sugar cane	6,635,500	12.50	10,789,000	13.02
NIHORT	citrus, fruit, vegetables	1,581,600	2.98	2,544,000	3.07
NRCRI	yams, cassava, cocoyams, sweet potatoes, Irish potatoes	3,205,000	6.04	6,280,800	7.70
IAR	sorghum, millet, wheat, barley	6,500,000	12.24	8,528,000	10.29
IAR&T	cereals, grain, legumes	3,000,000	5.65	5,600,000	6.76
Subtotal		20,922,100	39.40	33,841,800	40.84
Livestock					
NITR	cattle	2,500,000	4.71	4,560,000	5.50
NAPRI	cattle, sheep, goats, pigs, poultry	1,300,020	2.45	2,640,000	3.19
NVRI	cattle	5,090,450	9.59	7,472,360	9.02
LRIN	leather, hides	1,557,970	2.93	3,477,576	4.20
Subtotal		10,448,440	19.68	18,149,936	21.90
Fishery					
LCRI	fish, irrigated crops	450,400	0.85	2,520,320	3.04
KLRI	fish, irrigated crops	1,553,350	2.93	3,692,000	4.45
NIOMR	fish	1,510,210	2.84	4,629,768	5.59
Subtotal		3,513,960	6.95	10,842,088	13.08
Tree Crops					
CRIN	cocoa, coffee, kola, cashews	4,001,000	7.53	5,133,200	6.19
RRIN	rubber	3,046,000	5.74	1,755,680	2.12
NIFOR	oil palms, coconuts, raphia, dates	5,300,000	9.98	5,146,432	6.21
FRIN	forests	4,611,220	8.68	7,480,976	9.03
Subtotal		16,958,220	31.93	19,516,288	23.55
Total		53,103,320	100.00	82,878,592	100.00

Source: Nigeria, Federal Ministry of Information, *Recurrent and Capital Estimates of the Government of the Federal Republic of Nigeria*, 1976/77 and 1977/78 (Lagos: Federal Government Printer, 1976-78).

Notes: The full names of the institutes listed in the table are the following: National Cereals Research Institute (NCRI), National Institute for Horticultural Research (NIHORT), National Root Crops Research Institute (NRCRI), Institute for Agricultural Research (IAR), Institute of Agricultural Research and Training (IAR&T), Nigerian Institute for Trypanosomiasis Research (NITR), National Animal Production Research Institute (NAPRI), National Veterinary Research Institute (NVRI), Leather Research Institute of Nigeria (LRIN), Lake Chad Research Institute (LCRI), Kainji Lake Research Institute (KLRI), Nigerian Institute for Oceanography and Marine Research (NIOMR), Cocoa Research Institute of Nigeria (CRIN), Rubber Research Institute of Nigeria (RRIN), Nigerian Institute for Oil Palm Research (NIFOR), and Forestry Research Institute of Nigeria (FRIN).

research. Food crop research was emphasized further in the 1975-80 Plan.

Federal government agricultural research allocations are not made on a commodity basis. The relative emphasis on crops, livestock, forestry, and fishery has been inferred from the statutory responsibilities assigned to each institute (see Tables 20 and 21). Federal government annual allocations to food crop research averaged ₦27.4 million between 1976/77 and 1977/78, or 41.1 percent of total annual allocations to agricultural research.[24]

Federal government allocations to livestock research from 1976/77 to 1977/78 averaged ₦14.3 million annually. This was an average of 20.8 percent of annual federal allocations to all agricultural research. Allocations to fishery research averaged ₦7.2 million between 1976/77 and 1977/78, an

[24] Note that allocations to NIFOR have been grouped with foods since all the palm oil produced is now domestically consumed.

Table 21—Federal agricultural research allocations by commodity group relative to availability, 1976/77 and 1977/78

Commodity	Percentage of Allocations to All Research Institutes		Average Contribution to Total Calorie Availability	Average Contribution to Total Protein Availability
	1976/77	1977/78	(1972 to 1974)[a]	(1972 to 1974)[a]
			(percent)	
Cereals	n.a.	n.a.	49.83	42.59
Seeds and nuts	n.a.	n.a.	14.82	23.75
Pulses (cowpeas)	n.a.	n.a.	4.03	9.78
Sugar	n.a.	n.a.	4.10	0.00
Total	30.39	30.06	72.78	76.12
Fruits	n.a.	n.a.	1.65	0.79
Vegetables	n.a.	n.a.	0.81	3.18
Total	2.98	3.07	2.46	3.97
Roots and tubers	6.04	7.70	18.61	11.90
Palm kernel oil	9.98	6.21	2.08	...
Livestock	19.68	21.90	2.39	5.30
Fish	6.95	13.08	0.38	1.94

Sources: Nigeria, Federal Ministry of Information, *Recurrent and Capital Estimates of the Government of the Federal Republic of Nigeria*, 1976/77 and 1977/78 (Lagos: Federal Government Printer, 1976-78); Food and Agriculture Organization of the United Nations, *Provisional Food Balance Sheets: 1972-74 Average* (Rome: FAO, 1977).

Notes: Where the breakdown by commodity is not available, "n.a." has been inserted. The conversion factors are mainly from Samson Olajuwon Olayide, comp., *A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria 1968-85* (Lagos: Federal Department of Agriculture, 1972). The livestock conversion factors are from Food and Agriculture Organization of the United Nations, *Agricultural Development in Nigeria 1965-1980* (Rome: FAO, 1966).

[a] The total availability of calories or protein is the total supply of calories or protein from domestic production or output.

average of 10.0 percent of the total. Those to tree crop research averaged ₦17,937,824 per year during the period, an average of 27.7 percent.

Together, cereals, seeds and nuts, cowpeas, and sugar contributed an average of 72.8 percent of the country's domestic supply of calories from 1972 to 1974 (see Table 21). They also supplied 76.1 percent of the domestic protein available during the same period. The dominance of these crops as sources of calories and protein justified their share of government budget allocations.

Although seeds and nuts contributed more than 23 percent of total (domestic) protein available from 1972 to 1974, they were not covered in the Research Institute (Establishment) Order of 1975. It was only later, when NSTDA exercised funding control over IAR, that the federal government financed research on these crops. The research emphasis on oilseeds and nuts as well as grain legumes should be increased.

Though roots and tubers do not provide as many calories and as much protein per unit of labor as cereals and grain legumes, they are consumed by large segments of the population, especially the low-income group. For this reason a relatively high priority should be accorded roots and tubers research.

IAR is the only research institute with disaggregated research resource allocation data. Among the regular commodity programs, allocations of scientific man-years range from an annual average of 42 percent of total scientific man-years for grain legumes to 9.6 percent for groundnuts and oilseeds.[25] Among the general research programs, the largest share of all scientific man-years goes to socioeconomic research (see Appendix 2, Table 36).

The allocations of scientific man-years among commodities do not accord with the relative national importance of the various commodities as sources of calories and protein. These allocations are roughly the

[25] This includes the figure for Kano Station, where research is mostly on groundnuts.

same as for financial resources, though slightly higher for cereals.

Input Research

The federal allocations to institutes do not indicate relative emphasis on input research. Most input research in Nigeria—and the amount is small—has been done as part of commodity-oriented projects. Thus soil fertility studies have been carried out on a case-by-case basis, largely in response to the needs of crop agronomists working on specific crops. There is no coordinated national program to develop comprehensive basic knowledge as a basis for national land use and management. None of the existing agricultural research institutes has a mandate to study soils from a national perspective.

This omission is all the more glaring considering that the poverty of soils is a major obstacle to increased food production. Heavy leaching and rapid loss of nitrate from tropical downpours are serious problems that require applied research.

The need for a national soil management research policy arises also from the difference between private and social costs of rotational bush fallowing. The costs to private farmers of rotational bush fallowing are consistently lower than those to society, which include losses from soil exploitation. Therefore, private farmers have a tendency to overuse the land and deplete soil nutrients faster than they would if they shared the costs of soil exploitation. This lack of major institutional responsibility for soil research leaves gaps in research knowledge, especially concerning optimal agricultural production patterns.

Labor is the most important input in Nigerian agriculture, yet little research has been done on labor utilization and profiles in different crops and ecological zones, the structure of farm labor markets, the linkages between rural farm labor and nonfarm labor markets, and supply and demand patterns for farm labor. The few farm management studies that have been carried out have provided only limited insights into farm labor utilization.[26] No national study has ever been commissioned to examine this problem. Yet various projects are being undertaken with serious implications for farm labor utilization. And most ongoing programs and projects run into farm labor shortages, especially during the peak season of farming operations. No institute has responsibility for research into the nation's major resource—its people. From the viewpoint of farm employment, alleviation of poverty, and rural-urban social balance, a major research effort on the economics of farm labor utilization and the structure of national farm labor markets is needed.

Until recently there has been no delineated national program on water research and no planned utilization of water resources for agriculture. However, the 1975-80 Plan provides the following funding: National Soil Survey Services, ₦4 million; Soil and Water Conservation Training Center, ₦1 million; Soil Conservation Schemes, ₦5 million; National Institute for Water Resources, ₦0.5 million.

IAR's allocation of an annual average of 21.5 percent of total scientific man-years to socioeconomic research was much larger than that of any other institute. The virtual absence of socioeconomic research, aside from that at IAR, has been a serious deficiency. Socioeconomic research should receive high priority because adoption of agricultural research results by private farmers depends on their profitability.

Because of the perennial labor shortage, there is urgent need for research on mechanization. Between 1975/76 and 1977/78, IAR allocated an annual average of 8.9 percent of senior scientific man-years to farm mechanization, but the allocation for 1978/79 dropped to 4.34 percent.

IAR's allocation of research resources to soil fertility and nutrition research also has been impressive, averaging 13.3 percent of scientific man-years from 1975/76 to 1977/78, and continuing at that level in 1978/79. The importance of this program cannot be overemphasized.

Most agricultural research in Nigeria has concentrated on rainfed agriculture,

[26] David W. Norman, *Economic Analysis of Agricultural Production and Labor Utilization Among the Hausa in the North of Nigeria*, African Employment Paper No. 4 (East Lansing: Michigan State University, 1973); and David W. Norman, "Labor Inputs of Farmers: A Case Study of the Zaria Province of North Central State of Nigeria," *Nigerian Journal of Economic and Social Studies*, 1967.

neglecting irrigation. However, changes in national economic objectives in the 1970-74 and 1975-80 Plans have resulted in increased emphasis on irrigation. These objectives include a stable national economy, minimum nutritional standards for all citizens, and self-sufficiency in food. Irrigation would help ensure the economy against discontinuity resulting from droughts and severe environmental stress as in 1973/74. Irrigated production of cereals, dry season vegetables, and other foodstuffs would minimize nutritional deficiencies during the lean season. Irrigation of wheat, vegetables, and other crops would reduce dependence on imports. The new emphasis on irrigated agriculture is reflected in the creation of 11 river basin development authorities. The following tabulation shows the allocation for irrigation in the 1975-80 Plan. (Figures in parentheses are percentages of the total.)

	(₦ million)
Agriculture	765.0 (45.7)
Irrigation	535.1 (32.0)
Livestock	284.0 (17.0)
Fishery	54.6 (3.3)
Forestry	36.1 (2.2)
Total	1,674.8

The irrigation figure does not include several projects listed under agriculture. Irrigation research at IAR received an annual average of 11.3 percent of scientific man-years between 1975/76 and 1977/78, and 15.5 percent was proposed for 1978/79. Given the importance of irrigation in regional development and for stabilizing agricultural production, the amount allocated to irrigation should be raised substantially. For the 11 river basin development authorities to achieve maximum impact, irrigation research must be accorded high priority. Otherwise the enormous resources employed could go to waste.

