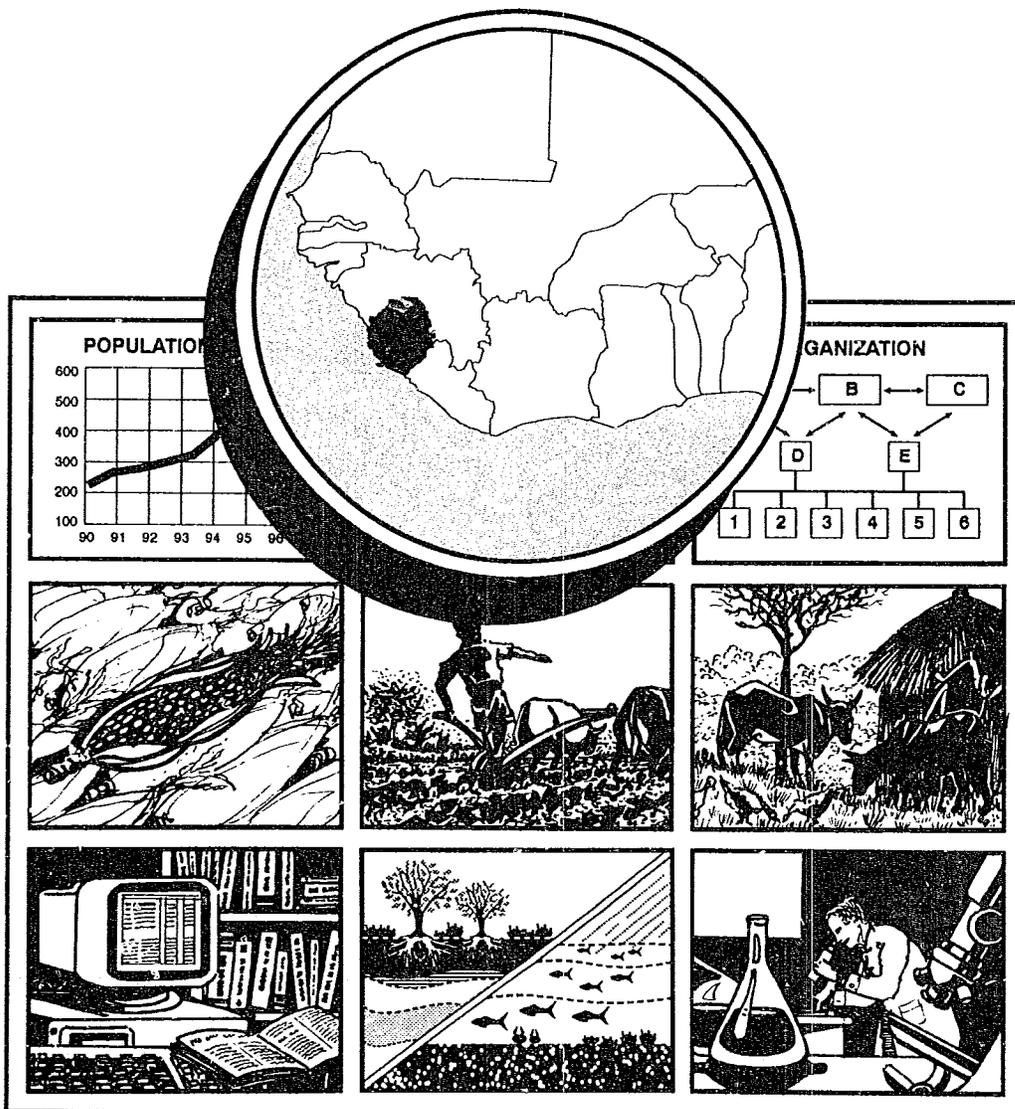


# Linking Science and the Farmer: Pillars of the National Agricultural Research System in Sierra Leone

M. T. Dahniya



The mandate of the International Service for National Agricultural Research (ISNAR) is to assist developing countries in bringing about lasting improvements in the performance of their national agricultural research systems and organizations. It does this by promoting appropriate agricultural research policies, sustainable research institutions, and improved research management. ISNAR's services to national research are ultimately intended to benefit producers and consumers in developing countries and to safeguard the natural environment for future generations.

ISNAR offers developing countries three types of service, supported by research and training:

- For a limited number of countries, ISNAR establishes long-term, comprehensive partnerships to support the development of sustainable national agricultural research systems and institutions.
- For a wider range of countries, ISNAR gives support for strengthening specific policy and management components within the research system or constituent entities.
- For all developing countries, as well as the international development community and other interested parties, ISNAR disseminates knowledge and information about national agricultural research.

ISNAR was established in 1979 by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force. It began operating at its headquarters in The Hague, The Netherlands, on September 1, 1980.

ISNAR is a nonprofit, autonomous institute, international in character and apolitical in its management, staffing, and operations. It is financially supported by a number of the members of the CGIAR, an informal group of donors that includes countries, development banks, international organizations, and foundations. Of the 18 centers in the CGIAR system of international centers, ISNAR is the only one that focuses specifically on institutional development within national agricultural research systems.

STUDY PAPER # 10

**Linking Science and the Farmer:  
Pillars of the National  
Agricultural Research System  
in Sierra Leone**

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**M. T. Dahniya**

***isnar***

International Service for National Agricultural Research  
1993

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### **AGROVOC Descriptors**

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case studies; management; organization of research; research; research policies; technology transfer; Sierra Leone

### **CABI Descriptors**

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agricultural research; case studies; management; organization of research; research; research policy; technology transfer; Sierra Leone

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# *ISNAR Small-Country Project*

## Introduction

In 1989, ISNAR began a global study of agricultural research systems in small, low-income developing countries with populations of fewer than five million people. Because of resource limitations and the inherent constraint of size that restrict the scale of the research effort in these countries, their national agricultural research systems (NARS) are small — often under 50 researchers. Nonetheless, these NARS have varied and complex tasks to perform in their respective countries.

The major goals of this study are to identify the strategic role of NARS in small countries and to determine how essential research tasks can be carried out in small research systems. Several

cases are to be examined in depth, and for these, the study will assess the research capacity and resources that are currently available or needed to conduct agricultural research. This is examined in light of their mandates under the agricultural development policy of their respective countries, as well as requirements for conserving the country's natural resource base.

The project is funded largely by the Italian Government with additional support from the Rockefeller Foundation, the Danish International Development Agency (DANIDA), and the CTA (Technical Centre for Agricultural and Rural Cooperation, ACP-EC Lomé Convention).

## Objectives

- To create and maintain a data base on 50 small countries, containing information on their agricultural research needs and national agricultural research systems.
- To devise means of measuring and classifying key factors related to agricultural research so that the NARS of small countries can be analyzed and compared. Such factors include agroecological zones, the scale of research systems (e.g., human and financial resources, sizes and types of institutes, types and quantity of local research programs), internal demand for technology, external sources of information on new technologies, and linkages to those sources.
- To identify suitable organizational models for NARS, as well as mechanisms and strategies for setting priorities and allocating resources to research.
- To evaluate national and regional research environments so as to help small countries exploit opportunities for acquiring new technologies from outside.
- To identify and assess mechanisms that enable NARS to manage their links with policy-makers, local producers, and external sources of knowledge and technology.
- To identify the skills needed by small-country research leaders to manage the alternative strategies open to them.

# Project Activities

## A Global Data Base on NARS in Small Countries

Fifty developing countries are included in a global data base on agricultural research needs and the state of the NARS. These countries have populations of less than five million (1980 census) and meet at least three of the following four criteria:

- The economically active agricultural population is 20 percent or more of the total economically active population.
- Per capita income is less than US\$2,000 (1980 US constant dollars).
- AgGDP per capita for the economically active agricultural population is less than US\$2,000.
- AgGDP is 20 percent or more of GDP.

For each country, this information will be used to assess the national demand for research as well as existing national research capacity. The data base should provide cross-country indicators of common constraints, options, and trends.

## Country Case Studies

Honduras, Jamaica, Sierra Leone, Togo, Lesotho, Mauritius, and Fiji have been selected for in-depth study. The studies cover institutional development, research organization and structure, external linkages, and information flows to the country.

## Regional Studies

Regional studies will be conducted in parts of West Africa, the Caribbean, and the South Pacific. The goal of the regional studies is to assess research capacity in regions where small countries predominate. The regional studies will also identify mechanisms and strategies by which national systems can increase their effectiveness and efficiency and gain access to the information and technology they need. The studies will consider the division of labor between NARS in a regional context as well as the role of regional research organizations and collaborative networks.

## Methods and Concepts

The ISNAR project will develop methods for analyzing research needs and capacity in small countries. These will identify key issues and employ the following concepts:

- **Scale:** the inherent research capacity of a national system: the combination of a NARS's human and financial resources, knowledge base, and infrastructure.
- **Scope:** the institutional agenda of a NARS, the set of research topics and objectives to which it is committed. Scope has two dimen-

sions: the range of research programs and the level of sophistication of the research.

- **Technology Gradients and Information Flows:** the varying intensities and levels of complexity in technology generation among national systems and the network of information exchange. An analysis of structure and levels of technology generation and transfer in a region is crucial for guiding the flow of information to smaller research systems. The study of gradients and flows also examines the capacity NARS must have in

place to have access to the technology and information they need.

- **Linkages:** linkages to institutions and systems outside the NARS itself. The study will explore two key sets of linkages that are

essential for the national agricultural research system. The first includes linkages to policymakers and to farmer knowledge systems in the country. The second includes linkages to external sources of knowledge, technology, and resources.

## Managing Scientific Information

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**I**n collaboration with the CTA (Technical Centre for Agricultural and Rural Cooperation, ACP-EC Lomé Convention) and agricultural research information specialists from developing countries, a study is underway to explore the management of scientific information in small research systems with limited resources.

Access to scientific information that is relevant to the development of objectives and appropriate to the conditions of developing countries is crucial for agricultural research systems. It is particularly critical in small countries because the resources to do all the research that farmers need are not always available. The scope of

research in a country can be increased through effective information management. Information can also be used to supplement or replace some kinds of research, releasing scarce resources to be used for programs that must be conducted locally.

NARS in small countries are often limited in their ability to identify and receive the information they need to conduct adaptive and resource management research. This study will assess and propose mechanisms for identifying and obtaining scientific information for research programs in small countries. It will then focus on mechanisms of managing this information.

## Dissemination of Results

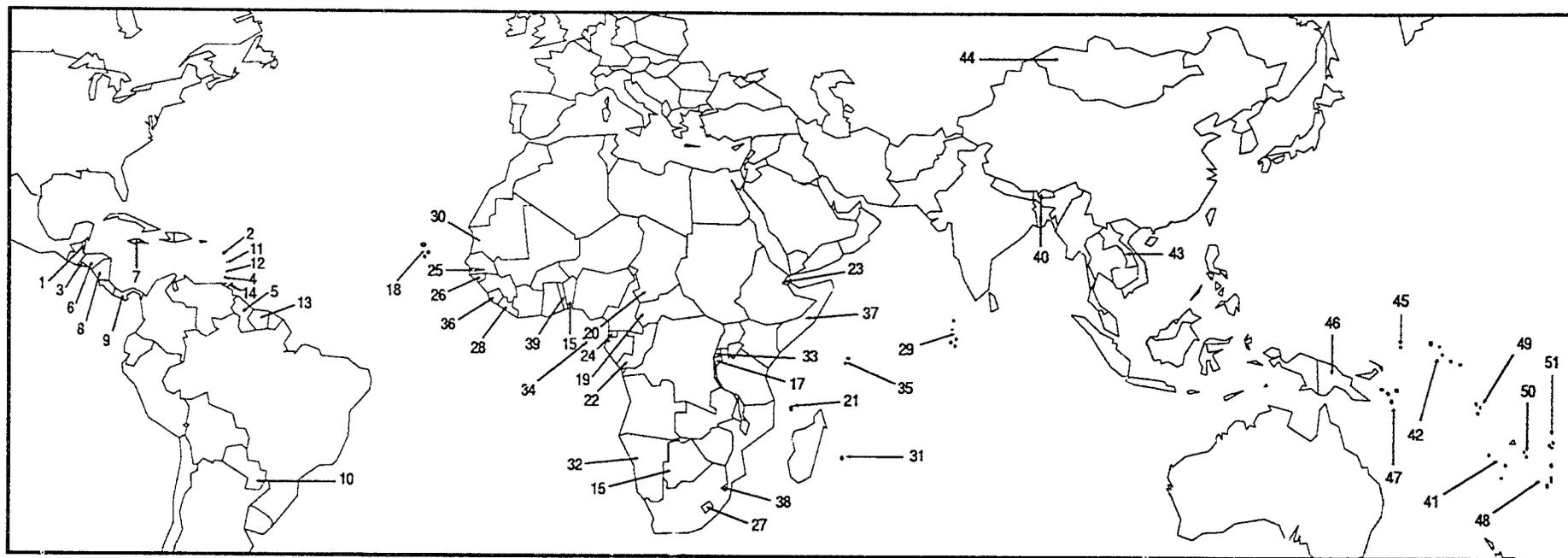
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**Seminars/Workshops:** Workshops are the key to disseminating the results of this study. The first workshop, held in The Hague in January 1990, reviewed project methodology and began implementation of country and regional studies. When the main phase of the study is complete, a global workshop of research leaders from small developing countries will be held. At this workshop, the conclusions of the study will be validated and applied.