Export Crop Bias

Prior to the launching of the First National Development Plan in 1962, there was a heavy bias toward export crop research. Table 22 shows the major export crops from 1900 to 1940. Of the eight crop and tree research institutes formally functioning before independence, five were working mainly on export crops.[27] Location of the institutes was largely dictated by their suitability for these commodities. In the case of the first agricultural research station (Moor Plantation), however, location was determined on the basis of a mistaken belief that the Ibadan area would be suitable for rubber and cotton production. Although Moor Plantation was later designated as mainly a food crops institute, most of its resources were

Table 22—Average annual exports, 1900 to 1940

Commodity	1900 to 1910 Quantity	1900 to 1910 Value	Percentage of all Exports	1915 to 1925 Quantity	1915 to 1925 Value	Percentage of all Exports	1930 to 1940 Quantity	1930 to 1940 Value	Percentage of all Exports
	(1,000 tons)	(₦1,000)		(1,000 tons)	(₦1,000)		(1,000 tons)	(₦1,000)	
Cocoa	1,021	62.9	1.14	25,099	1,534.7	7.26	88,899	3,439.3	17.96
Palm kernels	116,593	2,738.5	49.49	221,489	7,034.2	33.28	326,300	4,922.2	25.70
Palm oil	68,262	2,135.8	38.60	98,365	5,781.6	27.35	142,923	3,215.8	16.79
Groundnuts	1,076	16.7	0.30	55,516	1,790.2	8.47	195,206	4,060.5	21.20
Benniseed	303	3.6	0.07	1,835	49.6	0.23	12,559	223.5	1.17
Cotton	870	74.9	1.35	3,696	805.3	3.81	7,408	558.3	2.92
Rubber	864	353.3	6.38	399	78.2	0.37	2,312	206.9	1.08
All agricultural exports		5,490.6	99.22		18,542.3	87.73		16,008.3	83.60
All exports		5,533.5	100.00		21,135.6	100.00		19,148.9	100.00

Source: Gerald K. Helleiner, *Peasant Agriculture, Government and Economic Growth in Nigeria* (Homewood, Ill.: Richard Irwin, 1966).

[27] These were WACRI (now CRIN), WAIFOR (now NIFOR), RRIN, FRIN, the IAR Agricultural Research Station, Umudike, FDAR (now NCRI), and IAR&T. The last three were working mainly on food research.

devoted to tree crop research for WACRI as late as the early 1960s.

The search for a suitable site for cotton research ended with the establishment of a station at Samaru in Kaduna State in 1922. The choice was dictated primarily by its location in the cotton zone, though the community of Europeans and the strategic location of Zaria-Samaru for the assembly and shipment of agricultural produce were also considered. The Samaru station established a groundnut research substation at Kano early in its history to serve the main producing area (see Appendix 2, Tables 37 and 38 for the principal states' production percentages for cotton and groundnuts, respectively).

The Samaru station became the unified research station in 1952/53. The cotton section had 4 of the 9 senior research staff and 9 of the 48 technical supporting staff.[28] Cotton was the only commodity with a separate section and was the first formal commodity-oriented research program at the station. The other sections were organized along disciplinary lines. Thus cotton was in a position to benefit from the multidisciplinary approach from the beginning. The cotton section researchers—two breeders and two entomologists—were provided by the ECGC. The section was responsible for breeding, selection, introduction, pathology, and entomology of cotton.

In 1962/63 the Samaru station became the Institute for Agricultural Research and Special Services within the newly created Ahmadu Bello University. Again, cotton was the only crop with a separate section. Except for animal husbandry and grassland, the other sections were classified according to disciplines.[29]

The export crop research bias of IAR was recognized by its leadership. Darling, its first director, commented that "... In the past much of the research effort was concerned with the two main cash crops of the region, i.e., cotton and groundnuts."[30]

A similar emphasis on export crops was evident in the 640 fertilizer trials carried out on eight crops in northern Nigeria from 1952 to 1961.[31] The three export crops—cotton, groundnuts, and soybeans—accounted for 46.9 percent of all fertilizer trials during the period, but only 16.3 percent of estimated area of the eight crops. The staple cereals of the northern states (sorghum and millet) occupied an estimated 73.9 percent of area of all crops, but received only 14.8 percent of the research resources allocated to fertilizer trials. Export crops averaged 4,729 hectares per fertilizer trial compared with 21,433 hectares for food crops (see Appendix 2, Table 39). The bias toward research on export crops continued into the early 1960s. In 1962/63 export crops (groundnuts, soybeans, cotton, sesame, sunflower, and castor) accounted for 58.9 percent of all research investigations by IAR research personnel (see Appendix 2, Table 40).[32]

The bias toward export crops has a number of historical roots.

The Need of the British Economy for Raw Materials

The produce marketing boards established in colonial British West Africa originated from the need of the British economy for raw materials. When the Ghanaian cocoa farmers rebelled against monopsonistic practices of British firms in the late 1930s, the British Ministry of Food bought Nigeria's entire 1939/40 crop of cocoa, oils, and oilseeds. With the loss of the Far Eastern

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[28] The other staff members included: agronomy, 1 senior researcher and a technical support staff of 11; botany, 1 senior and 19 support; chemistry, 2 senior and 7 support; and pasture, 1 senior and 2 support. Nigeria, Northern Region, Department of Agriculture, *Annual Report 1952/53* (Kaduna: Northern Region, Department of Agriculture, 1954).

[29] The sections and the senior research staff were: agronomy, 3; botany, 8; cotton breeding, 5; pathology, 4; crop physiology, 1; entomology, 5; chemistry, 5; soil survey, 7; animal husbandry and grassland, 3; and agricultural engineering, 2. IAR, *Annual Report 1962/63*.

[30] Ibid.

[31] Fertilizer trials were initiated in 1952 following the recommendations of the British Oilseeds Mission of 1947/48. The first fertilizer trials at Samaru were carried out on groundnuts, a major oilseed export to Britain at the time.

[32] There is an upward bias to the extent that there was a home market for some of these crops. However, these crops were viewed for research allocative purposes as oilseeds for exports.

sources of oils and oilseeds in 1942, Britain came to rely solely on Nigeria and other West African colonies for oils and oilseeds. By 1942 the West African Produce Control Board had statutory control over the marketing of palm produce, cocoa, and groundnuts. There was a deliberate effort to depress prices paid to Nigerian farmers to hold down wartime inflation in Britain. This amounted to a tax on Nigerian farmers to finance the British war effort.

These raw materials became particularly important to Britain following the war, when factories were being rebuilt and the industrial economy rehabilitated. Prior to the launching of the Ten-Year Plan of Development and Welfare for Nigeria by the Colonial Office in 1946, economic policy consisted mainly of the development of export enclave economies: cocoa in western Nigeria, oil palm in eastern Nigeria, and cotton, groundnuts, and oilseeds in northern Nigeria. Timber exports were mainly in the form of logs. Under these circumstances, agricultural research consisted largely of work in these export crops.

Foreign Exchange Earnings

Exporting raw materials to Britain resulted in a relatively healthy balance of payments for Nigeria at the cost of exploiting the farmer's natural resources. The importance of agricultural exports in total foreign exchange earnings is evident from the following data:[33]

	Average Annual Export Earnings		
	1900-10	1915-25	1930-40
	(₦ million)		
Total agricultural exports	5.5	18.5	16.0
Total exports (all items)	5.5	21.1	19.1
Agricultural exports as percentage of exports	99.3%	87.3%	83.6%

At the time the 1962-68 Plan was initiated, the country's external terms of trade were deteriorating. One of the aims of the Plan was "to achieve a modernized economy consistent with the democratic, political, and social aspirations of the people (by an) increase in the production of export crops...." This was reflected in higher resource allocations to export crops during the period of the Plan.

During the 1967-70 Civil War, Nigeria experienced serious balance-of-payments difficulties leading to a continued emphasis on export crops. The role of agricultural exports for the 1970-74 Plan period is shown below:[34]

	Export Earnings (₦ million)	Percent of Nonoil Exports	Percent of Exports
Nonoil Exports			
Agricultural	1,377.2	79.90	31.05
Other	346.4	20.10	7.81
Total	1,723.6	100.00	38.87
Oil Exports	2,711.2		61.13
Total Exports	4,434.8		100.00

Even though petroleum had become the dominant factor in the country's balance of payments, agricultural exports were still expected to account for almost one third of all foreign exchange earnings.

A country may find it desirable to finance crop research at the national level if that crop is of strategic importance to the country's balance of payments. Foreign exchange, as well as ecological considerations, are relevant in deciding whether the state government or federal government should finance research on a particular crop.

Government Revenue and Export Crops

The contributions of export crops to the government treasury in Nigeria (and other

[33] Basic data for these calculations were taken from Nigeria, Federal Ministry of Information, *Second National Development Plan 1970-74* (Lagos: Federal Government Printer, 1970).

[34] Basic data from Gerald K. Helleiner, *Peasant Agriculture, Government, and Economic Growth in Nigeria* (Homewood, Ill.: Richard Irwin, 1966).

former British colonies) are well documented.[35] Consequently, governments were well disposed toward liberal funding of research designed to increase output of these crops. By 1949 three government monopsonies were established to handle export produce marketing in Nigeria: the Nigeria Cocoa Marketing Board, the Nigeria Groundnut Marketing Board, and the Nigeria Oil Palm Produce Marketing Board. Revenues accumulated by these boards from the surplus of selling prices over producer prices less marketing costs from 1947 to 1954 totaled ₦239.3 million and included ₦92.1 million for cocoa, ₦70.0 million for palm produce, ₦61.1 million for groundnuts, and ₦16.6 million for cotton.[36]

Huge sums were transferred from these boards to the new regional marketing boards established by the 1954 Constitution: eastern states, ₦22.9 million; northern states, ₦65.3 million; and western states, ₦85.8 million. During the 1954-61 period, the regional marketing boards accumulated huge surpluses: eastern states, ₦47.8 million; northern states, ₦63.8 million; western states, ₦125.1 million; total, ₦236.7 million.

Therefore the marketing boards and related statutory corporations were able to contribute large sums toward state capital projects during the 1970-74 Plan (see Table 23). The dependency rate was 11.9 percent for the northern states; for all the states, 18.7 percent.

The political leadership in the old regions easily accepted the continuing emphasis on export crop research. For most of their history, research institutes that received funds from the marketing boards were relatively well financed. This has been a major factor behind the export crop bias of research institutes.

In addition to the indirect financing for export crop research, the produce marketing boards were required by statute to spend 7.5 percent of operating revenue on research. Grants given by the regional marketing boards for agricultural research during 1955-61 were as follows: western states, ₦10.0 million (mainly cocoa research and extension);

Table 23—Total capital project financing by state, 1970 to 1974

State	Resources of Marketing Boards, Statutory Corporations, and Other Capital Receipts	Capital Investment Expenditure	Marketing Board Revenue Sources as Percentage of Capital Expenditure
		(₦ million)	
Benue, Plateau	3.2	31.8	10.06
Imo, Anambra	1.6	46.2	3.46
Kano	12.0	80.6	14.89
Kwara	1.6	34.4	4.65
Lagos	6.0	39.2	15.31
Bendel	6.4	53.6	11.94
Kaduna	6.4	58.2	11.00
Borno, Bauchi, Gongola	6.4	49.6	12.90
Sokoto, Niger	6.4	48.8	13.11
Rivers	6.0	48.8	12.30
Cross River	22.0	42.4	51.89
Oyo, Ogun, Ondo	56.0	144.4	38.78
All states	134.0	678.0	18.66

Source: Basic data from Nigeria, Federal Ministry of Information, *Second National Development Plan 1970-74* (Lagos: Federal Government Printer, 1970).

northern states, ₦5.6 million (mainly to Samaru Research Station, with ₦3.2 million for general research and ₦2.4 million for cotton development).

The World Bank recommended that the normal recurring costs of WAIFOR be met from an endowment to which the Nigerian Oil Palm Produce Marketing Board contributed 82 percent. The Cocoa Marketing Board also provided funds for WAIFOR. In 1963/64 it provided ₦474,000 for cocoa and soil surveys. In northern Nigeria the Cotton Marketing Board provided ₦226,000 for cotton development by 1953/54.

Private Sector Emphasis on Export Crop Research

Although the private sector usually played a minor role in agricultural research, in some cases its contributions were important.

[35] Helleiner, *Peasant Agriculture*; and Herbert C. Kreisel, *Cotton Marketing in Nigeria*, Consortium for the Study of Nigerian Rural Development report No. 24 (East Lansing, Mich.: Michigan State University, 1969).

[36] Data from Helleiner, *Peasant Agriculture*.

As mentioned earlier, the ECGC supported a team of cotton breeders, agronomists, and entomologists in the cotton section of the Northern Regional Research Station at Samaru and its successor, the Institute for Agricultural Research. The cotton section was the most stable of all research sections up until the departure of most ECGC researchers from Samaru. ECGC researchers also played an active role in the research leadership at Samaru.

Research Resource Allocation in National Development Plans

The launching of the National Development Plan, 1962-68, marked the beginning of a new era in planned economic development. The federal program outlined in the Plan placed considerable emphasis on food crop research:

"The Federal Research Departments have in the past concentrated on the improvement of domestic food crops. The work on the staple food crops, cassava, yams, maize, and rice, will continue. In addition, a major effort is being made to expand in particular rice production and the production of other domestic foodstuffs of high nutritional value, such as potatoes and legumes."[37] Total federal allocation was ₦2.9 million. The Plan did not make separate allocations for research in food and export crops, but, as indicated in Table 24, export crops continued to receive major emphasis. Those research institutes heavily engaged in export crop research (NIFOR, NSPRI, RRIN, CRIN, and IAR), excluding the universities, spent about

Table 24—Expenditures and main crop emphasis of food and export crop research institutes, 1965/66 to 1966/67

Institution	Total Expenditures		Percent of Total Expenditures of all Crop Research Institutes		Main Emphasis in Mid-1960s
	1965/66	1966/67	1965/66	1966/67	
	(₦)				
FDAR	563,700	906,544	13.83	19.44	Food crops research
NIFOR	710,394	528,000	17.43	11.32	Export crops
NSPRI	88,374	n.a.	2.17	...	Export crops
RRIN	48,240	42,240	1.18	0.91	Export crops
IAR	1,214,250	1,260,300	29.79	27.03	Export food crops
CRIN	404,594	1,004,000	9.93	21.53	Export crops
WNMANR	320,124	326,480	7.85	7.00	Food and export crops
ENMA	692,400	350,160	16.99	7.51	Food and export crops
MWMANR	33,860	65,660	0.83	1.41	Food and export crops
IITA	n.a.	180,000	...	3.86	Food crops
Total	4,075,936	4,663,384	100.00	100.00	

Source: Basic data from O.W. Herrmann, *Nigerian Agricultural Research: Review and Recommendations*, Consortium for the Study of Nigerian Rural Development report No. 22 (East Lansing, Mich.: Michigan State University, 1969).

Notes: It would be preferable to use data on allocations, but they are not available. Data on expenditures and on allocations probably correlate reasonably well, however.

FDAR is the Federal Department of Agricultural Research; NIFOR is the Nigerian Institute for Oil Palm Research; NSPRI is the Nigerian Stored Products Research Institute; RRIN is the Rubber Research Institute of Nigeria; IAR is the Institute for Agricultural Research; CRIN is the Cocoa Research Institute of Nigeria; WNMANR is the Western Nigerian Ministry of Agriculture and Natural Resources; ENMA is the Eastern Nigerian Ministry of Agriculture; MWMANR is the Mid-West Ministry of Agriculture and Natural Resources; and IITA is the International Institute for Tropical Agriculture.

[37] Nigeria, Federal Ministry of Economic Development, *National Development Plan 1962-68* (Lagos: Federal Government Printer, 1963), p. 55.

61 percent of the total financial resources available to agricultural research in both 1965/66 and 1966/67.[38]

The 1970-74 Plan urges that Nigeria bend its energies toward the achievement of the most rapid rate of economic development feasible as a means of raising the quality of the life of the people.[39]

The statement of the objectives of agricultural policy in the Plan is sound. The objectives are:

- to ensure food supplies in adequate quantity and quality to keep pace with increased population and urbanization;
- to expand the production of export crops with a view to increasing and further diversifying the country's foreign exchange earnings;
- to propagate the production of agricultural materials for extensive domestic manufacturing by agro-allied industries;
- to create rural employment opportunities to absorb more of the increasing labor force; and
- to evolve appropriate institutional and administrative apparatuses for the smooth, integrated development of the agricultural potential.[40]

The Civil War years (1967-70) were marked by stringent controls aimed at conserving foreign exchange reserves. Export licenses were required for each staple food item such as beans, cassava flour, cassava tuber, garri, maize, rice, yam flour, and yam tuber. Most food, drink, and tobacco items were removed from the open general import license and put under the special license system. When the war ended on January 15, 1970, the economy experienced strains and price distortions. Enormous pent-up demand was released in the war-torn eastern states that had been net importers of certain food items in pre-Civil War days.

The Plan was unduly optimistic about prospects for increased food production. It projected that "agriculture and allied activities show a level of price rise over the Plan period lower than the general price rise for the economy as a whole." The Plan also failed to adequately reflect the emerging importance of domestic food crops in its allocation to research (see Table 25). Although the total sum allocated to agricultural research (₦6.9 million) was the largest in the nation's history, only 33.0 percent was allocated to food crops compared to 63.2 percent to export crops.

In addition, the states made the following allocations for agricultural research during the 1970-74 Plan: Anambra and Imo, ₦2.3 million; Lagos, ₦0.5 million; Bendel, ₦0.3 million; and Rivers, ₦0.4 million. The Rivers State document emphasizes raising the low yields of yams, cassava, cocoyam, and maize, which implies that the bulk of the research allocation was meant for food crops. Similarly, the Lagos State government specifically proposed the establishment of a research center at Agege to concentrate on rice, maize, tomatoes, fiber, kenaf, pasture, and forage legumes. Table 26 shows the breakdown of allocations to agricultural research in these four states. The western and northeastern states and Cross River State made no specific allocations for agricultural research.

The table clearly indicates that states that made explicit allocations for research gave it more emphasis than the federal government, the grandiloquent statement on food and agricultural objectives notwithstanding.

The Third National Development Plan, 1975-80, contained the most comprehensive treatment to date of food policies, programs, and projects. The policy objectives were the same as those in the second Plan, but quantitative policy targets were set. Food policy measures closely followed those presented in the guidelines to the third Plan.

The 1975-80 Plan detailed guidelines for the organization of agricultural research institutes. It recognized the "need to intensify research to improve the existing varieties of industrial as well as staple food crops." It provided that ". . . during the Plan period, research will be conducted into the development of cheap and simple tools and small motor-powered and animal-drawn imple-

[38] This may underestimate relative export crop research bias because regional ministries of agriculture also engage in agricultural export crops research.

[39] Nigeria, Federal Ministry of Information, *Second National Development Plan.*

[40] The Plan advocated the integration of the research efforts of the institutes under the IAR, the faculties of agriculture in the universities, and the state ministries of agriculture.

Table 25—Federal allocations to food, export, and industrial crop research and the agricultural and public sectors, 1970 to 1974

Research Category/ Sector	Allocation	Percentage of Total Crop Research Expenditure	Percentage of Agricultural Sector Expenditure	Percentage of Public Sector Expenditure
	(₦ million)			
Food crops	2.3	33.02	3.71	0.21
Export crops	4.4	63.20	7.10	0.39
Industrial crops	0.2	3.78	0.42	0.02
Total	6.9	100.00	11.23	0.62
Total agricultural sector	61.7		100.00	5.55
Total public sector	1,110.2			100.00

Source: Basic data from Nigeria, Federal Ministry of Information, *Second National Development Plan 1970-74* (Lagos: Federal Government Printer, 1970).

ments."[41] Research efforts were to concentrate on food, tree, and industrial crops, and fisheries. The breeding of high-yield and disease-resistant varieties of food crops was recognized as a research priority. Other areas of research emphasis were reduction of gestation periods, pest and disease control, fertilizer response, and storage and processing.

The Plan envisaged bringing about institutional specialization in the federal research program. Stations were directed to concentrate on crops important in the station's ecological zone. Thus, the Umudike Research Station was to specialize in root crops; Moor Plantation in rice, maize, and pulses; and Samaru in wheat, millet, and sorghum.

Facilities for research on cocoa, oil palm, and rubber were to be developed at the main and substations. Research at NIFOR and CRIN was to include palms and other tree crops.

In industrial crops attention was to be given to local raw materials such as wood, wood banks, leaves, pods, and roots, used in leather manufacture. In fisheries the Kainji Lake research program was aimed at the comprehensive development of the country's man-made resources.

Unlike the 1970-74 Plan, this Plan made no specific reference to export crops research, possibly because the traditional export crops are now sold mainly in the domestic market. Only a few states have explicit allocations for agricultural research; Benue and Kwara have allowances of ₦0.5 million and ₦0.3 million, respectively, for agricultural investigation centers; Plateau, ₦0.2 million for irrigation research; and Bendel, ₦2.5 million for research.

Table 26—Selected state agricultural research allocations, 1970 to 1974

State	Agricultural Research Allocation	Total Allocations to the Agricultural Sector	Research Allocations as Percentage of Total Agricultural Sector Expenditure	Allocations to All Public Sectors	Research Allocations as Percentage of the State's Allocations to All Sectors
	(₦ million)			(₦ million)	
Rivers	0.4	2.0	17.67	8.2	4.41
Anambra and Imo	2.3	3.3	70.86	9.0	25.85
Lagos	0.5	2.0	24.56	8.4	5.72
Bendel	0.3	1.6	21.10	9.2	3.76

Source: Basic data from Nigeria, Federal Ministry of Information, *Second National Development Plan 1970-74* (Lagos: Federal Government Printer, 1970).

[41] Nigeria, Federal Ministry of Economic Development and Reconstruction, Central Planning Office, *Third National Development Plan, 1975-80*, vol. 1 and revised vol. 2 (Lagos: Federal Government Printer, 1975), p. 71.

6

AGRICULTURAL RESEARCH PRIORITIES

National economic objectives are linked to agricultural research priorities by transformation functions. National goals are transformed into agricultural sector goals, sector objectives into agricultural research policy objectives, and the latter into research priorities.

At present most developing countries have national economic development objectives, especially for development planning. In the past, when many of these countries were under colonial rule, this was not the case. Development objectives could only be inferred from the policies of the colonial administration. Today, national economic development objectives usually include some or all of the following:

- rapid increase in per capita national income;
- a minimum level of disequilibrium in the balance of payments;
- lucrative and meaningful employment opportunities for all citizens;
- a minimum and stable level of nutrition for all citizens;
- self-sufficiency in staple foods;
- industrialization beginning with import substitution;
- equitable regional development;
- reduction of poverty and inequalities in personal income;
- a stable economy.

Good planning translates these objectives into sectoral objectives. Reasonable transformation of the above objectives for agriculture are as follows.

Increases in Agricultural Production. A national objective of rapidly increasing per capita national income transforms into rapid increases in agricultural production. In many developing countries agriculture still accounts for more than half of the GDP, and more than 70 percent of the people live in rural areas. Consequently, the performance of the national economy is greatly influenced by the performance of agriculture.

Increasing per capita agricultural production requires both development and maintenance research objectives.[42] Development research aims at generating technology to increase yields. This involves development of improved strains of crops, livestock, fish, and trees and complementary work on agronomy, crop physiology, crop nutrition, animal husbandry, and animal nutrition. Maintenance research seeks to prevent reductions in crop and livestock yields from pests, diseases, and adverse weather. Both kinds of research need to be conducted within a multidisciplinary framework. It serves little purpose, for example, for the plant breeder to develop a high-yielding variety of rice that is vulnerable to rice blast disease.

Increases in Foreign Exchange Earnings. Most developing countries seek to avoid serious disequilibria in their balance of payments. The traditional method is to expand agriculture (in the face of limited domestic manufacturing capability) to pay for growing imports of capital and consumer goods. This leads to an agricultural policy target of accelerated export crop production.

The objective of increasing the foreign exchange contribution of agriculture might be met by reducing the drain on foreign exchange through import substitution. However, balance-of-payment difficulties in many developing countries are due to the cumulation of deficits over a number of years. Equally troublesome for these countries are fluctuations in foreign exchange earnings caused by variations in export crop production. Thus the objective of stabilizing foreign exchange earnings again is transformed into the research objective of breeding varieties of export crops resistant to water stress, pests, and diseases. In the case of exports, decreasing year-to-year variability is as important as increasing crop production. There is also a need for research on world market supply and demand conditions, which are often neglected by Third World exporters.