**Advisory Service and Training:** In collabora-

tion with national and regional agricultural research organizations, the methods developed in the study will be used for strategic planning and to produce improved management techniques for small research systems.

**Publications:** The data base, case studies, and issues papers will be published and made available to agricultural research managers, scientists, and development agencies concerned with agricultural growth and sustainability in developing countries.



**Small Countries (as Defined by this Project)**

**Latin America and Caribbean:**

- 1 Belize
- 2 Dominica
- 3 El Salvador
- 4 Grenada
- 5 Guyana
- 6 Honduras
- 7 Jamaica
- 8 Nicaragua
- 9 Panama
- 10 Paraguay
- 11 St. Lucia
- 12 St. Vincent
- 13 Suriname
- 14 Trinidad and Tobago

**Africa and the Indian Ocean:**

- 15 Benin
- 16 Botswana
- 17 Burundi
- 18 Cape Verde
- 19 Central African Republic
- 20 Chad
- 21 Comoros
- 22 Congo
- 23 Djibouti
- 24 Equatorial Guinea
- 25 Gambia
- 26 Guinea-Bissau
- 27 Lesotho
- 28 Liberia
- 29 Maldives
- 30 Mauritania
- 31 Mauritius
- 32 Namibia
- 33 Rwanda
- 34 Sao Tome e Principe
- 35 Seychelles
- 36 Sierra Leone
- 37 Somalia
- 38 Swaziland
- 39 Togo

**Asia and the Pacific:**

- 40 Bhutan
- 41 Fiji
- 42 Kiribati
- 43 Laos
- 44 Mongolia
- 45 Nauru
- 46 Papua New Guinea
- 47 Solomon Islands
- 48 Tonga
- 49 Tuvalu
- 50 Vanuatu
- 51 Western Samoa

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## Abstract

Sierra Leone is a small West African country with a long and distinguished history of research dating back to the early part of the 20th century. This study discusses the institutional evolution of the national agricultural research system (NARS) and its current scale and scope. Institutionalized research is focused on rice and tubers. Notable achievements have been made by the Rice Research Station at Rokupr and the Institute of Agricultural Research at Njala in improving the productivity of these global staples. The study also considers the prospects for extending the scope of national research to cover other domains such as nontraditional high-value exports and traditional agricultural exports (coffee and cocoa). It concludes that institutionalized efforts in these domains should be kept small in scale and should make the most of existing technologies in the region and the initiative of the private sector in technology transfer. In the case of socioeconomic and rural engineering research as well as research on natural resource management, there is potential for closer coordination to support the research capacity within the Planning, Evaluation, and Monitoring Services and the Land and Water Development Divisions of the Ministry of Agriculture, Natural Resources, and Fisheries. The Faculty of Agriculture at Njala and the Institute of Marine Biology and Oceanography of the University of Sierra Leone are important contributors to research on natural resource management and socioeconomics. The Faculty of Agriculture could also help fill the gap in livestock research. Increasingly, Sierra Leone has had to rely on ad hoc research efforts by nongovernmental organizations and development projects. This creates a greater need for policy coordination and has added to the expectations placed on the National Agricultural Research Coordinating Council. The study discusses options that would avoid building more or larger institutions which the country cannot afford. Instead, policy and program coordination among existing institutes and activities is proposed. The NARS is participating in a plethora of networks and is involved in plans for increased collaboration with other NARS in West Africa as well as international research centers in the region. This provides opportunities but it also creates management problems for institutions with small numbers of staff. This study examines ways that these regional opportunities can be managed to contribute to the national research capacity, which in turn can produce results in specific areas that would benefit the region as a whole.

## Résumé

La Sierra Leone est un petit pays de l'Afrique de l'Ouest qui a une longue et distinguée histoire de la recherche, dont l'origine remonte à l'aube du XX<sup>e</sup> siècle. La présente étude retrace l'évolution de son système national de la recherche agricole (SNRA) et en examine l'envergure et la portée actuelles. La recherche menée en institution porte essentiellement sur le riz et les tubercules. Les travaux accomplis à la Station de recherche sur le riz à Rokupr et à l'Institut de recherche agricole de Njala ont abouti à des résultats remarquables sur le plan de l'amélioration de la productivité de ces cultures vivrières de base. Cette étude de cas comporte aussi une analyse des possibilités d'étendre la portée de la recherche nationale pour y inclure des produits d'exportation non traditionnels, de haute valeur, ainsi que des cultures d'exportation traditionnelles, tels le café et le cacao. En conclusion de cette analyse il est recommandé de ne pas développer la recherche en institution relative à ces produits et de tirer profit au maximum des technologies présentes dans la région et des initiatives déployées par le secteur privé pour assurer le transfert de technologie. Quant à la recherche socio-économique ou relative au génie agricole, et à celle qui porte sur la gestion des ressources naturelles, il y a moyen, en renforçant les mécanismes de coordination, d'améliorer la capacité de recherche qui existe au sein des Services de Planification, d'Evaluation et de Suivi et du Département pour le Développement des Eaux et des Terres du Ministère de l'Agriculture, des Ressources Naturelles et des Pêches. La Faculté d'Agriculture à Njala et l'Institut de Biologie Marine et d'Océanographie de l'Université de Sierra Leone apportent une contribution importante à la recherche sur la gestion des ressources naturelles et à l'étude des aspects socio-économiques. Par ailleurs, la Faculté d'Agriculture pourrait augmenter ses activités de recherche pour combler les lacunes dans le domaine de la zootechnie. La Sierra Leone a vu croître sa dépendance de travaux de recherches entrepris de manière *ad hoc* par des organisations non gouvernementales et sous forme de projets de développement, situation qui nécessite une bonne coordination au niveau des politiques nationales et renforce ainsi les attentes vis-à-vis du Conseil National pour la Coordination de la Recherche Agricole. L'étude présentée ici contient l'analyse d'une série d'options qui, au lieu de prévoir une multiplication d'institutions de recherche ou l'établissement d'instituts plus importants — que le pays n'est pas en mesure de financer, visent plutôt une coordination des politiques et des programmes des instituts en place et des activités existantes. Le SNRA fait partie d'une multitude de réseaux et participe à l'élaboration de plans pour intensifier la collaboration avec d'autres SNRA de l'Afrique de l'Ouest, de même qu'avec les centres de recherche internationaux présents dans la région. Ces liens avec l'extérieur ouvrent certes des perspectives mais, pour des institutions aux effectifs réduits, ils créent aussi des problèmes sur le plan de la gestion. La présente étude cherche à déterminer comment gérer ces différentes collaborations régionales au profit de la capacité de recherche nationale qui, elle, à son tour, pourra produire des résultats spécifiques dont pourra bénéficier la région tout entière.

# Resumen

Sierra Leone es un país pequeño en África Occidental con una larga y distinguida tradición de investigación agrícola desde sus comienzos al inicio del siglo veinte. Este estudio presenta la evolución institucional del sistema nacional de investigación agropecuaria (SINIA) y la escala y el enfoque de sus actividades. Las instituciones de investigación trabajan principalmente sobre el arroz y raíces y tubérculos. Los logros de la Estación de Investigación Arrocería de Rokupr y el Instituto de Investigación Agrícola de Njala han contribuido para aumentar la productividad de estos productos básicos. Este estudio de caso también analiza las perspectivas para expandir el alcance de la investigación para cubrir otros dominios como los productos no-tradicionales de alto valor, los productos de exportación tradicionales, como el café y el cacao. Se concluye que los esfuerzos públicos en estos dominios deberían mantenerse a una escala reducida, y se debería aprovechar las oportunidades de transferir tecnologías y conocimientos existentes en la región. Para tal fin el sector privado sería indicado para tomar la iniciativa. En los casos de la investigación socioeconómica y de ingeniería rural, y de la investigación sobre el manejo de los recursos naturales, existe la potencial para una coordinación más estrecha con fines de reforzar la capacidad de investigación que existe dentro de los Servicios de Planificación, Evaluación, y Seguimiento y de la División de Desarrollo de Tierras y Recursos Hídricos del Ministerio de Agricultura, Recursos Naturales y Pesca. La Facultad de Agronomía de Njala e el Instituto de Biología Marítima de la Universidad de Sierra Leone contribuyen a la investigación en recursos naturales y socioeconomía. La Facultad de Agronomía podría aumentar sus actividades de investigación para cubrir la falta de investigación sobre pecuaria. Sierra Leone ha tenido que depender cada vez más de las actividades *ad hoc* de investigación llevados a cabo por las ONG's y los proyectos de desarrollo. Esta situación ha creado una mayor necesidad para establecer una coordinación a nivel nacional y por lo cual se espera que el Consejo Nacional para la Coordinación de la Investigación Agropecuaria pueda reforzar su capacidad de manejo al nivel de las políticas de investigación. El estudio analiza las opciones que evitarían la creación de instituciones de investigación nuevas o más grandes que el país no podría financiar o mantener. En vez del crecimiento institucional, se propone una coordinación más eficiente entre las instituciones y actividades existentes. El SINIA está involucrado en muchas redes de investigación y la colaboración con otros países y centros internacionales tiende a crecer en África Occidental. Las oportunidades que ofrecen las redes y actividades colaborativas con otras instituciones han creado problemas para el manejo de institutos pequeños. El estudio examina opciones para que estas actividades al nivel regional contribuyan a la capacidad de investigación nacional, que podría en turno producir resultados para el beneficio de la región en general.

# Acronyms

|         |  |
|---------|--|
| ACRE    | Adaptive Crop Research and Extension Project                       |
| ADB     | African Development Bank   |
| AFNETA  | Alley Farming Network for Africa                                   |
| ASSP    | Agricultural Sector Support Project                                |
| BADEA   | Banque Arabe de Développement Economique en Afrique                |
| CIMMYT  | Centro Internacional de Mejoramiento de Maíz y Trigo               |
| CORAF   | Conférence des Responsables de Recherche Agronomique Africains     |
| CSD     | Cropping Systems Development Project                               |
| EEC     | European Economic Community  |
| GRP     | Green Revolution Program   |
| GTZ     | Gesellschaft für Technische Zusammenarbeit                         |
| IAR     | Institute of Agricultural Research                                 |
| IADP    | integrated agricultural development project                        |
| IBRD    | International Bank for Reconstruction and Development (World Bank) |
| ICLARM  | International Center for Living Aquatic Resources Management       |
| ICRISAT | International Center for Research in the Semi Arid Tropics         |
| IDRC    | International Development Research Center (Canada)                 |
| IFAD    | International Fund for Agricultural Development                    |
| IITA    | International Institute of Tropical Agriculture                    |
| IMBO    | Institute of Marine Biology and Oceanography                       |
| IRRI    | International Rice Research Institute                              |
| LWDD    | Land and Water Development Division                                |
| MANRF   | Ministry of Agriculture, Natural Resources and Fisheries           |
| NARCC   | National Agricultural Research Coordinating Council                |
| NUC     | Njala University College   |
| PEMSD   | Planning, Evaluation, and Monitoring Services Division             |
| RRS     | Rice Research Station at Rokupr                                    |
| UNDP    | United Nations Development Program                                 |
| USAID   | United States Agency for International Development                 |
| WAFSRN  | West Africa Farming Systems Research Network                       |
| WAIFOR  | West African Institute for Oil Palm Research                       |
| WARDA   | West Africa Rice Development Association                           |

# Introduction

This study of agricultural research in Sierra Leone has several purposes. One is to reconsider some of the widely held assumptions about the role and functions of agricultural research in small West African countries. Another is to examine the organizational options and policies that are available to build an effective agricultural research system in a country with severe financial constraints and an unstable policy environment.