[42] See Evenson and Kislev, *Agricultural Research.*

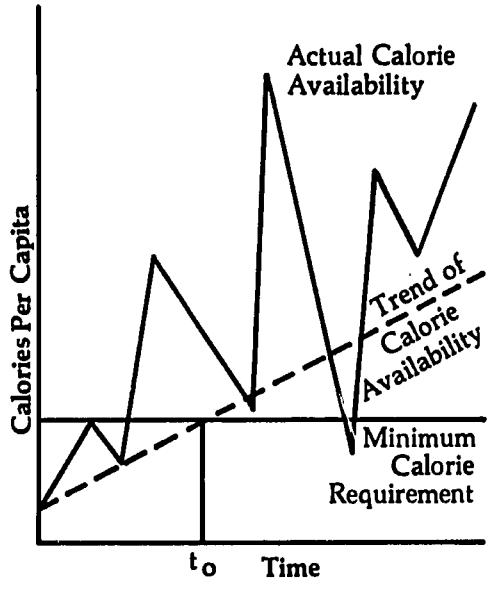
Gainful Employment Opportunities in Agriculture. Countries with rapid population growth and limited growth in industrial employment seek to alleviate unemployment and underemployment by promoting labor-intensive technologies—or better still, technologies that properly reckon with social opportunity costs of labor. They avoid labor-saving technologies that would further aggravate the problem.

Efforts to expand employment opportunities in agriculture foster research to develop technologies that realistically consider the country's factor endowments. Such research must be concerned with factor shares of alternative technologies as well as their employment implications.

Optimal Cropping-Livestock Systems. Food-deficit countries try to raise per capita nutrition to at least the minimum required level. This is part of the new emphasis on nutrition policy as the centerpiece of food and agricultural policy. It is now recognized that the caloric deficiency in these countries is more serious than the protein deficiency. Raising nutritional levels, therefore, transforms into a major effort to produce the needed calories. Once again stability of production must be emphasized to avoid fluctuations in nutrition levels. Even though per capita calorie availability may be adequate on the average, actual availability may vary considerably from year to year (see Figure 3).

The goal of producing an optimal ratio of crops to livestock for a balanced diet requires research to develop efficient sources of calories and plant and animal protein. For example, research could be directed at enhancing the nutritional value of roots and tubers, vitalizing cassava chips for animal feed to increase the relative share of animal protein, and improving processing of cereals to preserve essential nutrients. Research should also seek to develop nutrient sources that require less input of scarce productive resources. Stabilizing nutritional levels involves not only stabilizing food production but also reducing losses in storage, processing, and transportation, and ensuring reliable market supplies for dependent segments of the population.

Figure 3—Changes in per capita calorie availability



Self-Sufficiency in Food. Many developing countries, though poor, identify self-reliance with national pride and integrity. This general idea is often transformed into the specific objective of attaining self-sufficiency in food staples.[43]

Research policy based on the objective of self-sufficiency would aim at accelerating domestic production of products that are now being imported. It should also seek to minimize the costs in resources and welfare that accompany any such food policy. Researchers should point out to policymakers that autarky is not without cost.

Accelerated Production of Industrial Crops. The national objective of industrialization through import substitution is often transformed into the agricultural objective of accelerating production of industrial crops. Many countries have begun industrialization by developing industries that process cotton, sugarcane, fruits, jute, and so forth. This calls for policies that seek to ensure adequate and stable supplies of raw materials for

[43] A societal goal of self-reliance need not always include becoming self-sufficient in food. Nigeria would l. consider the domestic resource costs required to become self-sufficient in wheat.

infant industries. Research projects such as those to produce long-staple cotton, to control cotton pests, to control nematodes and diseases of sugarcane, and to develop varieties of fruits and vegetables suitable for canning and processing may be in order. Economic research to determine, for example, the most efficient size for firms to be under existing conditions to minimize unit fixed costs of processing and manufacturing may also be needed.

Regional Agricultural Development Developing countries normally seek to avoid wide disparities in regional development. This objective transforms into agricultural programs and projects that span all major ecological zones. For example, a country may undertake irrigation projects in all regions even though they are needed in only a few. Research policies to equalize access to income-earning opportunities among regions may include development of irrigated agriculture and large river basins. Or they may concentrate on programs to control animal and human diseases, to eliminate undesirable physical and chemical properties of soils, or to improve varietal performance.

Raising Personal Incomes of Farm People Many approaches may be taken to realize a national goal of reducing poverty: increasing per capita agricultural production, equalizing access to education (especially for rural people), and narrowing the rural-urban income differential.

Because education plays a definite role in reducing income inequalities, it is especially important to identify through research the main variables that determine the quality of education available to rural people. Other research should study ways to increase wealth and income in rural areas, how national policies affect rural personal incomes, and how to distribute resources to equalize opportunities for increasing income.

Another major research focus concerns the consequences of alternative technologies on income distribution. For example, recommendations to use ultra-low-volume (ULV) spraying equipment for the control of cotton pests or to use new mechanized sowing equipment may be adopted by only a few large-scale farmers who can afford it, which may widen personal income inequalities.

Other research objectives include identification of the factors influencing access to land, water resources, new technology, farm machinery, and other items of wealth. These involve studies of such policies as minimum producer (support) pricing, input subsidies, location of schools, special incentive programs, public subsidies for rural school systems, taxes on personal income, land or water taxes, and credit facilities. Research also could be directed at crops with relatively high income demand elasticities (especially at low-income levels), which are consumed by the poorer segments of the society.

Many developing countries have adopted policies to redistribute income to narrow the gap between rich and poor. These have taken many forms, such as differential pay raises and subsidies for public education from primary to university levels in Nigeria and redistribution of land in Ethiopia. These policies have altered the structure of demand for foods and have led to phenomenal upswings in prices of foods for which income elasticity is high; for example, meat, fish, and certain kinds of rice in Nigeria.

Stable Agricultural Production and Marketed Surplus Much of the economic instability in developing countries results from fluctuations in supply rather than in demand, as is the case with most developed economies. This results from the dependence of developing economies on domestic production, which is sensitive to environmental stress. Stabilizing agricultural production, therefore, is necessary to realize the goal of a stable national economy. Achieving production stability in agriculture translates into such research objectives as developing seed varieties resistant to moisture stress, pests, and diseases; devising measures to cope with large-scale outbreaks of locusts and grasshoppers; breeding livestock resistant to endemic diseases; and improving agrometeorological knowledge as a basis for reliable crop forecasts. Agricultural research policy should also aim at improving on-farm and off-farm storage capabilities and transportation systems to ensure stability in market supplies.

Priorities for Allocating Research Resources

Given the derived agricultural research objectives, the following criteria could be

employed for determining research priorities among crops and agricultural inputs.

With traditional technology, the geographical distribution of a product indicates its importance for rural employment and welfare and its potential in regional development. It also gives some indication of the importance of the product in utilization of land, a resource with which Nigeria is relatively well endowed. As a short-run criterion, the larger the land area covered by the crop, the higher its research priority.

Other criteria for determining research priorites are: importance of the crop as a source of calories or protein; contribution toward the balance of payments—either through export earnings or savings from import substitution; importance as a supply of raw materials for expanding agro-allied industries; and importance as a food staple of the poor. In general, the closer a crop comes to meeting these criteria, the higher should be its research priority.

All policies—including agricultural—must be assessed from a sociopolitical viewpoint. Some commodities have more social impact than others; shortages can cause disorder. For example, a country may decide that total dependence on imports for all domestic requirements of sugar or wheat is politically undesirable and request the research leadership to investigate possibilities for domestic production, even though production possibilities appear marginal at best! The more strategic a crop is in these terms, the higher the research priority that will be assigned to it.

The proportion of value added by a crop to the GDP indicates its relative social valuation to the extent that this is reflected in prices paid for foods. Thus crops with relatively high social importance would require a relatively high research priority. This criterion should reflect projected as well as current social valuations. This is an extension of earlier criteria in which priorities for the main subsectors in agriculture were evaluated in terms of their relative importance in the national economy, and those for individual crops were evaluated on the basis of their relative importance in the agricultural sector.

Many governments depend on taxes on crops for revenue and tend to accord these crops high research priority.[44] In such countries the higher the dependence of government on tax revenue from a crop, the higher the research priority that should be accorded to the crop, if the elasticity of revenue to the tax rate is not to turn negative at low tax rates. Unless agricultural research policy does this, government taxation of crops will lead to adverse short- and long-run capacity contraction.[45]

For countries faced with large-scale rural unemployment (even after adjusting for seasonal farm labor patterns), agricultural research policy should accord high priority to labor-intensive crops. Agricultural research also could benefit employment in the nonfarm sector. In Nigeria groundnut oil mill factories in Kano have had to periodically lay off thousands of workers because of disastrous outbreaks of rosette disease in groundnut crops, as was the case in 1975. Textile factories in Kaduna have had similar difficulties because of poor rainfall distribution in the cotton-growing areas. Research to solve such problems would indirectly promote off-farm employment.

Demand for research on agricultural inputs is derived from demands for crops and fibers. Allocations for factor-oriented research should be based on importance of the input to crop production, projected fluctuations in factor markets as reflected in shortages and surpluses, and strategic importance of inputs.

The importance of an input could be measured by its output elasticity. This could be obtained from aggregate production function studies to measure the importance of key resources in the agricultural sector. Where aggregate production function estimates do not exist, proxies could be obtained from location-specific, cross-section production function estimates. The underlying supply-

[44] For a treatment of second-best aspects of crop tax revenue within a Cobb-Douglas production framework, see Francis Sulemanu Idachaba, "Marketing Board Crop Taxation and Input Subsidies: A Second Best Approach," *Nigerian Journal of Economic and Social Studies* 15 (November 1973): 317-24; and Francis Sulemanu Idachaba, "Policy Distortions, Subsidies and Rural Employment Generation: A Second-Best Approach," *Indian Journal of Agricultural Economics* 29 (April-June 1974): 20-32.

[45] This argument should not be interpreted as supporting crop taxes.

demand conditions of some agricultural inputs transcend state or local government boundaries and should be treated within a national research framework. These include land, water, and labor. In the case of labor, markets are also linked (for example, where minimum wage laws may have adverse consequences for farm labor).

Research to correct drastic market disruptions in inputs should take priority. For example, policies such as free primary education in Nigeria could lead to reductions in farm labor force. Therefore, research priority should be accorded to crops that are labor intensive with existing technologies. Alternative production technologies should be evolved to reflect the new social opportunity costs of labor.

The strategic importance of certain resources calls for research priority. For example, the timely availability of irrigation water in a particular zone may make the difference between a good crop and failure.

Efficient management is necessary to attain the desired goals in agricultural production. The priority accorded management research should be equal to those in commodity and input research.

The government can influence agricultural research policy in various ways. Wages of research personnel usually constitute the bulk of government recurrent research expenditures. In some cases the subsidy amounts to 100 percent. Research allocations among crops, livestock, fishery, and forestry are substantially determined by allocations for wages of research personnel. Government can also affect research policy through control of additions to staff, and by subsidies for training.

Another way in which government affects research priorities is by manipulating its funding for research equipment and materials. Import duties on needed equipment and materials can be reduced or eliminated. In other cases equipment and materials could be supplied wholly by government.

A useful policy instrument for achieving a given target is a government subsidy to the final output of research. For example, the government might subsidize application of fertilizers for a particular crop in different zones, based on soil analysis and classification studies and fertilizer trials. Or the government might subsidize production of a new seed variety that would be unprofitable for private firms to produce because of the limited market or the poor infrastructures. Or the government might subsidize large-scale multiplication and distribution of cereal seeds to be grown for livestock feed in order to achieve the national goal of increased per capita protein consumption. In many countries selective use of this policy instrument has been a major weapon in the modernization of traditional agricultural economies.

It is not enough for research priorities to produce concrete results. The findings must be adopted by millions of small-scale farmers in rural environments characterized by imperfect capital markets. The access of farmers to credit varies. Adoption of new research results normally raises the proportion of nonfarm input costs to total farm costs and further widens the income inequalities. Thus, by subsidizing credit, the government could help to achieve the objectives of increasing total farm production through the adoption of new research results and narrowing interpersonal income inequalities.

Crop pricing is another policy instrument used to achieve adoption of research results. Small-scale farmers, subject to heavy post-harvest losses, poor transportation, and imperfect market structures, need assurances that the increased output promised by research will translate directly into higher income for them. This suggests the hypothesis: the more organized and guaranteed the marketing outlets for a crop, the greater the chances that new research results will be adopted and that research goals will be achieved.[46]

The experiences of many developing countries are consistent with this hypothesis. Historically, the fact that markets for export crops were reasonably well organized probably explains their head start in the use of new research results. Although these marketing arrangements also had negative effects, they guaranteed a price to farmers. In making decisions to allocate resources to a new input or technique, a farmer could pinpoint fairly well the price he would receive for his crop, at least after a few years of statutory price fixing.

But guaranteed marketing and pricing arrangements also could influence the time-

[46] The presumption here is that there are no concurrent commodity taxes.

resource allocation patterns of agricultural researchers. It is presumed that researchers will devote their research efforts to those pursuits in which they perceive a potential demand by farmers. They are not likely to be enthusiastic about research to raise output in crops with fragmented markets and collusive, oligopsonistic pricing systems. This leads to the related hypothesis: the better organized the marketing outlets for a crop, the greater the motivation of researchers to conduct research into that crop.

This is because the demand for research is derived from demand for the final products.[47] If final demand is not reflected in prices paid to the farmer, researchers are likely to feel that the chances of adoption of new research results are slim. Thus, government marketing programs such as guaranteed minimum producer prices, the building of marketing cooperatives, and subsidies for on-farm storage facilities help set research priorities.

The diffusion of research results also is affected by the quality of rural infrastructures. It is of little use to try to persuade farmers to adopt fertilizer-responsive seeds where poor roads prevent transporting fertilizer to the production zones before the rains start. New labor-intensive farm technologies have limited use when the lack of good schools, hospitals, and electricity drives farm youth to the cities.

It is also difficult to encourage farmers to adopt new research results when they lack adequate information on market opportunities.

A powerful instrument for achieving agricultural research targets is the correct location of research facilities: main stations, substations, experimental stations, and field trials. The value of research results depends on how well they can be adapted to conditions in specific ecological zones. Development of varieties suitable for areas with short growing seasons, or with heavily leached soils, calls for substations and experimental plots in zones where these conditions exist. Decentralized research systems can further such national goals as narrowing regional income disparities, reducing poverty and interpersonal income inequalities, and ensuring stable agricultural production by spatial diversification. However, the danger of spreading research resources too thin should be noted, particularly in African countries. The location of research facilities should be determined by spatial objectives rather than historical considerations.

Developing countries change national economic development objectives over time. These changes are transmitted to agricultural research priorities but are subject to lags of varying lengths. The transformation of national economic development objectives into agricultural sector objectives in a typical developing country is affected principally by the degree of intersectoral coordination in the planning process. Although the transformation usually is expected to be made within the planning period and even to be reflected in the plan document, lags of at least one planning period are not uncommon. For example, many countries committed to raising national income and strengthening their balance-of-payments positions have simultaneously tried to maximize revenue from agriculture by levying export and other crop taxes, thus killing the goose that lays the golden egg! These paradoxes demonstrate that countries can ill afford a long lag in the transformation of national economic development objectives into a consistent set of agricultural sector objectives.

The lags in transforming agricultural sector objectives into agricultural research objectives are largely due to poor liaison between the leaders of the ministries of agriculture and the research institutes. Quite often there are no regular clear lines of communication, with the result that agricultural research bears little relationship to the nation's objectives. Such lags are brought about by the inefficiency of the research establishment in identifying programs and projects that conform to the objectives.

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[47] Researchers' perception of market opportunities for the potential research crop are important where, as in most developing countries, there are no effective farmers' organizations to articulate demands for research. In contrast, farmers' organizations played a key role in specifying research problems in the United States. J. C. Fitzharris and W. L. Peterson, "Organization and Productivity of the Federal State Research System in the United States," in Thomas M. Arndt, Dana G. Dalrymple, and Vernon W. Ruttan, eds., *Resource Allocation and Productivity in National and International Agricultural Research* (Minneapolis, Minn.: University of Minnesota Press, 1977). The problem discussed is similar, particularly for new crops: the Northern Nigeria Regional Government organized ginger markets in parts of Plateau State to promote production of the crop.

What interests the researchers is not always most important from the standpoint of solving practical problems. One solution is to strengthen the budget control of the board of each research institute over funded research projects.

Assigning Responsibility for Agricultural Research

The issue of the proper division of responsibility for agricultural research between state and federal governments in Nigeria remains unresolved. For many countries with a federal system, patterns of responsibility for agricultural research have evolved largely out of historical circumstances. In Nigéria, however, it was never formally established which tier of government should engage in which kind of agricultural research. Rational guidelines for the division of executive responsibilities over research presuppose a clear idea of the benefits to be obtained from research, especially within a developmental context.

It is traditional to distinguish between basic, applied, and adaptive/developmental research.[48] According to Schultz, research is "a specialized activity requiring special skills and facilities that are employed to discover and develop special forms of new information, a part of which acquires the properties of economic information."[49]

Basic research is defined as that which yields new ideas, concepts, and models, the benefits from which are usually not specific enough for exclusive use of the researcher or the funding agency. Examples include fundamental biological nitrogen fixation research, breeding for resistance to environmental stress to minimize fluctuations in crop output, general agrometeorology, genetic manipulation, physiology of nutrient absorption, bioecology of pests, biological control of pests (such as sex attractants and male sterilization techniques), and epidemiology of widespread livestock diseases. Basic research often can be utilized by "free riders"—firms, individuals, and others who have contributed nothing to funding the research.[50]

Applied research, on the other hand, is directed at a practical goal. The findings usually are specific enough so that it is possible to exclude free riders. Examples include varietal selections and trials in local environments, trials of insecticides based on knowledge of the seasonal distribution of pests in particular zones (timing and dosage of insecticidal applications), and residual effects of pesticide applications.

Adaptive research consists of field or on-the-spot trials of results of applied research. These include configuration of farm machinery for certain soil types, as was the case in field applications of tractors and sprayers in the farm mechanization programs of the Institute for Agricultural Research, Samaru; the caking problem of storage silos as related to local temperature in western Nigeria; and agronomic practices such as timing and rate of fertilizer applications. Adaptive researchers are the link between the applied researchers and the ultimate users—the farmers. An effective agricultural research system in a developing country requires subject specialists (production agronomists, seed technologists, entomologists, agricultural economists, and so forth) within or working hand in hand with the extension system.

Two qualifications should be made. First, there are few water-tight compartments in research: basic, applied, and adaptive researchers interact with one another. For example, it was found in Nigerian fertilizer trials in lowland rice that nitrogen in sulfate of ammonia was rapidly leached off with onset of the rains and floods. This led to more basic research into methods of slowing down nitrogen release so that plants could adequately utilize the nutrients during their critical growth period. Researchers have been experimenting with sulfur-coated urea as a substitute for sulfate of ammonia.

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[48] The "adaptive research" category was emphasized in a recent report of the Indian National Commission on Agriculture.

[49] Theodore Schultz, "The Allocation of Resources to Agricultural Research," in Walter L. Fishel, ed., *Resource Allocation in Agricultural Research* (Minneapolis, Minn.: University of Minnesota Press, 1971).

[50] The context in which the "free rider" problem arises in a federal system is explained below.

Second, some types of research may not fit into any of the categories. For example, soil analysis, mapping, and classification yield practical results which can be appropriated by residents. Most of it is not basic research, but it is an important input for agronomists studying plant nutrition and seeking optimal fertilization regimes. In this case the classification of research according to whether output is final or intermediate has merit,[51] but this does not imply that one kind of research is good and the other bad. From a national viewpoint there are strong reasons for such soil research to be handled by a higher tier of government.

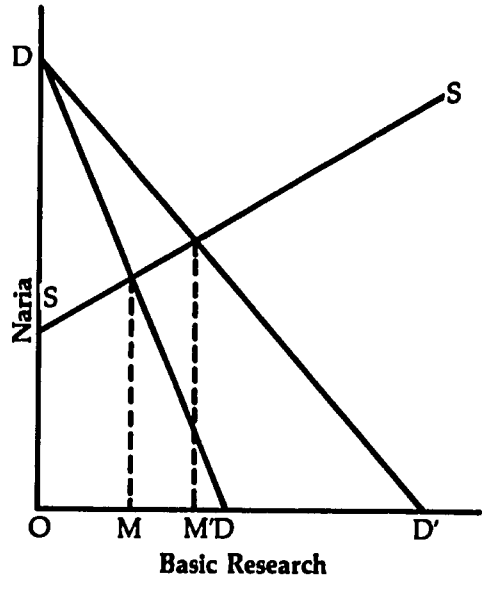
With these classifications in mind, what are the guidelines for state and federal responsibility over agricultural research?

Assume that the following situation exists in a country: agriculture is still the dominant sector; there is a democratic federal/state form of government in which the political decisionmakers within each state seek to maximize the welfare of their constituents in order to be reelected; the electorate will not tolerate waste or inefficient allocation of resources indefinitely; and residents of the state are primarily concerned with their own agricultural problems and would therefore be most likely to support and finance projects—research and nonresearch—that benefit citizens of that state.

Suppose a state government is considering basic agricultural research that would yield information of value to residents of other states who would then receive a free ride. Because the benefits to the state would be less than those to society, the state is unlikely to be sufficiently motivated to adequately allocate resources to the basic research. The reluctance of individual states to invest in research that does not promise immediate and direct benefits to its own residents is the rationale for federal government financing of basic agricultural research. This leads to the following hypothesis: the more ecologically diverse a country, the greater the likelihood that the national government will support basic agricultural research and leave applied and adaptive research to lower levels of government.

The reasoning behind the hypothesis is illustrated in Figure 4. The collective demand by residents of a state within a federation for the fruits of basic research is represented by DD. This demand curve reflects the social valuation of research benefits by the state's residents. The upward slope of the supply curve, SS, reflects the increasing cost of additional basic research. There are two possible explanations: first, it costs more to hire additional scientists at the margin; and second, basic research rapidly experiences diminishing returns when technical supporting staff and supplies are limited. The optimum amount of basic agricultural research to be supported and financed by a state government is given as OM.

Figure 4—Demand and supply of basic research



Note: Curve DD is the demand for basic agricultural research by the residents of one state. Curve DD' is the demand for basic agricultural research by all Nigerians. Curve SS is the supply of basic agricultural research. OM is the optimum amount of basic agricultural research for one state. OM' is the optimum amount of basic agricultural research for Nigeria.

[51] Evenson and Kislev, *Agricultural Research.*

The demand for basic research by the nation is represented by DD'—reflecting the fact that benefits to the whole federation from basic research are greater than those to residents of the state that finances such research.[52] From the whole federation's viewpoint, the optimum amount of basic research is OM', where the marginal social value of basic research equals the marginal social cost. The amount of underinvestment in a given line of basic research is MM'. This model carries the entirely plausible assumption that a state's decision to allocate resources to basic research is made with the welfare of residents in mind.

Examples of research requiring federal support in Nigeria include studies of the bioecology of the maize stem borer; breeding of lowland rice varieties for resistance to rice blast *(Pyricularia oryzae);* technologies of mass production of seed yams involving studies of vine-cutting propagation, bud stimulation, yam seed germination, and tuber topping; cassava bacterial blight; certain aspects of control of the trypanosomiasis vector, the tsetse fly; and control of rinderpest and bovine pleuropneumonia.

The Nigerian experience with maize and rice research has been consistent with the hypothesis. Most of the research on maize and rice, which are grown in most parts of the country, has been supported by the federal government at Moor Plantation and Badeggi. The northern and western regions did support some applied research on maize and rice at IAR and IAR&T. Groundnut production has largely been confined to northern Nigeria, especially Kano State. Until Ahmadu Bello University was federalized in 1975/76, groundnut research was the responsibility of the old northern regional government with research facilities based mainly at Kano, Samaru, and Mokwa.

There are already grumblings about the present financing of all agricultural research by the federal government. For example, IAR feels that the present budget cuts would not have occurred if the northern states had remained its financial sponsors. There may be benefits to the local economy from well-financed research into some crops that the federal leadership is unable to fully appreciate. On the other hand, there are instances in which local authorities are willing for the federal government to fund research into a crop, for example, cocoa and coffee, when the benefits will accrue to the local producing areas. The above hypothesis would imply that Ondo, Oyo, Ogun, and to some extent Cross River States would bear a significant part of the cost of research on cocoa, though as seen in Chapter 4, there are other considerations.

[52] For a similar approach for the individual and the society, see L. Sjaastad, "Economics of Basic and Applied Research," University of Chicago, Chicago, Ill., 1966. (Mimeographed.)