Recent news has focused on the decline in Sierra Leone's economy and administrative structure. This small country has been transformed from one of West Africa's more developed countries, in terms of resources and income per capita, to one of the poorest. But even in the midst of all this, the research institutions have continued to function, strengthening their linkages to producers and generating useful technologies.

Sierra Leone's significance in agricultural research and development is larger than its economic size. It has a comparatively long history and a distinguished tradition of scientific research in agriculture. Many of the early agricultural research activities in British West Africa were based in Sierra Leone, and later, many Sierra Leonean nationals were prominent in the development of an indigenous research capacity in West Africa (Richards 1986). It was this noteworthy tradition of research and the significance of its contributions to food production in West Africa that led to the selection of Sierra Leone as a case study for this project. Sierra Leone also offers an excellent opportunity to analyze several key management issues that face agricultural research in a small country.

It has been widely argued that research systems in small countries will do less technology generation and more technology transfer. This, however, raises several policy and management questions which must be addressed. The first concerns the management and delineation of research and technology-transfer functions. Second is the research capacity that is needed to support effective technology transfer. Third is how essential research functions can be supported, managed, and monitored when they are intertwined with rural development and technology transfer.

One way to understand the distinctive functions of national agricultural research systems in small countries is to determine the relative importance of research *management* functions in relation to research activities, or *experimentation*. In Sierra Leone, the research system has moved closer to the farmer, which has led to a blending of research and extension tasks. This has been an important way for research organizations to increase their impact on farmers (Ewell 1990). The increased knowledge of farming systems and farmers' situations has enabled the research institutions to become more selective in their scanning and screening of external technologies — a strategy that has not been without problems. Notably, while the close integration of research and extension activities has been positive as a way to orient research towards clients, it has created problems for the management and monitoring of research activities.<sup>1</sup>

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1. See Eponou (1990) for a more complete discussion of issues relating to research linkages with technology transfer.

Experience in other agricultural research systems in West Africa suggests that the national agricultural research systems (NARS) in small countries should "devote a higher percentage of resources to external and internal linkages than to 'research'" (Gilbert and Sompo-Ceesay 1990: 166). These linkages to producers, to technology transfer, and to sources of knowledge are another key area in which the Sierra Leone experience provides several useful lessons.

The overall composition and coordination of national research systems in small countries is another issue addressed in this study. It is often assumed that small research systems are less complex than large ones and therefore have less need for national coordinating councils such as those found in the larger NARS of India, Pakistan, or the Philippines. In Sierra Leone, however, the research policy formulation, coordination, and monitoring functions have become more important as the country has come to rely on a plurality of institutions, departments, and projects to carry out research. In such a case, the need for a high-level coordinating council is self-evident.

The creation of a National Agricultural Research Coordinating Council (NARCC) has been Sierra Leone's response to these problems. This case study explores the roles that such a body should play in setting national research policy and coordinating the activities of diverse research units. Furthermore, it assesses the council's ability to provide a common focus to the cooperating institutions and a forum where the comparative advantages of different research organizations, faculties, and projects can be established.

The involvement of the Faculty of Agriculture at Njala University College in re-

search is another interesting feature of the research system. This has been more important than just the contribution of needed scientific personnel — the link between the research institutes and the university has created a favorable environment for research, especially by providing a model for conditions of service and management that has been applied to all the research components under the NARCC umbrella.

Networks are another means by which Sierra Leone's research organizations gain access to knowledge as well as technology and resources. These external links are promising, but they can be costly in time and they may not deliver the information or technology that is most appropriate to the country's needs. This study shows where improved management is needed in order to get the greatest benefit from these external sources.

New regional initiatives are brewing in West Africa. Some of these are focused around key staple food crops like rice and cassava; others focus on the broad ecoregions that cut across the West Africa. In both areas, Sierra Leone would occupy a central role in a regional system of technology generation. The implications that this kind of involvement might have on the NARS of a small country are considered here.

Finally, this case study identifies areas where research in Sierra Leone has produced technologies that have had an impact both in the country and throughout the region. This regional impact is not what is usually expected from a small research system, but it does illustrate how a NARS in a small country can use its well-focused programs and strong linkages to make significant research contributions.

# Agricultural Policies and Production

Although agriculture is the largest sector in Sierra Leone's national economy, employing about 70% of the total work force, it only accounts for 30% of gross domestic product (GDP) and contributes some 30% to 40% of export earnings. The contribution of agriculture to the GDP began to decline in the late 1970s, and since 1979/80 the estimated real value of production has declined by an average of 3.7% per year. Production decreases of 20% for husked rice and 49% for coffee from 1980 to 1984 are indicative of this trend. This decline is mainly attributable to counterproductive government pricing policies and a lack of marketing facilities, which have acted together as powerful disincentives to increased production.

The basic policy objective for agricultural development is to achieve self-sufficiency in food crops, especially rice, and to optimize the production of export crops. Government policies and institutional structures reflecting these policies have undergone major changes over the last two decades.

In 1972, policies were based on seven donor-supported integrated agricultural development projects (IADPs). The failure

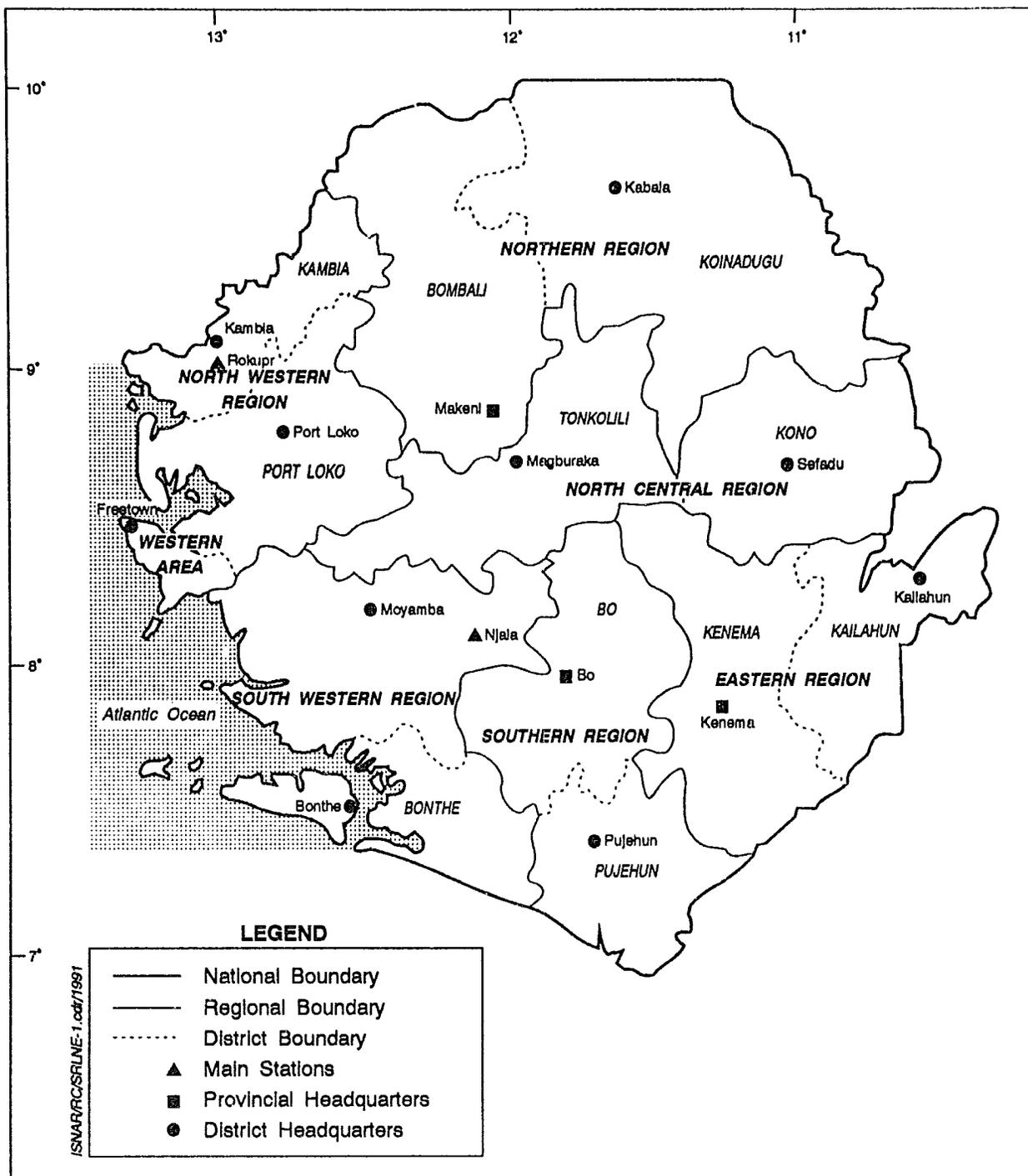
of these projects to achieve the desired results was partly due to weak supporting government structures, inadequate government budgetary support, and very difficult agronomic conditions for which there were few technological packages available. Following their failure, the IADPs were integrated into the Ministry of Agriculture, Natural Resources and Forestry (MANRF). In the early 1980s, MANRF was reorganized into a decentralized structure with field operations coordinated by staff in the Agricultural Sector Support Project (ASSP) (figure 1).

Realizing that the agricultural sector will be the principal focus of growth in the foreseeable future, MANRF formulated a Green Revolution Program (GRP) in 1986. This was intended to accelerate the national drive towards food self-sufficiency and economic recovery. It was conceived as a program of national survival, one that would revolutionize agricultural production by both feeding the people and producing a farm surplus for export. The ASSP was discontinued when World Bank funding was suspended, and the GRP failed to take off, primarily because of inadequate financial resources.

## Food Security

The GRP and the IADPs have been the key features of government policies to promote food security. From a research viewpoint, these commendable objectives and programs were not easy to implement. The GRP was intended to intensify production of rice — the principle staple food crop in the country. The technology was

available and the Rokupr Rice Research Station did a great deal of work to develop and adapt technologies that were suited to local swamps. However, most of the subsistence farmers could not afford the increased inputs of capital, technology, and labor that the GRP required. Another factor was the increasing reliance on im-



**Figure 1. Sierra Leone: Ministry of Agriculture, Natural Resources and Forestry regional administrative boundaries**

ported rice and food aid to feed the cities. Low prices in the towns neither encouraged farmers to produce a surplus for the market nor enabled them to cover the investments that intensive rice cultivation required. The dramatic increases that were required to reverse declines in productivity and attain self-sufficiency re-

quired investments in research, infrastructure, and policy incentives that government was unable to provide. No other sources of investment appeared.

The IADPs were aimed not at single crops or technologies but at whole farming communities and regions. Hence, they had to

accommodate the complex needs and farming systems of most subsistence producers. But local development required local infrastructure and services that a fiscally impoverished government could not afford in the middle to late 1980s. When donor funding for the administration and infrastructure of these projects came to an end, there were no national institutions able to assume the responsibility and costs. The IADPs began to fade.

The technologies required by the IADPs were varied and difficult to generate — they had to address the complex needs of several farming systems with a diversity of crops. A systems approach would have worked better, but this was clearly beyond the scale of the two small research institutes that were organized around research on staple commodities such as rice, maize, beans, and tubers (the Institute of Agricultural Research [IAR] and the Rice Research Station at Rokupr [RRS]).

### **Crop Production**

Most farmers practice shifting cultivation and produce a wide variety of crops under predominantly rainfed conditions. These include cereals, root and tuber crops, tree crops, food legumes, and vegetables. Cocoa and coffee are grown for export; the others are mainly for local consumption. Other crops grown include rice, maize, sorghum, millet, cassava, sweet potatoes, yams, cocoyams, mangoes, oranges, oil palms, groundnuts, beans, cowpeas, peppers, okra, garden eggs (*Solanum melongena*), tomatoes, and local spinach (*Amaranthus* spp. or *Hibiscus sabdariffa*).

Crop yields per unit land are quite low (table 1). Food crop production in Sierra Leone is in the hands of small-scale farmers who produce enough for home consumption with little or nothing for market. They are generally constrained by a lack of necessary resources, except perhaps land. Low-yielding local crop varieties are widely grown, and fertilizers and other inputs are rarely used.

**Table 1. Production of Crops in Sierra Leone, 1990**

| Crop                  | Area (ha) | Total Production (mt) |
|-----------------------|-----------|-----------------------|
| Rice (paddy)          | 330,000   | 450,000               |
| Maize                 | 17,000    | 12,000                |
| Sorghum               | 9,000     | 21,000                |
| Sweet potatoes        | 6,000     | 14,000                |
| Cassava               | 38,000    | 118,000               |
| Groundnuts (in shell) | 28,000    | 20,000                |
| Palm Kernels          | —         | 33,000                |
| Coffee (green)        | 32,000    | 9,000                 |
| Cocoa beans           | 50,000    | 9,000                 |
| Millet                | 18,000    | 23,000                |
| Taro                  | 5,000     | 28,000                |
| Tomatoes              | 3,000     | 22,000                |
| Plantain              | —         | 28,000                |
| Citrus                | —         | 71,000                |
| Palm oil              | —         | 50,000                |

Source: FAO Statistics Division.

Eighty-five percent of farmers produce rice. The varieties, methods of culture, and yields vary considerably among the different types of rice ecologies — uplands, inland valley swamps, tidal mangrove swamps, *bolilands*,<sup>2</sup> and deep-flooding grasslands. Total rice production for 1986 was estimated at 525,000 mt. Net rice imports increased from 4,100 mt in 1961 to 265,000 mt in 1971. At present, the country is importing well over 100,000 mt of rice annually.

Sixty to seventy percent of the total rice area in the country is upland rice planted by small farmers practicing shifting cultivation. Due to the growing population and increasing pressure on land, the fallow and cropping cycles have been drastically reduced in many areas, which has led to declining soil fertility and crop yields. A system of land management that allows intensive use of the land but at the same time maintains a relatively stable level of

2. These are extensive, seasonally flooded, grassy depressions typically found throughout the riverine coastal plains of Sierra Leone.

agricultural production is urgently needed.

Government policy over the years has been to encourage lowland rice cultivation, which gives much higher yields, and to discourage the use of the uplands for rice cultivation. In spite of this policy, farmers, particularly in the southern parts of the country, have been reluctant to practice lowland rice culture. Some of the reasons for this are that they cannot intercrop on the lowlands, initial swamp land preparation is difficult and expensive, farmers cannot earn extra cash as they do from the wood obtained during the slash-and-burn operations in the uplands, and there are waterborne diseases associated with swamp rice cultivation.

Cassava and sweet potatoes are the second and third most important food crops in Sierra Leone after rice. These and other root crops play a vital role in alleviating famine by providing sustained food supplies even when other crops fail. When the price of rice is beyond the means of many Sierra Leoneans, as it is at present, cassava and sweet potatoes have been life-savers to many people.<sup>3</sup>

In spite of the obvious advantages of root and tuber crops, research and development (R&D) on them seems to have been neglected. One reason for this is that root and tuber crops are generally regarded as inferior to rice. People believe that there is an inverse relationship between root crop consumption and standard of living. Most Sierra Leoneans are ashamed to disclose that they have eaten any of the root and tuber crops as a full day's meal. Another reason is that the government has been importing large quantities of rice and selling it at subsidized prices, which discour-

3. FAO production data have been used for comparative purposes. Based on local experience, however, it is believed that paddy rice production has been overestimated and the production of upland rice, tuber crops, and other noncommercial food crops has been significantly underestimated.

ages farmers from producing either rice or the root and tuber crops that are adapted to local conditions.

The major constraints on production of other crops include plant diseases and pests, the use of low-yielding varieties, weeds, poor cultural practices, low fertilizer use, the unavailability of planting material for some crops, storage losses, high labor requirements, poor soils, and inadequate postharvest practices.

### ***Livestock Production***

Nutrition surveys have shown that most Sierra Leoneans consume livestock products (cattle, goats, pigs, and poultry) in small amounts and on an irregular basis (table 2). The main constraints to livestock production in Sierra Leone include

- lack of feed;
- limited veterinary services;
- poor animal housing;
- few improved breeds of animals;
- weak extension services;
- poor animal husbandry techniques.

**Table 2. Livestock Population in Sierra Leone, 1990**

| Type    | No. of Head |
|---------|-------------|
| Cattle  | 330,000     |
| Sheep   | 330,000     |
| Goats   | 180,000     |
| Pigs    | 50,000      |
| Poultry | 6,000,000   |

Source: Hunting Technical Services (1979) and FAO animal production and health paper 67/2 (1987).

Despite the gravity of the problem, little R&D has been undertaken in the area of animal production and animal health. Since the crop sector is so dominant in agricultural production in the country, policymakers have not paid much attention to livestock development. This is unfortunate, given the high potential for growth in production with relatively modest investments in R&D. Improvements in

animal production techniques, particularly with small ruminants and poultry, could contribute a great deal to the incomes of small farm households, as well as reducing the high cost of animal products for urban dwellers.

The distribution of cattle throughout the country varies greatly with time and location, depending on the availability of water, the grazing potential of different regions, and a combination of socio-economic factors. Cattle are largely managed under the traditional extensive pasture regimes of the Fula<sup>4</sup> communities, with considerable seasonal migration in search of pastures and fodder.

There appears to be no systematic method for rearing sheep; they roam about in almost all villages. The animals are hardy and can withstand the nutritional stress imposed by the dry season. They are prolific breeders and their turnover rate is high. There is no organized marketing system for mutton. The animal is eaten mostly at festivities, and it is raised to have on hand for such occasions.

Goats also roam around villages, virtually as scavengers, and are exceptionally hardy. Like sheep, they are used mostly for festivities and sacrifices. Goats are sold live because there is no organized system for selling the meat to consumers.

The pig industry is commercialized to some extent in the western area of the country as well as in the principal towns in the provinces. Local breeds of pigs can be seen roaming around villages in the provinces. The local pig (West African dwarf pig) is a small and thickset breed, very hardy and prolific. The litter size is very high, but piglet mortality is also high, probably because of poor management. Lack of feed is the major constraint to raising improved breeds of pigs in Sierra

Leone. There is virtually no piggery in the northern province because it is inhabited primarily by Muslims.

The limited availability of day-old chicks is one of the major constraints to increased poultry production. At present, there are only a few functional hatcheries, and the demand for day-old chicks is higher than the supply. The other constraint to poultry production is the high cost of feed, which makes poultry products very expensive.

### *Fisheries*

Fish constitute about 70% of the national consumption of animal protein and is also the cheapest source of protein. The supply comes from both coastal marine and fresh or inland waters. Aquaculture is also practiced on a limited scale. The tropical Atlantic provinces account for the bulk of the catch for the fishing industry.

Fishing is carried out by large-scale commercial organizations such as the Sierra Fishing Company, as well as small commercial fisheries controlled by local fishermen. Both national and foreign fleets are involved in tapping fish resources in the coastal waters. Most of the industrial fishery's catch is exported and the rest is consumed locally. In 1983, total fish production was 146,000 mt, of which 51,000 mt was caught by large domestic fisheries and 95,000 mt was foreign.

The artisanal fishery used to produce more fish than the industrial fisheries, but this trend has now been reversed because of the increasing numbers of industrial fishing vessels. The artisanal fishery has great potential, especially in the freshwater fisheries. Of the country's nine major rivers, only three have been fully exploited for fishing. Approximately 1000 mt of fish are taken annually from the nation's freshwater sources, compared to a total artisanal catch of over 45,000 mt. The artisanal fishery is underdeveloped and constrained by a lack of

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4. This is a large ethnic group with a strong pastoral tradition. Subgroups of the Fula are also found in other West African countries. Variations of the name are Peul, Fulbe, and Fulani.

facilities for preserving the catch at sea, inadequate processing and storage techniques, lack of all-weather feeder roads, and the absence of a well-coordinated marketing network.

Freshwater fish farming in ponds is at a rudimentary stage of development but has great potential for boosting the incomes of small farmers. This is especially true for those farmers who can integrate their rice farming with aquaculture.

## The Demand for Research

The research system in Sierra Leone has had to respond to a series of diverse demands from the agricultural sector over the years. In the 1980s, agricultural policies based on large-scale development programs needed "systems" approaches. In the 1990s, the research system has had to maintain its systems approaches and disciplinary strengths, as well as moving to cope with the natural resource management challenges posed by growth in the forestry, fisheries, and mining sectors.

Traditional demands for research fall into two main areas: one is to introduce new technologies that raise the productivity of major cultivated crops; the other is to raise the lot of the farmer by improving the overall production environment. Both sets of demands are perhaps unrealistic given the size of the agricultural research system in Sierra Leone. What did emerge from the policy initiatives of the 1980s was an appreciation of the fact that if increased productivity were to be achieved, it would be through increases in the overall productivity of the farming systems of the mass of poor farmers. Breakthroughs in single commodities, in single technologies, and in a single region were not enough — a comprehensive systems approach was needed.

Another feature of the demand for research is the virtual disappearance of export crops over time. The revitalization of traditional export crops should begin with socioeconomic and marketing research on the feasibility of such a revival, as well as research on new technologies to sup-

port producers. Previous research on export crops such as rubber, coffee, and cocoa was done within a regional framework. This made such research investments more justifiable for a small country like Sierra Leone.

New ways to revitalize research on export crops need to be found, without incurring the costs of major research installations that the export sector could not sustain. Nontraditional export crops hold some potential, but the key to developing this area is socioeconomic research and market intelligence. Major developments will need to wait for improvements in the transport and marketing infrastructure.

Natural resource management, including forestry and fisheries, is an area where a great deal of work is needed. Fisheries, the most lucrative area in the food and agriculture sector, have had little research on production and resource management on which to base sustainable exploitation and growth. Forestry is also a major resource without a matching research effort. Sierra Leone contains some of the last remaining expanses of forests on the Upper Guinea Coast of West Africa. This resource is valuable and threatened. Research is needed to advise policy on the its best use and to propose strategies for its sustainable development.

Mining is a major industry in Sierra Leone and it has major impacts on the resources used in agriculture. Natural resource research can contribute a great deal to monitoring the effects of mining on the

agricultural environment, and it can contribute to the restoration of lands and water supplies, as well as to the identification of new agricultural production techniques and systems for communities that are displaced by the extensive mining operations in the south of the country.

All of these are important development objectives that deserve research support. Where and how this research capacity will be institutionalized are key questions that must be addressed.

## Agricultural Research in Sierra Leone

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### Institutional Evolution and Framework

Formal agricultural research in Sierra Leone began with the establishment of the Njala Experiment Station in 1910. In its initial stages, research was focused on soils, varieties of tropical crops, pigs and poultry, plant and animal diseases, and insect pests. A livestock (later veterinary) station was established at Teko in the Northern Province in 1942, and later, in 1948, the Musalia Livestock Station was established. Both stations were responsible for research on ruminants — mainly cattle, sheep, and goats.

In the 1950s, the British Colonial Government upgraded the Oil Palm Station at Njala into a research station as part of the West African Institute for Oil Palm Research (WAIFOR) which had its headquarters in Nigeria. When Ghana and Nigeria became independent in 1958 and 1960, WAIFOR's components were incorporated into their NARS, and Sierra Leone was left to manage the Oil Palm Station on its own. It has suffered a steady decline ever since and at present very little if any research is done.

During the colonial period, other traditional export crops (cocoa and coffee) also received research attention. At indepen-

dence in April 1961, some of the colonial researchers stayed on but there was almost a complete exodus five years later. Although the research system had some experienced technicians, there was a severe shortage of trained and experienced local researchers. Research on the traditional export crops of West Africa has lain dormant ever since.

Today, the most important centers for agricultural research in Sierra Leone are the Institute of Agricultural Research (IAR) located at Njala and the Rice Research Station (RRS) in Rokupr (table 3, figure 2). Some research is also carried out at Njala University College and at Fourah Bay College, two of the three constituent colleges of the University of Sierra Leone. The Land and Water Development Division (LWDD) and the Planning, Evaluation, Monitoring and Services Division (PEMSD) of the ministry of agriculture also conduct some research (table 4). Figure 3 provides an overview of the organization of research in Sierra Leone.