7

PROPOSALS FOR A NIGERIAN AGRICULTURAL RESEARCH SYSTEM

Food Crops Research

Federal government financing of agricultural research institutes should be replaced by joint federal/state funding. The research system would then consist of some research institutes funded and controlled by the federal government, some in which state and federal governments jointly fund and coordinate research, and some wholly funded and controlled by the state governments. Federal government control and coordination in the first two cases should ensure that agricultural research is not unduly fragmented.

Basic or intermediate-level research on crops that span the major ecological zones should be the responsibility of the federal government. Breeding and crop protection for particular ecological requirements should be done at federal zonal crop research stations. States in each zone would provide researchers to work with the federal team. It is unrealistic to expect the federal government to shoulder the entire cost of basic and applied research in these crops. Some of the state governments should be encouraged to invest in agricultural research instead of channeling large resources to state-owned agricultural companies that produce food at high cost.

Research into crops that are localized should be largely the responsibility of the producing states.

Federal support is urged for intermediate- or low-level research on cereal crops based on their importance in overall regional rural development and the role of cereals as livestock feeds.

The federal government should aid states that need applied research but cannot afford it. It is possible that some research institutes would be better off financially with state funding, the IAR, for example. State governments are in a better position to appropriate the benefits of research to their local economies. Furthermore, it is often difficult for distant federal funding agencies to respond quickly to the research needs of states and local government council areas. However, it should be emphasized that the national goal should be an integrated agricultural research system based on a true partnership between federal and state governments.

Research on crops with convenience features should be financed largely by the federal government. Bread is becoming an important food, with wheat imports rising at an annual rate of 86.7 percent from 1970 to 1976. Although production is confined to a few states, wheat research should be financed by the federal government because of its strategic importance. Other commodities in this group include sugarcane and cotton, which are essential for the country's policy of industrialization through import substitution.

Livestock and Fishery Research

Research on livestock and fisheries should be a federal government responsibility because of their great significance to national nutrition. Research conflicts in this area can be resolved only within a national framework. For example, should research concentrate on eradication of the tsetse fly so that the production of the Zebu cattle breed can be extended to the south, or on selective breeding of the Muturu and other breeds resistant to the tsetse fly? Federal livestock production research began with the creation of NAPRI. Its predecessor, the Shika Research Station, concentrated mainly on ruminants. But the federal government should greatly increase its allocation for research on both ruminants and nonruminants. The present allocation of only 0.027 percent of value added in the agricultural sector is grossly inadequate.

Forestry Research

Most forestry research should continue to be funded by the federal government. Unless utilization is carefully controlled, exploitation of forests could easily reduce many regions to wastelands. States could provide partial funding for specific local problems such as optimal silviculture systems.

Agricultural Input Research

The federal government should initiate research in a systems context on farm labor, soils, agrometeorology, irrigation water, farm mechanization, and related fertilizer and pesticide research. Factor-oriented research at federal institutes has tended to be residual. None of the institutes has responsibility for doing such research within a national framework. This probably reflects the belief of political and research leaders that the required production inputs will somehow be forthcoming once the research results are on the ground. This belief has been fallacious and costly. For example, farm labor supply difficulties have hampered elaborate development schemes. Yet there is not a single institute charged with studying farm labor market structures, demand and supply relations, labor profiles in major ecological zones, the interaction between farm and urban labor markets, the effects of socioeconomic policies on the farm labor force, and so forth. Lack of information on farm labor markets has caused bottlenecks in programs to accelerate food production. A research institute or a university with a strong department of agricultural economics should be designated as a center for farm labor research.

It is recommended that the IAR be designated as the National Center for Soil Fertility and Soil Nutrition Research and also as a center for farm mechanization research. In the latter role it would work closely with the faculty of engineering of Ahmadu Bello University and the Farm Mechanization Center at Ilorin. Strong federal support is also urged for agrometeorological research.

Work on fertilizer and pesticide trials should be largely a state responsibility, although a strong case could be made for federal funding of fertilizer research on slow nitrogen release for crops such as lowland rice.

Irrigation Research

Most irrigation research should be financed by the federal government. Irrigated agriculture has strategic importance for three reasons. First, it is an important policy instrument for promoting development in regions with inadequate rainfall. Second, it helps to stabilize agricultural production, rural welfare, and the national economy. And third, irrigation is required for important specialty crops such as wheat, cotton, dry-season tomatoes, and other vegetables.

Federal allocations to irrigation research should be substantially increased. The 1977/78 approved irrigation budget for IAR, the only major institute engaged in irrigation research, was ₦ 88,122, only 0.11 percent of total federal allocation to all institutes and only 0.61 percent of federal expenditures by the Ministry of Water Resources.[53] Thus, whereas ₦148.1 million was allocated for water resources in 1977/78, very little was spent on research to develop irrigation.

Location of Research Institutes

The agricultural research system should be decentralized. The main criteria for locating institutes working on applied or adaptive research should be location in the main producing zone; accessibility to universities and technological institutes; and availability of good roads, schools, hospitals, and other infrastructure. Location in a main producing area helps to link laboratory research with experimentation on farmers' fields. The present locations of the main stations and substations are shown in Tables 27 and 28.

Suitability indexes were constructed to

[53] The Ministry of Water Resources commanded a high priority in federal government allocations: it had 19.77 percent of all federal government expenditures on all sectors in the 1977/78 budget.

Table 27—Distribution of stations and substations of agricultural research institutes, 1978

Institute	Research Emphasis	Main Station (Headquarters)	Substations
IAR	Sorghum, millet, wheat, barley	Samaru (Kaduna State)	Mokwa, Kano, Ngala, Bakur, Yandev
NCRI	Rice, maize, grain legumes, sugarcane	Ibadan (Oyo State)	Badeggi Umudike, Uyo, NIFOR, Kebbi, Bacita, Mokwa, Samaru, Ubarri, Shendam, Bende, Umudike
NRCRI	Yams, cassava, cocoyams, and potatoes	Umudike (Imo State)	Mbato, Ugwoba, Otobi, Offa, Benin, Kuru
IAR&T	Cereals and legumes	Ibadan (Oyo State)	
NIHORT	Fruits and vegetables	Idi-Ishin, Ibadan (Oyo State)	Baguda, Mbato
CRIN	Cocoa, kola, coffee, and cashews	Gambari (Oyo State)	Ikom, Uhommora, Mambilla, Plateau, Kusuku, Bende
RRIN	Rubber	Iyanomo (Bendel State)	Akwete
FRIN	Forests, wild flora and fauna	Ibadan (Oyo State)	Zaria, Umuahia, Saroba, Kano
NIFOR	Oil palm, raphia, coconuts, dates	Near Benin City (Bendel State)	Abak, Badagry, Dutse, Obotme
KLRI	Fish and irrigated crops	New Bussa (Kwara)	Shagunu, Papiri, Cafana, Bin Yauri, Yaskikira, Tiga (Kano State)
LCRI	Fish	Ngala (Borno)	
NIOMR	Fish	Lagos (FCT)	
NAPRI	Livestock	Shika—Samaru (Kaduna State)	
NITR	Trypanosomiasis and onchocerciasis	Kaduna (Kaduna State)	Vom
NVRI	Cattle	Vom (Plateau State)	
LRIN	Leather	Zaria (Kaduna State)	
AERLS	Extension services	Samaru (Kaduna State)	
NSPRI	Storage of food and export crops	Lagos (FCT)	Ibadan, Kano, Sapele

Note: The full names of the institutes listed in the table are as follows: Institute for Agricultural Research (IAR), National Cereals Research Institute (NCRI), National Root Crops Research Institute (NRCRI), Institute of Agricultural Research and Training (IAR&T), National Institute for Horticultural Research (NIHORT), Cocoa Research Institute of Nigeria (CRIN), Rubber Research Institute of Nigeria (RRIN), Forestry Research Institute of Nigeria (FRIN), Nigerian Institute for Oil Palm Research (NIFOR), Kainji Lake Research Institute (KLRI), Lake Chad Research Institute (LCRI), Nigerian Institute for Oceanography and Marine Research (NIOMR), National Animal Protection Research Institute (NAPRI), Nigerian Institute for Trypanosomiasis Research (NITR), National Veterinary Research Institute (NVRI), Leather Research Institute of Nigeria (LRIN), Agricultural Extension and Research Liaison Services (AERLS), and Nigerian Stored Products Research Institute (NSPRI).

determine the central location of each research institute headquarters within the producing area.[54] If the three nearest states to institute headquarters produce at least one-third of national output, location is suitable; otherwise it is unsuitable.

As shown in Table 28, Samaru is a suitable location for groundnut, cotton, millet, and sorghum research but not for melons and benniseed. An outstation should be established in Benue State to handle benniseed and other oilseeds. In the past Samaru conducted marginal research (mainly variety trials and selections) on these minor oilseeds for export. Now that these seeds are being produced entirely for domestic food consumption, a new location is desirable.

Table 29 indicates that Ibadan is only marginally suitable as NCRI headquarters for rice research, fairly suitable for maize,

[54] An index of suitability was defined as:
where I is the index of the central location of the headquarters of a research institute, Y_{jit} is output of the j^{th} crop in the i^{th} state, one of the three nearest states to institute headquarters, t is the time period, and Y_{jt} is national output of the j^{th} crop in time t. The normative decision criterion used is: if $I \geq 33.33$, the headquarters of the institute are centrally located in a major producing area; if $I < 33.33$, they are not.

and clearly unsuitable for beans and soybeans. It is recommended that all grain and legume research be transferred to IAR, with Ibadan serving mainly as a substation for legume research.[55] It is further recommended that Badeggi be expanded into the national headquarters for rice research with new substations in the Derived Savannah zone.[56] The newly established national rice research headquarters at Badeggi should be developed into a semiautonomous research institute. The marginal suitability of Ibadan as NCRI headquarters implies that crop research programs will have to be pursued by NCRI. Operationally, this implies that there should be a limit to further growth of the NCRI headquarters. Short of relocating the headquarters, NCRI is perhaps the station that most needs to be decentralized. Given its present statutory commodity research responsibilities, relocation should be seriously

Table 28—Distribution of agricultural research institutes by ecological zone, 1979

Zone	Area of Zone	Main Stations	Substations
	(square kilometers)		
Sahel	20,812	0	0
Sudan	241,800	1	10
Northern Guinea	231,000	6	5
Southern Guinea	174,200	0	4
Plateau	n.a.	1	3
Derived savannah	n.a.	0	2
Rain forest	25,537	10	15
Freshwater swamp	n.a.	0	1
Mangrove swamp	n.a.	0	0

Source: Figures supplied by the National Science and Technology Development Agency.
Note: "n.a." means not available.

Table 29—Suitability of agricultural research institutes headquarters by crop, 1968/69 to 1974/75

Institute	Nearest Three States to Headquarters	Crop	Index Location of Suitability
			(percent)
IAR	Kaduna, Kano, Sokoto	Groundnuts	65.60
		Sorghum	55.14
		Millet	50.29
		Melons	7.35
		Benniseed	15.65
NCRI	Oyo, Ondo, Ogun	Maize	40.75
		Rice	35.10
		Beans	3.95
		Soybeans	0.00
		Sugarcane	...
NRCRI	Imo, Anambra, Cross River	Yams	22.80
		Cassava	29.49
		Cocoyams	65.98
NIFOR	Bendel, Ondo, Imo	Palm kernels (1969–71)	56.40
RRIN	Bendel, Ondo, Imo	Rubber	...
NIHORT	Oyo, Ogun, Ondo	n.a.	...
CRIN	Oyo, Ogun	Cocoa (1968/69–70/71)	90.05
NAPRI[a]	Kaduna, Kano, Sokoto	Cattle	n.a.
NVRI[a]	Plateau, Kaduna, Bauchi	Cattle	n.a.
NITR[a]	Kaduna, Niger, Plateau	Cattle	n.a.

Note: The full names of the institutes listed in the table are as follows: Institute for Agricultural Research (IAR), National Cereals Research Institute (NCRI), National Root Crops Research Institute (NRCRI), Nigerian Institute for Oil Palm Research (NIFOR), Rubber Research Institute of Nigeria (RRIN), National Institute for Horticultural Research (NIHORT), Cocoa Research Institute of Nigeria (CRIN), National Animal Production Research Institute (NAPRI), National Veterinary Research Institute (NVRI), and National Institute for Trypanosomiasis Research (NITR).

[a] Though indexes of suitability are not available, indications are that the locations of livestock research institutes in Kaduna State are suitable.

[55] The International Institute for Tropical Agriculture (IITA) would also be suitable if there were sufficient national control over its research program.

[56] The World Bank Mission recommended that Ibadan be the site for the Federal Department of Agricultural Research, citing the infrastructural facilities at Ibadan, and the complementarities with other institutions of higher learning. The Mission did not concern itself with the relationship of Ibadan to the main producing areas or the fact that Moor Plantation actually became by default, as seen earlier, a seat of the Federal Department of Agricultural Research.

considered at the highest policymaking levels.

Recent demonstrations by NCRI researchers of consistently higher maize yields in the Derived Savannah and Guinea ecological zones than in the rain forest zones reemphasize the need for decentralization of NCRI maize research. It is ironic that the Derived Savannah and Southern Guinea zones, which are traditionally referred to as the food granary of the country, do not have a single research institute and only 6 of 40 substations.

These zones also span the "Middle Belt" traditionally considered an area with enormous potential for food. Neglect of the Middle Belt in the old political setup of the Northern Region may be reflected by IAR. There is only one operational station in the Derived Savannah and Southern Guinea ecological zones combined. Although the Middle Belt is a major producer of yams, IAR has only a nominal research program on roots and tubers. And yet its mandate is to "conduct research into all aspects of agriculture in northern Nigeria."

The first two completely food-oriented agricultural development projects sponsored jointly by the federal government and the World Bank are located in Ayangba and Lafia in the Middle Belt. These heavily emphasize roots and tubers, confirming the potential of the belt as a main food-producing area. Two more projects are proposed for Bida (Niger State) and the Ilorin area (Kwara State).

Umudike is clearly suitable for cocoyam research, but a location more central to Benue, Plateau, and Kwara would have been more suitable for yam and cassava studies. Also, Umudike is far removed from other related institutions. This reemphasizes the urgent need to shift focus of rice, maize, yam, and cassava research to the Middle Belt.

Because of the enormous potential for dry-season vegetable and fruit production in the northern states, where large irrigation schemes are planned, the major crop headquarters of NIHORT should be sited in that area. It is also recommended that the states bear part of the costs of applied horticultural research.

CRIN and RRIN are located in major tree crop producing areas. But the link between CRIN, RRIN, and the university system urgently needs strengthening. More data are needed for firm judgments on locational suitability of FRIN and NIFOR.

The original choice of Lagos as headquarters of NSPRI was based on its work on storage problems of agricultural produce destined for export through Lagos port. This location is now unsuitable in view of the projected reduction of agricultural exports and increased emphasis on storage of food crops. It is recommended that the headquarters of NSPRI be moved to some central food-producing ecological zone where storage research can have more relevance for the small-scale farmer. The research emphasis on bulk storage is premature. For the next decade at least, most of the marketable surplus of farm produce will be stored by millions of farmers in small-scale, on-farm storage facilities.

The location of NAPRI is suitable. What is required is adequate funding so that it can improve its research program, attract competent scientists, and decentralize. The locations of NITR and NVRI also appear suitable, but it is recommended that a special task force be established to look into the possibility of merging some of the livestock research institutes. It would appear that substantial economies could result.

The locations of KLRI and LCRI are, of course, predetermined. It is hoped, however, that these, together with NIOMR, can map out a comprehensive program so that the country will not have as many fishery research institutes as there are lakes. Otherwise, new institutes will have to be established on completion of the Lokoja and Shiroro Dams, large man-made lakes now under construction.

AERLS is the only federally funded autonomous research institute devoted solely to extension. Its mandate is to assist Guinea, Sudan, and Sahel States in their agricultural extension programs. In practice, AERLS provides the link between research and farmers in the 10 northern states that constitute the former Northern Region. AERLS was made autonomous mainly to give it freedom to criticize IAR research. Because of lack of money and trained staff, it is recommended that no new AERLS units be established. Rather, institutes should reinforce their AERLS sections to ensure that research is oriented to practical problems and real needs.

Research Institutes and the University System

The need for a close working relationship between the agricultural research institutes and faculties of agriculture of Nigerian universities has been under discussion for a long time. Following a meeting of the deans of the faculties of agriculture and veterinary medicine of Nigerian universities and directors of research institutes on February 7, 1977, a number of areas of cooperation were identified. These were visiting by scientists, honorary appointments, the use of facilities of institutes by graduate students, joint seminars and workshops, joint use of scientific equipment, training of intermediate staff by the universities, joint research programs, and short-term exchanges of staff.

The matter has not advanced much beyond this point. Yet, countries in which research stations and institutes are associated with faculties of agriculture with large postgraduate programs often have very successful research systems. To think that research institutes such as NRCRI, NCRI, and NIHORT can make sustained breakthroughs without active cooperation with universities is probably an illusion. Much of the success of the IAR has been due to its relationship with Ahmadu Bello University.[57] It is recommended that Nigeria merge the European concept of a research institute and the American concept of the land grant system. Nigeria has tried to use both of these systems in parallel fashion and has ended up with the worst of both. The faculties of agriculture in Nigerian universities are supposed to train people to do research at the agricultural research institutes but have very limited exposure to the problems and opportunities at the institutes. On the other hand, the institutes do not have access to the talent in the universities.

The problem posed by this duality was implicitly recognized in the Research Institutes (Establishment) Order of 1975, which gave Ahmadu Bello University control of NAPRI. But the order made no provision for formal links between the remaining institutes and the university system. It is recommended that agricultural research at the institutes and the faculties of agriculture and veterinary medicine in Nigerian universities be integrated. These institutions should maintain separate legal identities but jointly conduct research and share facilities. Unless this step is taken, exhortations of the need for cooperation will amount to mere platitudes.

Delivery of Research Results

To effectively transmit research results to farmers requires a knowledge of the traditional production system from a technical as well as a behavioral viewpoint, an understanding of the new research recommendations of the institutes, research into the most efficient and effective methods of communicating with farmers, the ability to conduct on-the-spot adaptive and verification research and to transmit findings to institutes, and the ability to train farmers and those who work directly with them.

A national approach to agricultural extension and the delivery of agricultural research results is needed. The federal government now funds and controls all the agricultural research institutes. The 1963 Constitution does not define responsibility for agricultural extension, but traditionally it has been headed by the states.

It is recommended that the federal government take over all schools for training agricultural extension personnel, and establish schools of agriculture in all ecological zones with the provision that such schools be formally linked with the main stations and substations of the research institutes in the zone. The latter recommendation would ensure integration of agricultural research, training, and extension. The extension services should have a core of subject matter specialists who can effectively handle the two-way communication between institute researchers and farmers.

[57] The Kansas team that arrived at Ahmadu Bello University in 1963/64 to advise on the establishment of a new faculty of agriculture recommended that, although IAR and the Ahmadu Bello faculty of agriculture should maintain their separate legal standings, they should share facilities and responsibilities. This recommendation, which was adopted, has worked admirably. It is recognized, however, that research institutes in other parts of the world have performed well without significant formal links with the university system. Examples are CIMMYT and IRRI.

APPENDIX 1

ABBREVIATIONS OF THE NAMES OF ORGANIZATIONS

AERLS	Agricultural Extension and Research Liaison Services
ARCN	Agricultural Research Council of Nigeria
ARTS	Agricultural Research and Training State
CIMMYT	International Maize and Wheat Improvement Center
CRIN	Cocoa Research Institute of Nigeria
ECGC	Empire Cotton Growing Corporation
ENMA	Eastern Nigerian Ministry of Agriculture
FAO	Food and Agriculture Organization of the United Nations
FDAR	Federal Department of Agricultural Research
FDFR	Federal Department of Forestry Research
FMST	Federal Ministry of Science and Technology
FRIN	Forestry Research Institute of Nigeria
IAR	Institute for Agricultural Research
IAR&T	Institute of Agricultural Research and Training
IITA	International Institute for Tropical Agriculture
IRRI	International Rice Research Institute
KLRI	Kainji Lake Research Institute
LCRI	Lake Chad Research Institute
LRIN	Leather Research Institute of Nigeria
MWMANR	Mid-West Ministry of Agriculture and Natural Resources
NAFPP	National Accelerated Food Production Program
NAPRI	National Animal Production Research Institute
NCRI	National Cereals Research Institute
NIFOR	Nigerian Institute for Palm Oil Research
NIHORT	National Institute for Horticultural Research
NIOMR	Nigerian Institute for Oceanography and Marine Research
NITR	Nigerian Institute for Trypanosomiasis Research
NRCRI	National Root Crops Research Institute
NSPRI	Nigerian Stored Products Research Institute
NSTDA	National Science and Technology Development Agency
NVRI	National Veterinary Research Institute
RRIN	Rubber Research Institute of Nigeria
UNDP	United Nations Development Program
UNESCO	United Nations Economic and Social Council
WACRI	West African Cocoa Research Institute
WAIFOR	West African Institute for Oil Palm Research
WAITR	West African Institute for Trypanosomiasis Research
WNMANR	West Nigerian Ministry of Agriculture and Natural Resources

APPENDIX 2

SUPPLEMENTARY TABLES

Table 30—Rice varieties recommended by the National Cereals Research Institute, 1954/55 to 1976

Variety	Areas of Production
Shallow Swamp Rice with Water 4½–5 months	
FARO-1 (1954/55); FARO-2 (1957) to replace FARO-1	Kaduna–southern Zaira, Bauchi, Gongola states
FARO-5 (1960)	Bauchi, Borno
FARO-8 (1963)	Kaduna River basin, Abakaliki, Ogoja Zone
FARO-9 (1963)	Areas with water for 7 months
FARO-10 (1963)	Low temperatures on plateau around Jos
FARO-12 (1963): an improvement over FARO-8 because it is a nonlodging stiff-strawed variety	Kaduna River basin, Abakaliki, Ogoja Zone
Shallow Swamp and Irrigated Areas	
FARO-13 (1970)	Northern states
FARO-15, responsive to nitrogenous fertilizer	Kaduna River basin, Abakaliki, Ogoja Zone
FARO-19 (1974)	Kadawa, Katsina-Ala, Diep, Longkart, Bakura, Yau, South Chad, Borno
FARO-20, moderately resistant to blast	Niger
FARO-21 (1974), highly nitrogen-responsive and high-yielding	Kaduna River basin
FARO-22 (1974), early maturing and nonlodging	Kaduna, Katsina-Ala
FARO-23 (1974), high-yielding and nonlodging	Abakaliki, Ogoja, Niger, Kaduna River basin
FARO-24 (1974), very good grain quality	Worno, Yau, Ngala
Upland Rice	
FARO-28 (1958)	

Source: Figures supplied by the National Cereals Research Institute.

Table 31—Articles cited in *Abstracts on Tropical Agriculture* by crop and institutional affiliation, 1972 to 1977

Crop	CRIN	ARTS/NRCRI	NIFOR	RRIN	IAR	IAR&T	FDAR/NCRI	FDFR/FRIN
Tree crops	64	...	...	...	2	...	...	...
Cereals	...	1	...	...	27	...	9	...
Fibers	...	...	1	...	15	...	...	...
Roots and tubers	...	...	...	...	1	1	4	...
Vegetables	...	1	...	...	7	2	...	...
Livestock and inputs[a]	...	...	...	...	18	...	2	...
Fruits and nuts	5	...	...	...	2	...	...	...
Oils, fats, and waxes	...	...	11	2	2	...	...	...
Forests	...	...	...	...	...	...	1	2
Grain legumes	...	1	...	...	20	7	7	...
General agriculture	1	...	...	...	36	1	1	...
Total	70	3	12	2	130	11	24	2

Source: Material from *Abstracts on Tropical Agriculture*, various issues.

Note: The full names of the institutes listed in the table are as follows: Cocoa Research Institute of Nigeria (CRIN), Agricultural Research and Training State/National Root Crops Research Institute (ARTS/NRCRI), Nigerian Institute for Oil Palm Research (NIFOR), Rubber Research Institute of Nigeria (RRIN), Institute for Agricultural Research (IAR), Institute of Agricultural Research and Training (IAR&T), Federal Department of Agricultural Research/National Cereals Research Institute (FDAR/NCRI), and Federal Department of Forestry Research/ Forestry Research Institute of Nigeria (FDFR/FRIN).