In April 1985, the Sierra Leone Cabinet approved the establishment of a National Agricultural Research Coordinating Council (NARCC). Its mandate was to set

**Table 3. Distribution of Staff in Crop Research: Rice Research Station and Institute of Agricultural Research**

| Institution Station                       | Number of Researchers |           | Technicians |
|---|-----------------------|-----------|-------------|
|   | Full-time             | Part-time |             |
| <i>Rice Research Station</i>              |                       |           |             |
| Rokupr (H.Q.)                             | 19                    | 0         | 82          |
| Makeni                                    | 1                     | 0         | 2           |
| Bo  | 1                     | 0         | 2           |
| Blama                                     | 0                     | 0         | 2           |
| Gbomsamba                                 | 0                     | 0         | 2           |
| Mange                                     | 0                     | 0         | 2           |
| <i>Institute of Agricultural Research</i> |                       |           |             |
| Njala (H.Q.)                              | 16                    | 20        | 9           |
| Rokupr                                    | 1                     | 0         | 6           |
| Makeni                                    | 1                     | 1         | 10          |
| Kabala                                    | 2                     | 0         | 8           |
| Njala Zone                                | 1                     | 0         | 9           |
| Kenema                                    | 1                     | 0         | 6           |
| Magbosi                                   | 1                     | 0         | 6           |
| Total                                     | 44                    | 21        | 146         |

agricultural research policy, determine research priorities, and coordinate research activities so that they maximize the use of scarce resources and strengthen research linkages with extension. Specific functions include the following:

- providing information to the government to assist it in formulating agricultural policy and considering agricultural, scientific, and technological advances affecting the use and conservation of the nation's renewable natural resources;
- managing and coordinating existing re-

search institutions and advising the government on the establishment of new stations;

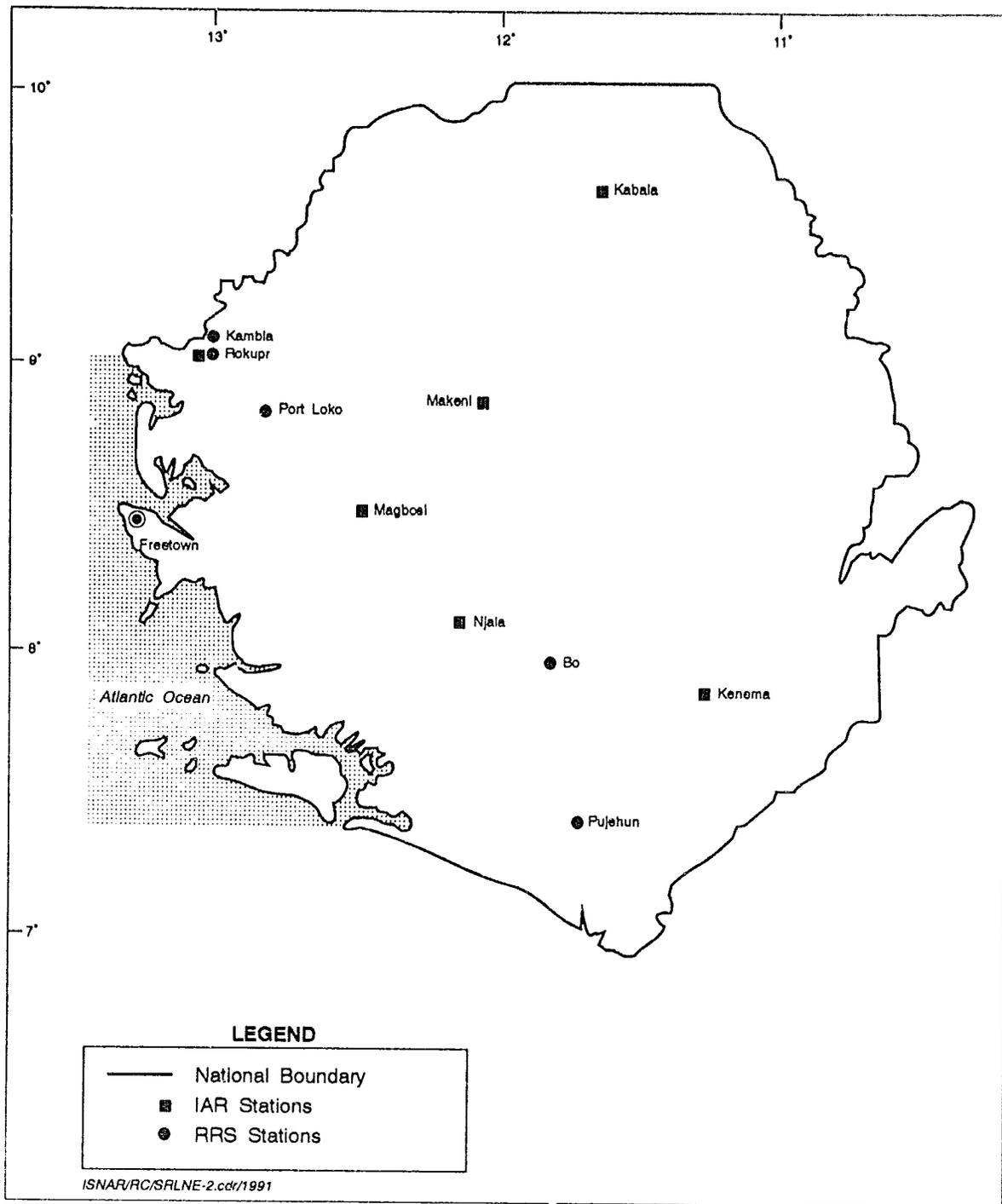
- establishing a research-extension link;
- diffusing technology;
- overseeing training in agriculture and related areas.

For several years, NARCC remained dormant, meeting only a few times from its inception until 1989, when it was reactivated with the appointment of a full-time chairman. In February 1992, NARCC was again reconstituted with a part-time chairperson and a research coordinator as chief executive of the secretariat.

### **Rice Research Station, Rokupr**

The RRS at Rokupr was established in 1934 for research on rice, the staple food crop of the country. Early work was confined to the mangrove swamp areas but was later extended to cover the uplands, the inland valley swamps, the bollands, and riverine grasslands. RRS has had several changes in mandate and administra-

tion: from 1934 to 1953, it was administered by the Colonial Department of Agriculture, focusing largely on Sierra Leone. Between 1953 and 1962, it became the West African Rice Research Station for all of British West Africa, reverting to the Sierra Leone Ministry of Agriculture at independence in 1962. In 1964, it was



**Figure 2. Areas of field operations of Institute of Agricultural Research (IAR) and Rice Research Station (RRS)**

incorporated into the Faculty of Agriculture at Njala University College. In 1971, it reverted to the Ministry of Agriculture once again as a semiautonomous institution with its own board of management.

Most of the physical facilities, which include laboratories and housing, were con-

structed in the 1930s and early 1940s. None of the laboratories have the necessary scientific equipment, so almost all research is restricted to field work. There is a severe shortage of field equipment, and the existing threshing and drying areas are also totally inadequate. Buildings need extensive repairs and mainte-

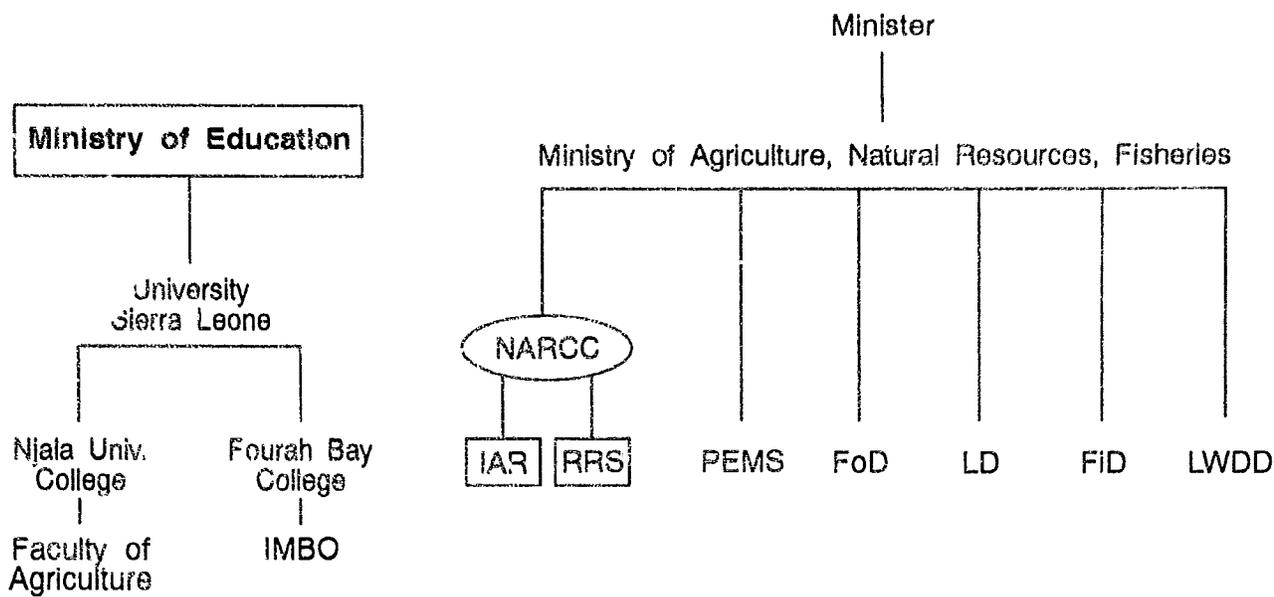
**Table 4. Research Institutions in Sierra Leone**

| Institution  | Researchers |                 |     |     |     |       |        | Expenditures |                                |                 |
|--|-------------|-----------------|-----|-----|-----|-------|--------|--------------|--------------------------------|-----------------|
|  | Year        | Total           | PhD | MSc | BSc | Tech. | Expat. | Year         | Leones <sup>a</sup>            | US <sup>b</sup> |
| National Agricultural Research Coordinating Council, Ministry of Agriculture, Natural Resources & Forestry (MANRF) |             |                 | 2   |     |     |       |        | 1991         | Le 12.5 million (admin. costs) | 55,436          |
| Rokupr Rice Research Station, (MANRF)  | 1991        | 21              | 4   | 13  | 4   | 92    | —      | 1991         | Le 75.0 million (80% salaries) | 332,084         |
| Institute of Agricultural Research, Njala (MANRF)  | 1991        | 24              | 1   | 13  | 10  | 54    | —      | 1991         | Le 66.0 million (76% salaries) | 292,234         |
| Institute of Marine Biology and Oceanography, University of Sierra Leone, Fourah Bay                               | 1991        |                 | 4   | 1   |     |       |        |              |                                |                 |
| <i>Total</i>   | 1991        | 45              | 11  | 27  | 14  | 146   | —      |              |                                |                 |
| <b>Other Contributors</b>  |             |                 |     |     |     |       |        |              |                                |                 |
| Faculty of Agriculture & Environmental Sciences, Njala University College  | 1991        | 30 <sup>c</sup> | 13  | 16  | 1   |       |        |              |                                |                 |
| Planning, Evaluation & Monitoring Division (MANRF)   |             | -na-            |     |     |     |       |        | 1991         | Le 10.0 million (86% salaries) | 44,278          |
| Forestry Division (MANRF)  |             | 2               |     |     | 2   |       |        |              | -na-                           |                 |
| Land and Water Development Division (MANRF)  | 1991        | 19              |     | 14  | 5   |       |        | 1991         | Le 23.0 million (74% salaries) | 101,839         |
| Ministry Division (MANRF)  | 1991        | 28              |     |     |     |       |        |              |                                |                 |

a. Amount in local currency.

b. Converted to 1987 constant dollars at market exchange rate.

c. Twenty-five percent of researchers' time is spent on research.