[a] Shika Farm, the nucleus of the National Agricultural Products Research Institute, was part of IAR until 1965. The "livestock-inputs" classification employed by *Abstracts on Tropical Agriculture* may appear clumsy.

Table 32—Articles cited in *Abstracts on Tropical Agriculture* by discipline and institutional affiliation, 1972 to 1977

Discipline	CRIN	ARTS/NRCRI	NIFOR	RRIN	IAR	IAR&T	FDAR/NCRI	FDFR/FRIN	Total
Biology	33	...	5	1	24	5	9	...	77
Chemistry	1	...	...	...	...	1	1	...	3
Geography	...	...	...	...	5	...	...	...	5
Engineering	...	...	...	...	1	...	...	...	1
Animal husbandry	...	...	...	...	12	...	1	...	13
Soil science	1	...	1	...	15	...	1	1	19
Water resources	...	...	...	...	5	...	...	...	5
Environmental science	...	...	...	...	2	1	...	...	3
Crop operations	2	1	...	...	12	1	3	...	19
Crop damage	8	2	2	...	10	2	3	...	27
Crop protection	7	...	...	1	15	...	4	...	27
Fertilizers	5	...	...	...	8	1	1	...	15
Product constituent	4	...	...	...	1	...	...	...	5
Product technology	3	...	...	...	3	...	...	...	6
Socioeconomics	5	...	2	...	13	...	1	1	22
General	1	...	2	...	4	...	...	...	7

Source: Material from *Abstracts on Tropical Agriculture*, various issues.

Note: The full names of the institutes listed in the table are as follows: Cocoa Research Institute of Nigeria (CRIN), Agricultural Research and Training State/National Root Crops Research Institute (ARTS/NRCRI), Nigerian Institute for Oil Palm Research (NIFOR), Rubber Research Institute of Nigeria (RRIN), Institute for Agricultural Research (IAR), Institute of Agricultural Research and Training (IAR&T), Federal Department of Agricultural Research/National Cereals Research Institute (FDAR/NCRI), and Federal Department of Forestry Research/Forestry Research Institute of Nigeria (FDFR/FRIN).

Table 33—Senior scientific man-years and proposed research projects, Institute for Agricultural Research, 1977/78

Project	Senior Scientific Man-Years[a]	Projects/Subprojects	Projects Per Scientific Man-Year
Socioeconomics	22.50	57	2.53
Cotton and other fibers	7.15	13	1.82
Cereals	14.00	14	1.00
Groundnuts and oilseeds	8.05	37	6.41
Grain legumes	3.75	34	9.07
Horticultural crops	6.70	37	5.52
Cropping systems	8.10	14	1.73
Soil fertility and nutrition	20.00	34	1.70
Agricultural mechanization	12.00	29	2.42
Irrigation research	24.00	65	2.71

[a] A senior research scientist is a scientist with enough research experience or other qualifications to place him on or above Grade Level 10.

Table 34—Senior research staff members and research projects, National Cereals Research Institute, 1976/77

Program	Projects	Senior Research Staff	Projects Per Research Member
Rice	116	12	9.67
Maize	69	16	4.31
Cowpeas	65		8.90
Soybeans	21	10	
Other legumes	3		
Cropping systems	12	10	1.20
Soil fertility	10	[a]	2.50
Pasture agronomy, crop processing, and utilization	14	2	7.00
Agricultural mechanization	16	...	...
Economics	5	...	...
Statistics	4	...	...
Sugarcane	17	2	8.50
NAFPP	9	5	1.80

Notes: The senior research staff is the ROI or those with postgraduate credentials. The National Cereals Research Institute makes a list of projects that is incredibly long when compared with the number of people on its staff. Either this list is meant to impress or mislead its readers or it includes many deadwood projects. Even the number of projects for each member of the research staff is misleading because each staff member works on more than one project. Had this data been put in equivalent man hours, the work load would have seemed much higher.

The NAFPP is the National Accelerated Food Production Program.

[a] Researchers working on soil fertility are listed under crop nutrition.

Table 35—Research staff turnover rates for selected agricultural research institutes, various years

Discipline	IAR 1962/63 to 1967/68	IAR 1967/68 to 1977/78	FDAR/NCRI 1967/68 to 1973/74	NIFOR 1963/64 to 1973/74
			(percent)	
Agronomy	66.67	66.67	12.50	100.00
Botany	57.14	80.00		
Cotton breeding	40.00	100.00		
Pathology	50.00	60.00	25.00	
Crop physiology	100.00			
Entomology	71.43	80.00	20.00	
Soil science chemistry	60.00	100.00	60.00	100.00
Soil survey	71.43	60.00		
Animal husbandry and grassland	100.00			
Agricultural engineering	100.00			
Plant breeding			20.00	66.67
Statistics/information			100.00	
Agricultural economics		100.00		

Notes: The rate of research staff turnover (I_j) is defined as:

$$\left[\sum_{i=1}^{k} N_{ji,t-n} - \sum_{i=1}^{k} N_{ji,t}\right] \Big/ \sum_{i=1}^{k} N_{ji,t-n} \times 100,$$

where N_i stands for the i^{th} individual researcher whose value is set equal to 1 if he is on the job or 0 if he has left the research institute; j stands for the discipline, commodity program, or department; k stands for the number of researchers; t stands for the time period; and n is some chosen time interval.

The full names of the institutes listed in the table are as follows: Institute for Agricultural Research (IAR), Federal Department of Agricultural Research/National Cereals Research Institute (FDAR/NCRI), and Nigerian Institute for Oil Palm Research (NIFOR).

Table 36—Allocation of research resources to various research programs, Institute of Agricultural Research, 1975/76 to 1978/79

Program Research Station	1975/76 Senior Scientific Man-Years	1975/76 Percentage of All Scientific Man-Years	1976/77 Senior Scientific Man-Years	1976/77 Percentage of All Scientific Man-Years	1977/78 Senior Scientific Man-Years	1977/78 Percentage of All Scientific Man-Years	1978/79 Senior Scientific Man-Years	1978/79 Percentage of all Scientific Man-Years	Mean Percentage 1975/76 to 1977/78	Percentage Share of Financial Resources to All Programs 1978/79[a]
Cereals					14.0	6.56	n.a.	n.a.	6.56	5.17
Cotton and fibers	8.0	11.80	7.0	8.71	7.2	3.35	8.2	5.26	7.95	
Groundnuts and oilseeds	6.1	8.97	8.9	10.97	8.1	3.77	9.8	6.29	7.90	2.27
Grain legumes	4.4	6.47	3.4	4.21	3.8	1.76	3.8	2.42	4.15	1.37
Agricultural Research Station, Kano	0.5	0.74	0.5	0.62	8.0	3.75	8.0	5.16	1.70	
Irrigation Research Station, Ngala	0.5	0.74	0.5	0.62	4.0	1.87	4.0	2.58	1.08	
Horticultural crops	5.1	7.50	5.1	6.32	6.7	3.14	8.4	5.39	5.65	2.18
Cropping systems	5.0	7.35	5.0	6.20	8.1	3.80	14.6	9.42	5.78	3.78
Socioeconomic and extension	18.5	27.20	21.5	26.65	22.5	10.55	21.5	13.87	21.47	4.56
Soil fertility and soil nutrition	10.5	15.44	12.5	15.49	20.0	9.37	20.6	13.25	13.43	5.95
Food science and technology project	0.9	0.13	2.8	3.47	3.1	1.43	6.1	3.90	1.68	
Agricultural mechanization	5.5	8.09	10.5	13.02	12.0	5.62	5.0	4.34	8.91	3.35
Irrigation research					24.0	11.25	24.0	15.48	11.25	3.23
Termite project	3.0	4.41	3.0	3.72	4.1	1.90	4.1	2.61	3.34	2.35
Irrigation Research Station, Bakwa					4.0	1.87	3.0	1.94	1.87	
Agricultural Research Station, Yandev					5.0	2.34	4.0	2.58	2.34	
Agricultural Research Station, Mokwa					9.0	4.82	9.0	5.81	4.22	
Total	68.0	100.0	80.7	100.0	163.6	100.0	154.1	100.0		40.41

Source: Institute for Agricultural Research, *Approved Research Programmes 1977/78, 1978/79* (Samaru: IAR, 1978).

Note: The figures for 1975/76 to 1977/78 are the approved figures. The figures for 1978/79 are proposals. "n.a." means not available.

[a] In addition to the figures listed in this column, 40.41 percent was allocated for administration.

Table 37—Annual average share of cotton production by contributing state, various years

State	1948 to 1952	1955 to 1959	1963 to 1967
		(percent)	
Kaduna[a]	57.62	42.26	35.17
Sokoto	34.44	26.39	14.23
Bauchi	5.85	17.00	15.48
Others	2.84	14.39	34.61

Source: The basic data for 1948-52 are from Nigeria, Northern Region, Department of Agriculture, *Annual Report 1952/53* (Kaduna: Northern Region, Department of Agriculture, 1954). The data for 1955-67 are from Herbert C. Kriesel, *Cotton Marketing in Nigeria*, Consortium for the Study of Nigerian Rural Development report No. 24 (East Lansing, Mich.: Michigan State University, 1969).

[a] Location of Samaru Research Station.

Table 38—Annual average share of groundnut production by contributing state, various years

State	1952 to 1956	1958 to 1962	1963 to 1967
		(percent)	
Kano[a]	50.34	47.47	49.51
Sokoto	10.77	12.47	12.63
Plateau, Kaduna	18.35	17.73	14.93
Bauchi, Bornu, and Gongola	20.26	21.75	22.10
Niger, Benue, and Kwara	0.39	0.57	0.74

Source: Basic data from Herbert C. Kriesel, *Marketing of Groundnuts in Nigeria*, Consortium for the Study of Nigerian Rural Development report No. 19 (East Lansing, Mich.: Michigan State University, 1969).

[a] Location of groundnut research station.

Table 39—Fertilizer trials on food and export crops in Northern Nigeria, 1952 to 1961

Crop	Number of Fertilizer Trials	Percentage of Trials by Crop	Estimated Annual Area	Percentage of Area by Crop	Average Annual Crop Area Per Trial
			(hectares)		(hectares)
Sorghum	87	13.59	3,189,375	36.63	36,659
Millet	8	1.25	3,240,000	37.22	405,000
Groundnuts	186	29.06	894,321	10.27	4,808
Cotton	23	3.59	477,090	5.48	20,743
Yams	90	14.06	370,980	4.26	4,122
Cassava	28	4.38	352,755	4.05	12,598
Rice	59	9.22	138,105	1.59	2,341
Soybeans	46	7.19	47,385	0.54	1,030
All export crops	300	46.88	1,418,796	16.30	4,729
Food crops	340	53.12	7,287,215	83.70	21,433
All crops	640	100.00	8,706,011	100.00	13,603

Table 40—Research investigations classified by crops and sections, Institute for Agricultural Research, 1962/63

Crop/Research Staff	Agronomy	Botany	Crop Protection	Crop Physiology	Chemistry and Soils	Total
Groundnuts	12	15	11.0	1	1	40.0
Sorghum	27	7	2.0	2	...	37.0
Millet	12	1	...	...	...	13.0
Wheat	...	1	...	...	...	1.0
Barley	...	1	...	...	...	1.0
Grain legumes	...	...	1.0	...	...	1.0
Horticultural crops	...	4	...	...	...	4.0
Maize	12	...	...	...	...	12.0
Yams	5	...	...	...	...	5.0
Soybeans	4	3	...	...	...	7.0
Sesame	2	4	2.0	...	...	8.0
Cotton	13	23	8.0	1	...	45.0
Sunflowers	...	5	...	...	...	5.0
Castor	...	1	...	...	...	1.0
Total	87	65	25.0	3	1	180.0
Research staff	3	13[a]	9.0	1	15[b]	
Number of research investigations per research staff member	29	5	2.8	3	General	4.4

Source: Material in Institute for Agricultural Research, *Annual Report 1962/63* (Samaru: IAR, 1964).

Notes: Research at the Mokwa and Kano substations was reclassified by research discipline. Entomology and pathology have been combined in this table into "crop production."

[a] This figure includes five cotton breeders.

[b] This figure includes seven soil survey research staff members.

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