**Key:**  
 IMBO Institute of Marine Biology and Oceanography  
 NARCC National Agricultural Research Coordinating Council  
 IAR Institute of Agriculture

PEMS Planning, Evaluation and Monitoring Services  
 FoD Forestry Division  
 LD Livestock Division  
 FID Fisheries Division  
 LWDD Land and Water Development Division

**Figure 3. Overview of the national agricultural research system of Sierra Leone**

nance work. Not only is the library building completely unsuited for this purpose, but the range and number of recent publications in the library are inadequate and cannot service a major center for rice research in West Africa.

There is no perimeter wall around the station and there is constant trespassing by townspeople and inhabitants of nearby villages. The station's security personnel are unable to exercise much control and the institution's property is at the mercy of thieves. The roads in the station are not paved and the traffic generates a lot of dust, especially during the dry season.

The water supply system is presently being upgraded with assistance from the Japanese Government, but electrical supply is still a problem. Power is generated by the National Power Authority when diesel fuel is available, but the machines

are old and often out of order. A standby generator owned by the station is unserviceable and power is generated in the evening by a generator owned by the West African Rice Development Association (WARDA) station at Rokupr.

### **Human Resources**

A shortage of professional staff has reduced the capacity of the divisions within the station to function properly. Only four of the present staff, including the director, have Ph.Ds (table 4). The researchers at RRS have had an average of 5.4 years of work experience since acquiring their highest academic qualifications. There has been steady attrition of the more qualified research staff. Since 1980, five research assistants who were sent abroad for advanced training failed to return to the service and have since secured international jobs in various countries.

## ***Rokupr Rice Research Station's Regional Contributions***

The relationship between Rokupr and WARDA deserves special mention. WARDA is an international center with a mandate for rice research in West Africa based on partnership with national rice programs. Rokupr has the greatest concentration of scientists working on West African rice. In 1977 the two institutions entered a partnership, which over the next 13 years, produced many significant results. Rokupr's national scientists were linked to WARDA's regional program in mangrove swamp rice. Of the program's six senior

scientists, five were national program staff from Rokupr (WARDA 1988).

The blending of national and international responsibilities at Rokupr provided operating funds for the station in times of great scarcity. And the partnership was crucial in allowing the station to maintain its critical mass of rice researchers. However, with WARDA's withdrawal from Rokupr at the start of the 1990s, the country's ability to maintain this capacity has been in question. It is hoped that new mechanisms can be found to maintain this valuable concentration of expertise in West African rice research.

## **Institute of Agricultural Research, Njala**

The institute owes its origins to the Adaptive Crop Research and Extension (ACRE) Project established in 1978 by MANRF and Njala University College (NUC) with support from the United States Agency for International Development (USAID). It was conspicuous among agricultural development projects in Sierra Leone for its deliberate linkage to extension and its focus on the smallholder. It promoted a farming systems perspective within the national research and extension system.

Following the end of the ACRE project in 1987, a Cropping Systems Development (CSD) Project was designed to institutionalize a unified, national-level unit for policy-making and coordination of agricultural research and extension. The project was also intended to complete essential initial steps required to establish an adaptive research and technology diffusion program for food crops in the smallholder sector. The project did not materialize, but in March 1988 the Institute of Agricultural Research (IAR) was established at Njala using the infrastructure left by the ACRE project. IAR's primary responsibility is to conduct research

on major food crops other than rice. This includes sorghum, maize and millet, grain legumes, and tubers, along with a few horticultural crops. The institute also conducts socioeconomic and technical studies on farming systems and postharvest and production technologies.

The facilities at IAR date from the ACRE project. The buildings urgently need renovation and repair. This is also true of the office and housing furniture as well as laboratory and office equipment. A store for fertilizers, tools, and chemicals is now under construction at Njala.

Institute staff use the library at NUC. This is a great advantage for IAR, particularly for access to some of the more basic and applied scientific information that IAR needs for its work, which is oriented toward commodity and farming systems at the level of adaptive research and testing. And the library collections are stronger in socioeconomic research than could be justifiably maintained by a small research organization. Information on commodity and farming systems research is also often exchanged through various types of research networks and occasional publi-

cations, which are best maintained at IAR. For this purpose there is an urgent need to upgrade the woefully inadequate documentation center at the institute.

The experimental farm, which is adjacent to the main administrative building, has no fence, and the crops are subject to pilferage, which affects experiment results. The well-equipped laboratory is now experiencing some problems because of a lack of foreign exchange, meaning that much-needed spares and chemicals can not be procured.

The water supply system is virtually nonexistent at Njala. The administrative building and laboratory receive no running water, while the houses get no more than an hour's supply daily. The supply of water, which is pumped directly to consumers from the Tala river, is totally dependent on whether the pumping station at Njala has been supplied with diesel fuel.

Electric power, which is generated by the National Power Authority, is supplied for only five hours during the evening, which means that the institute cannot operate most of its equipment during normal working hours. Only two of the institute's three 150-kilovolt standby generators are in working condition, but they could not be operated anyway, since the government does not provide sufficient funds to cover their running costs. A smaller generator of 18.5 kilovolts is now being installed to serve the analytical services laboratory.

## **Human Resources**

The core staff of the institute is composed of a director with a PhD, 13 research officers with Master's degrees, and 10 research assistants holding Bachelor's degrees, three of whom are presently studying for their Master's degrees. The average work experience of the research staff after gaining their highest academic qualification is 3.7 years with a range of 0 to 11 years. Twenty-nine percent of the research staff is female.

The institute has an arrangement with NUC, on whose campus it is located, to commission specific research projects by university staff. There are 17 researchers with the classification of *associate scientist*; 12 of them hold PhDs and the rest have Master's degrees. In addition, there are three other associate scientists at other institutes. Two of them are faculty members of Fourah Bay College and hold PhDs; the third has a Master's degree and is on the staff of the Crop Protection Division of MANRF. The average number of years these people have been involved in agricultural research after obtaining their highest academic qualification is 6.1.

The institute has also suffered from staff turnover. Four of the staff members who received advanced degrees in the United States have left and others failed to return home. The entire staff of the analytical services laboratory left soon after the establishment of the institute for more financially rewarding jobs elsewhere.

## **University of Sierra Leone**

The University of Sierra Leone has three constituent colleges — Fourah Bay College, NUC (which has a Faculty of Agriculture), and the College of Medicine and Allied Health Sciences. NUC is the principal university-based institution contrib-

uting to agricultural research in Sierra Leone. It was established in 1964 following the pattern of the American land-grant system. It was intended to provide education at the degree and subdegree levels, conduct research on the major food

crops in the country, and extend research information to the four chiefdoms surrounding the college.

The academic and research programs in the Faculty of Agriculture are coordinated through eight academic departments: Animal Science, Agricultural Economics and Extension, Agricultural Engineering, Crop Protection, Crop Science, Certificate Training Center, Home Economics, and Soil Science. Honors and postgraduate programs were recently introduced in some departments to meet the specialized labor needs of the country. New programs in forestry and postharvest technology are envisaged in the near future.

The focus of the Faculty of Agriculture also includes basic and applied agricultural research. Through research and experimentation, it hopes to contribute to improved agricultural products as well as methods of production, processing, distribution, and utilization. It has collaborated closely with several research institutions in the country, including RRS and WARDA at Rokupr and IAR, which is located on the campus.

Although the academic qualifications of the faculty are impressive, there has been a high turnover of staff within the last decade and some departments are now grossly understaffed. The recruitment of new staff has been difficult because of the inability of national institutions to narrow the gap between local and international salaries. This problem is acute; however, the fact that Sierra Leone continues to promote a high level of training for its professionals means that the supply of national expertise is not as restricted as it might otherwise have been, given the brain drain.<sup>5</sup>

Nonetheless, the continuity of the faculty's output in teaching and research could be regarded as impressive given the constraints they face: inadequate research materials, inadequate maintenance and supply of basic workshop and

laboratory facilities, out-of-date textbooks and scientific journals, and a lack of microcomputers to aid in the analysis of experimental results. The shortage of electrical power during the day also means that no effective laboratory or workshop practicals can be conducted during normal working hours.

At the end of December 1990, there were 30 staff members at the faculty (table 4), but there were also 28 vacant positions. NUC operates a staff-development scheme that has promoted the selection and training of outstanding graduates, both locally and abroad. It had depended heavily on foreign governments and international bodies for the provision of grants to these people, but with the decline in the number of grants because of the increased cost of postgraduate study abroad and the increase in the number of qualified trainees failing to return home, the university has introduced a new staff-development policy to guide the recruitment and training of prospective faculty members.

At Fourah Bay College, there is an Institute of Marine Biology and Oceanography (IMBO) that undertakes research mainly on marine fisheries. However, the same constraints that mitigate against effective research work in other departments within NUC are also evident at IMBO. The University of Sierra Leone has established a University Research and Development Services Bureau to promote and coordinate the contributions of faculty in national development projects on a consultancy basis, but this does not constitute an institutionalized research capacity in agriculture; it is a way for the expertise of individual faculty to be mobilized, albeit on donor-funded projects.

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5. The continuing decline in the economy of the country coupled with instability in the region may however accelerate the trend to the point that an absolute shortage of trained agriculturalists will exist.

## Other Units Contributing to National Research

### ***The Land and Water Development Division***

The Land and Water Development Division (LWDD) of MANRF is an important contributor in the area of natural resource management. Its mandate is to appraise the land and water resources of the country in order to provide information to improve the use of land, soil, water, and climatic resources for agricultural development on a sustained basis.

The division has 19 senior scientific staff (table 4). One of the scientists is being supported under an Egyptian technical assistance arrangement. The areas of specialization of the staff, who have an average work experience of 12.4 years, include remote sensing, soil survey, soil conservation, land evaluation, agrometeorology, crop protection, hydrogeology, irrigation and drainage, computer data processing, and laboratory analysis. LWDD has recently lost some of its more experienced research staff to the university or the United Nations volunteer service.

### ***The Planning, Evaluation and Monitoring Services Division***

The Planning, Evaluation and Monitoring Services Division (PEMSD) was established in 1979 as the agricultural data collection office of the ministry of agriculture. PEMS could be an important contributor to research in the area of socioeconomic studies and in the crucial task of monitoring the impacts of national R&D on agricultural productivity and rural well being. Unfortunately, this division is perhaps the one that has been most severely affected by the resignation of trained and experienced local staff to join the United Nations Volunteer program. The main reason for this is that because of lack of financial support, the Division has not been able to carry out its mission for the past few years.

### ***The Forestry Division of MANRF***

The Forestry Division of MANRF has two officers who have been assigned to research work, but they cannot function effectively because of lack of financial and logistic support. The division has therefore welcomed the establishment of NARCC, which it hopes will mobilize resources to support forestry research. The division has cooperated with the university and IAR in one of the ministry's alley-farming research areas, as well as in a forestry research project sponsored by the European Economic Community (EEC) and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ).

### ***Livestock Division of MANRF***

For many years, livestock research in Sierra Leone has been almost completely neglected, despite the potential to improve productivity, diet, and rural incomes with modest research investments. Although there was a slaughterhouse project and several of IADP's projects in the north had livestock components, virtually no research was done. There are some livestock research facilities in the country but these are in a serious state of disrepair. The Teko livestock station has a diagnostic laboratory, which if upgraded, could serve the needs of veterinary research. The Musala Livestock Station is presently being upgraded with EEC support.

One serious problem facing livestock research is the lack of well-trained and experienced researchers. The Faculty of Agriculture has only four staff members at post and has been unable to fill vacant positions. The Livestock Division of the Ministry is staffed largely by veterinarians with no specialization in areas like poultry and swine production.

## ***Role of Integrated Agricultural Development Projects***

In the early 1970s, donors had doubts about the Ministry of Agriculture's ability to effectively make use of additional resources, especially in light of the ministry's serious administrative inefficiency. The Integrated Agricultural Development Project (IADP) was then created to facilitate continued development assistance to the country without jeopardizing the effectiveness of project implementation.

There were eventually nine semi-autonomous projects under the auspices of ministry. The projects were funded by the International Fund for Agricultural Development (IFAD), the International Bank for Reconstruction and Development (IBRD) of the World Bank, the African Development Bank (ADB), Banque Arabe de Développement Economique en Afrique (BADEA), the EEC, GTZ and the United Nations Development Program (UNDP). The IADPs were basically extension-oriented, but since the technological packages available were rather limited, most of the projects were forced to do some research, mainly on crop variety evaluation and fertilizer trials.

At the start, the IADP concept facilitated the integration of functions normally un-

dertaken by various ministries and agencies. There was close coordination in each project area, flexible procedures, and freedom to adapt projects to smallholder priorities. IADP staff generally received higher compensation than other ministry personnel, were provided with better facilities, and were better managed and supervised.

As the IADPs proliferated, problems began to develop, the most serious being a duplication of effort because IADP and ministry personnel operated side by side in the same areas but not in collaboration. With the demise of virtually all the IADPs, the ministry has integrated the projects into its regular programs in the hope that the advantages of the IADP will be retained, but at the same time reducing the duplication that was so evident.

Externally funded projects are essential when national institutions cannot assume the necessary R&D functions. However, close integration of project activities with those of national research institutions is critical. This coordination and integration were weak in the past, but it is now hoped that NARCC can provide the mechanism for managing these valuable externally funded activities as part of the long-term institutional development of Sierra Leone's national research.

## **Financial Resources for Research**

**F**unding of agricultural research has been a difficult problem for many years; only comparatively recently have funds been directed through the government's regular budget (table 5). Prior to the 1986/87 fiscal year, only RRS was included in the government's recurrent budget. Other research-oriented institutions and projects were supported through the development budget, and a sizable percentage of the funds allocated under this budget were never disbursed.

Government support, on which the research institutions depend almost entirely, has dwindled considerably in real terms. This has been mainly due to the depreciation of the local currency from Le 2.5 to the US dollar in the early 1980s to Le 450 at the end of 1991. From 1988 to 1990, the decline in the value of the currency was so dramatic that it was virtually impossible to make any realistic budget allocation. The effect of the current situation has been that most of the

**Table 5. Sierra Leone Government Subvention to Agricultural Research and Development Institutions, 1985-1990**

| Institute   | Government Subvention in Constant 1987 US\$ |               |               |               |               |               |                |               |                |               |                |                |
|---|---|---------------|---------------|---------------|---------------|---------------|----------------|---------------|----------------|---------------|----------------|----------------|
|   | 1985  |               | 1986          |               | 1987          |               | 1988           |               | 1989           |               | 1990           |                |
|   | PE  | OC            | PE            | OC            | PE            | OC            | PE             | OC            | PE             | OC            | PE             | OC             |
| Rice Research Station, Rokupr                       | 142,430                                     | 32,271        | 89,375        | 20,313        | 38,350        | 10,075        | 101,160        | 8,874         | 106,259        | 31,878        | 152,131        | 48,041         |
| Institute of Agricultural Research                  | —   | —             | —             | —             | —             | —             | —              | —             | 47,816         | 3,036         | 64,055         | 24,021         |
| National Agricultural Research Coordinating Council | —   | —             | —             | —             | —             | —             | —              | —             | —              | —             | 20,017         | 16,014         |
| Land & Water Development Division                   | —   | —             | —             | —             | 27,750        | 6,500         | 39,932         | 11,092        | 36,432         | 13,662        | 26,432         | 10,409         |
| Planning Evaluation & Monitoring Services Division  | —   | —             | —             | —             | —             | —             | —              | —             | 20,037         | 3,036         | 25,222         | 4,004          |
| <b>Total</b>  | <b>142,430</b>                              | <b>32,371</b> | <b>89,375</b> | <b>20,313</b> | <b>61,100</b> | <b>16,575</b> | <b>141,092</b> | <b>19,966</b> | <b>210,544</b> | <b>51,612</b> | <b>287,848</b> | <b>102,489</b> |

*Note:* Data collected in Leones and converted into constant 1987 US\$ at market rate.

PE = personnel emoluments.

OC = operating charges.

money provided by the government has been used for staff salaries and allowances with little left for day-to-day operations and for the inputs necessary to maintain basic standards of research.

IAR was included in the regular government budget in fiscal year 1988/89, after funding from the USAID/ACRE Project ended in 1987; LWDD started receiving regular government grants in 1986/87, when outside funding ended, as did and PEMSD in 1988/89. Although established in 1985, NARCC was unable to function properly until 1989/90, when it started receiving regular government grants.

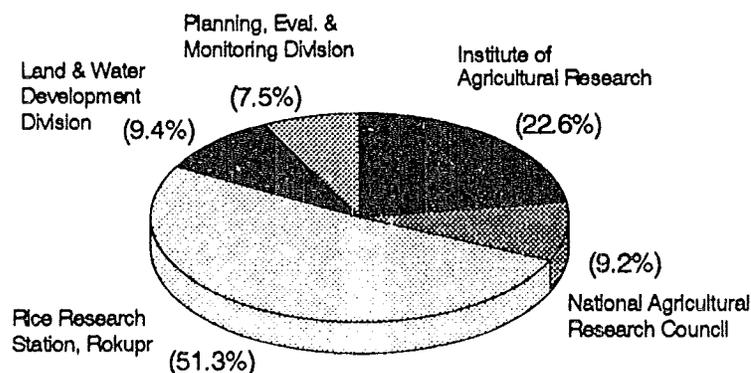
Table 4 reveals the high proportion of expenditures used to pay salaries and allowances. These high personnel costs are related to the large numbers of unskilled laborers, especially at the Rice Research Station and the Ministry of Agriculture Divisions. A serious effort is now being made to reduce their numbers so that a greater proportion of the available funds could be used for more productive purposes. (See figure 4 for the distribution of resources per institution.)

Within the past two years, staff salaries and other benefits for RRS and IAR, which are tied to those of the University of Sierra Leone, have been substantially increased, but this did not affect the researchers within PEMSD and LWDD because their salaries are still tied to the civil-service

scales. This has resulted in a mass exodus of trained and experienced staff members from these divisions to the university and to the UN Volunteer Service. The salary increases will no doubt increase the percentage of total government funding used for personnel emoluments, thereby putting a further strain on the money left for day-to-day operations.

Donor funding to agricultural research has concentrated largely on capital investment for construction and equipment, as in the case of the ACRE project. A significant portion of donor support has also gone to training and technical assistance provided under the ACRE project and UNDP assistance to PEMSD and LWDD, as well as to RRS. The support provided by USAID through the ACRE project was a major contribution to research in the country. The project was authorized in 1978 with five-year funding estimated at US\$ 6.1 million. There were two project authorization amendments that increased the funding to US\$ 9.06 million and extended the project to June 1987. Extensive construction work was undertaken to provide structures for administration, seed processing, maintenance services, a power plant, a soil laboratory, storage, staff housing, and other facilities.

Some of the research institutions have received special grants from government and international organizations to undertake specific projects or to support certain



Note: Total expenditures for 1990 = US\$390,337.

**Figure 4. Allocation of government resources per institute, 1990**

essential services (table 6). These include grants from the government to IAR for crop multiplication and to make up for the shortfall in operational funds. The US government has made funds available to both RRS and IAR. RRS also receives development grant from the Ministry of Development and Economic Planning, while the International Development Research Center (IDRC) of Canada has supported a project dealing with postharvest losses and a solar dryer at the station. The LWD and PEMS Divisions have received grants from FAO/UNDP and the International Institute of Tropical Agriculture (IITA), while the university continues to receive finan-

cial support from several international organizations for the execution of specific projects. IITA has provided funds to support on-farm work on rice at Rokupr and on cassava, maize, and cowpeas at Njala. It is also supporting collaborative work with IAR on inland valley swamps at Makeni and an impact study of IITA-released cassava and sweet potato varieties in the Mano River Union countries (Sierra Leone, Liberia, and Guinea). The Alley Farming Network for Tropical Africa (AFNETA),<sup>6</sup> with funds provided by IFAD, is implementing a two-year research project in cooperation with IAR and RRS.

## National Scope of Research

A large number of food crops are grown and consumed in Sierra Leone, but research over the years has concentrated on only a few of them. The scope of agricultural research has been dominated by RRS concentrating on rice, the nation's staple food crop, with a lesser emphasis on sorghum and millet. IAR works mainly on cassava, sweet potatoes, maize, groundnuts, and cowpeas (global staples in the ISNAR methodology, see table 7). For global staples there is a vast and accessible fund of research information and technology, combined with the availability of international support for work on these crops. This has led, perhaps wisely, to a concentration of national efforts on adaptive research in this area. As a result, research on rice in Sierra Leone has produced improved varieties that are now widely diffused in both the country and the region. More recently, research on cassava and sweet potatoes has also led to improved cultivars that have been widely accepted by farmers.

Work in both institutes relates mainly to breeding, agronomy, crop protection, and

postharvest technology; research in the social sciences is just now picking up with assistance to RRS on farming systems research from the EEC and the execution of special projects by IAR in collaboration with IITA's Resource and Crop Management Program. Aside from rice, the type of research conducted in Sierra Leone has been largely adaptive, with testing and agronomic studies on food crops.

Token research has been conducted in the areas of livestock and forestry, with very little in fisheries. Research work on perennial crops, such as oil palm, cocoa, coffee, and citrus ceased in Sierra Leone almost 30 years ago.

The potential demand for research is quite broad when distributed across the various categories of research domains (see table 7) that reflect the diversity of production and natural resource issues in the country. Obviously covering such scope would be beyond the scale of a small research system such as Sierra Leone's,

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6. AFNETA is based at IITA in Nigeria.

**Table 6. Sources of Financial Support for Specific Projects/Programs for All NARS Institutions, 1985-1990**

| Funding Source                                  | Year      | Amount in Constant US \$ 1987 | Purpose   |
|---|-----------|-------------------------------|---|
| <b>1. Rice Research Station</b>                 |           |                               |   |
| Sierra Leone Govt. (Min. of Devel.)             | 1985      | \$29,003                      | Development grant   |
| Sierra Leone Govt. (Min. of Devel.)             | 1986      | \$48,750                      | Development grant   |
| Sierra Leone Govt. (Min. of Devel.)             | 1987      | \$22,750                      | Development grant   |
| Sierra Leone Govt. (Min. of Devel.)             | 1988      | \$37,950                      | Development grant   |
| IITA (EEC grant)                                | 1990      | \$4,750                       | Conduct on-farm trials  |
| <b>2. Institute of Agricultural Research</b>    |           |                               |   |
| Sierra Leone Govt. (Min. of Finance)            | 1988      | \$22,184                      | Multiplication of crops for farmers   |
| Sierra Leone Govt. (Min. of Devel.)             | 1988      | \$13,033                      | General development   |
| Sierra Leone Govt. (Min. of Finance)            | 1989      | \$7,590                       | Make up for shortfall in operating changes  |
| Sierra Leone Govt. (PL 480) — US funds          | 1988-1990 | \$129,080                     | Make up for shortfall in operating changes and construction of fertilizer/chemical/tool store |
| FAO Regional Office, Accra                      | 1990      | \$7,150                       | Conduct on-farm trials on cassava, sweet potato, maize, upland and inland valley swamp rice   |
| IITA  | 1990      | \$7,500                       | Weed trials in inland valley swamps at Makeni   |
| IITA  | 1990      | \$7,000                       | Impact study of IITA cassava and sweet potato varieties in Mano River Union countries         |
| IITA — AFNETA (IFAD grant)                      | 1990      | \$53,170                      | Collaborative research on alley farming   |
| IITA (EEC grant)                                | 1990      | \$16,250                      | On-farm trials on maize and cassava   |
| IITA (EEC grant)                                | 1990      | \$2,000                       | Training extension agents and farmers on maize and cassava production                         |
| <b>3. Land &amp; Water Development Division</b> |           |                               |   |
| IITA  | 1986      | \$24,375                      | Collaborative research work   |
| IITA  | 1987      | \$13,000                      | Collaborative research work   |
| IITA  | 1988      | \$22,184                      | Collaborative research work   |
| IITA  | 1986      | \$7,590                       | Collaborative research work   |
| World Bank                                      | 1986      | \$81,250                      | Collaborative research work   |

**Table 7. Categories of Potential Research Domains in Sierra Leone**

| Global staples  | Traditional export crops  | Minor food crops   | High-input, nontraditional export crops  | Livestock  | Socioeconomics and rural engineering  | Natural resource management  |
|---|---|--|--|--|---|--|
| Beans<br>Cassava<br>Cowpea<br>Groundnut<br>Maize<br>Rice<br>Sorghum<br>Soya | Bananas<br>Cashew nuts<br>Cocoa<br>Coconuts<br>Coffee<br>Cotton<br>Oil palm<br>Rubber<br>Sugar<br>Tobacco | Cabbage<br>Carrots<br>Fruits (local use)<br>Millet<br>( <i>Pennisetum</i> ,<br><i>Panicum</i> )<br>Findo ( <i>Digitaria</i> )<br>Okra<br>Onions<br>Peppers<br>Pigeon peas<br>Plantain<br>"Spinach"<br>( <i>Amranthus</i> )<br>Sweet potatoes<br>Cocoyam/Taro<br>( <i>Xanthosoma</i> ,<br><i>Colocasia</i> )<br>Tomatoes<br>Vegetables (local use)<br>Yams ( <i>Dioscorea</i> ) | Broccoli<br>Brussels sprouts<br>Cardamom<br>Citrus<br>(limes, grapefruit)<br>Flowers/<br>oramentals<br>Fruits<br>Ginger<br>High-value<br>vegetables<br>Jojoba<br>Litchi<br>Mangos<br>Melons<br>Papaya<br>Passion fruit<br>Pineapples<br>Quinquina<br>Spices<br>Starfruit<br>Strawberries | <b>Small Ruminants</b><br>Goats<br>Sheep<br><br><b>Large Animals</b><br>Cattle<br>Horses<br>Donkeys<br><br><b>Small Stock</b><br>Chickens<br>Ducks<br>Turkeys<br>Swine<br><br>Animal health<br>Feeds and<br>nutrition<br>Animal breeding<br><br><b>Wildlife<br/>Management</b> | Farm management<br>Farm structures<br>Farming systems<br>research<br>Marketing research<br>Postharvest and<br>storage<br>Machinery and tools<br>Irrigation<br>Rural engineering<br>Agroprocessing<br>Agroindustries<br>Agricultural waste | <b>Fisheries</b><br>Coastal fisheries<br>Inland fisheries<br>Aquaculture<br><br><b>Forestry</b><br>Forest products/<br>processing<br>Agroforestry<br>Genetic resources<br>Plant pest and<br>disease management<br><br><b>Land Use &amp; Water<br/>Management</b><br>Soil (fertility,<br>erosion,<br>conservation)<br>Water resource<br>management<br>Range and pasture<br><br><b>Genetic resources</b> |

which cannot muster more than 60 research scientists. The next section reviews the research taking place in these various domains and considers how the

institutions can make the best use of their resources. Another aim is to examine the functions of research in the small-country context.

## Global Staples

### *Rice research*

Sierra Leone's Rice Research Station at Rokupr has worked on rice for almost 60 years and has been a significant contributor to global research, particularly in improving and documenting local varieties and species of rice (*Oryza glaberrima*) and in adapting Asian rice (*Oryza sativa*) to West African conditions. The work has concentrated on the improvement of mangrove and swamp rice production and has resulted in the selection and release of many superior cultivars. Most of the varieties released are adapted to lowland ecologies, but 60% to 70% of the area annually planted with rice in the country is on the uplands.

RRS has recently begun work on improving rice varieties for upland conditions. The station is also involved in varietal improvement of sorghum and millet but work is limited to selection of materials provided by the substation belonging to the International Center for Research in the Semi-Arid Tropics (ICRISAT) in Niamey.<sup>7</sup>

**Research results.** Sierra Leone was once a leader in rice research.<sup>8</sup> Selection and screening of local varieties of upland rice began in 1934. During the war years, selection work ceased and the number of strains still under observation was reduced. Work on upland rice increased again in the 1950s, beginning with mass selection of white-grained local upland rices in 1950. A small collection of these varieties was established at that time.

Work on the adaptation of Asian rice varieties was also fruitful. A pollination technique using the hot-water-bottle method was developed, and a hybridization program was initiated involving japonica and indica crosses as well as local upland and introduced short-duration swamp indicas. By the end of 1964, there were about 500 varieties/lines in the seed collection, with approximately 50% being upland varieties.

The multiplication of pure seed of introduced or locally selected pure seed of improved rices occupied an important part of the work at Rokupr. All seed was tested for purity before distribution. Dur-

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7. Some general screening and testing of other technologies and crops has been done, with new varieties grown on a small scale for distribution to local farmers. These crops include yams, cassava, sweet potatoes, pineapples, pawpaws, plantains, and bananas. Demonstration plantations of coffee, citrus fruits, vegetables, and improved oil palms were also maintained. In 1973, animal traction was tested but ox-plowing never proved satisfactory and later experiments focused on full mechanization of tillage. Dairy cattle continued to be kept to demonstrate to small farmers the ease of their maintenance and the value of their milk and manure.

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8. Between 1949 and 1961, Asian varieties Faya and Radin China 4 (Malaya) were released for cultivation. SR 26 from Sri Lanka was released as a salt-resistant variety for tidal mangrove swamps instead of Lead, an earlier release. Between 1965 and 1976, varieties RH 2, CP 4, and BD 2 were released. Also released were varieties ROK 1, 2, and 3 for upland cultivation, while ROK 4, 5, 6, and 7 were released for swamp cultivation. The name ROK was derived from ROK-upr. To date, over 30 ROK varieties have been released for use by farmers. These varieties have been widely adopted in many parts of West Africa.

ing the war years, it was not possible to maintain the standard of purity, but by 1949, all seed grown had been raised to a mechanical purity approaching 100%. Genetic impurity of varieties was noticed after a number of years but when this became marked in any variety, reselection was carried out.

Rice characteristics of both local and introduced varieties were recorded in the field for growth characteristics as well as in the laboratory for grain measurements. Observations were also made on yields and maturation periods, and attempts were made to correlate these with other factors. Some rice research was also done at Njala under the auspices of the Department of Agriculture from 1912 to 1976, after which Njala University College and IAR took it over.

The fund of accumulated knowledge and expertise on rice in Africa that the RRS has accumulated is a significant resource for the region as a whole. Whether this effort can be sustained on a purely national basis is unclear. The support of WARDA has been instrumental in providing logistical support and operating funds for research at Rokupr. Now that WARDA has removed its direct support to Rokupr's research program, the scale and scope of the station's research work is threatened.

### ***Other Global Staples and Minor Food Crops***

The Institute of Agricultural Research has responsibility for research on cassava and sweet potatoes. Over the past few years, superior cultivars of these crops have been selected and popularized among farmers. The response to the new sweet potato varieties has generally been good but cassava varieties were rejected by farmers because they lacked some of the characteristics demanded by consumers.

One of the probable reasons these varieties were generally not accepted was that the original germplasm came from IITA in

Nigeria where the local considerations are very different. For example mealiness is important for Sierra Leone consumers, and the Sierra Leone program had to work alone on this characteristic for almost 10 years. IAR has identified several new high-yielding mealy clones which are being tested nationally as well as in The Gambia, Guinea, and Guinea-Bissau.

IAR also has the responsibility for research on cowpeas and groundnuts. Over the years, a lot of effort has been channelled into cowpea work, probably because of the close association with IITA, which has the global research mandate for the crop. The varieties that have been selected and introduced to farmers have generally been very susceptible to insect pests and have lacked the white seed coat that is preferred by local consumers — these varieties have not been popular.

Many agronomic studies on groundnuts were undertaken at Njala between 1912 and 1962, but this stopped in the early '60s despite the fact that groundnuts remain the most important legume in the national diet and food economy. It is also better adapted to local growing conditions than cowpeas. Only recently, when IAR started collaborative work with ICRISAT, has groundnut research been resumed. IAR decided to emphasize groundnut research while continuing work on cowpeas.

Maize is another crop that is at the core of the IAR research program. Maize research at Njala dates back to 1913 when the first maize trials began with material from South Africa. Work currently underway is done with the support of technologies and training provided by Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT) and IITA.

Since 1964, the Faculty of Agriculture at Njala University College has been undertaking research into various aspects of agricultural production. Present work includes the collection, propagation, and

evaluation of indigenous and exotic multipurpose trees; optimum plant populations, planting dates and nitrogen fertilization of maize; and rapid multiplication techniques and optimum plant populations for high root and leaf yields

of cassava and sweet potatoes. Field experiments are being conducted to investigate the effects of soil moisture stress applied at various growth stages and the intensity of moisture stress on the growth and yield of bambara groundnuts.

## Traditional Export Crops

Although Sierra Leone exports small amounts of coffee, cocoa, and rubber, research on tree crops virtually ceased after independence in 1961. With the country's present financial situation, it is unlikely that work on these crops will begin again very soon. However, there are stations in the east of the country that were originally used for tree crop research and where valuable germplasm is being maintained.

NARCC has the responsibility to establish new research institutions, and a tree crop research institute is on its agenda. It may be more economical at this stage to reactivate one or two of the old stations as part of IAR, which could then hire a few scientists and technicians to initiate research

on the more important tree crops. The number of coffee and cocoa producers has been increasing and global consumption has remained fairly constant, so long-term price trends are not promising; Sierra Leone would have to consider investments in this area very carefully. Fortunately, there is a great deal of research being done on these crops regionally, which could be applied to national conditions. Cooperation with other national institutes in the subregion could bring in fast and beneficial results. The same approach should be considered for forestry research with the Forestry Division of the Ministry handing over responsibility of its Bambawo Research Station to IAR, since no research is going on there.

## Livestock

Livestock research was prominent in the colonial department of agriculture prior to independence and concentrated on sheep, goat, cattle, and poultry. Livestock research is presently at a very low level. Animal traction is receiving attention because of problems with wheeled tractors. The Ministry of Agriculture has established a Work-Oxen Project with the aim of popularizing work oxen, which have been in use in some parts of the northern province since the early 1930s.

The Livestock Department of the Ministry undertakes no research, and the only on-

going research project in the country is on small ruminants carried out cooperatively by Njala University College and Southern University in the US. Njala University College is the only institution in the country with any capacity to conduct livestock research. It is therefore reasonable to suggest that the research capabilities of the Animal Science Department be strengthened to take on the national mandate for livestock research. The Ministry of Agriculture, with its field stations at Newton, Musala, and Teko, could be made a partner in this venture.

## Socioeconomics, Farming Systems, and Rural Engineering

There is research in the social sciences at Njala University College, IAR, Fourah Bay College, PEMSD, and RRS, which is presently participating in a farming systems research project supported by the EEC. Work in this area is fragmented and uncoordinated and has been severely limited by local staff leaving for more financially rewarding job opportunities. There is a need to emphasize research on production, utilization, and marketing of various food commodities and to assess the impact of the new technologies being introduced to farmers. NARCC should play a key role in coordinating the diverse group of researchers and institutions engaged in this type of research.

The Department of Crop Science of Njala University College has just completed a farming systems research project in two surrounding chiefdoms, identifying methods of crop and land management in order to promote sustained and gradual improvement in farmers' systems.

Other social science research has included studies on extending the shelf life of sweet potatoes and cassava using simple storage methods. Crop protection trials in progress or just completed have looked at the development of screening techniques for sweet potato scab disease, the effects of palm oil and sand on the establishment of the cowpea weevil (*Callosobruchus maculatus*) during storage, the incidence and severity of banana leafspot at Njala, and the effects of weeds on the growth and yield of sweet potatoes. Other socioeconomic studies just completed or underway include maize marketing and extension, the economics of using oxen for tilling versus manual rice cultivation, communication patterns among the rural inhabitants and urban poor, promotion of employment through nonfarm activities, decision making

among farm families, and rural organization and participation.

The Department of Agricultural Engineering's thrust in research has been the development of appropriate technologies for use in farming and in general rural development activities. These include the hydrologic surveys of several inland valley swamps as a basis for more rational designs for development, development of human-powered pumps for crop irrigation, hand-drawn sprinkle irrigation devices, and an all-weather biomass-fired natural convection crop drier.

### *Production Systems*

Testing and developing improved varieties of staple food crops has been a major activity at IAR; at the same time, another equally important objective is to solve problems in production systems identified by researchers, extension agents, and farmers. The main problems causing low crop yields that have received research attention include weeds, poor soil fertility, pest damage, and the use of low-yielding varieties. The initial work undertaken by the ACRE project included baseline socioeconomic and agronomic surveys and a cassava and sweet potato improvement program that resulted in the release of many superior cultivars.

Agronomic studies completed or underway include methods of planting sweet potatoes; the effects of nitrogen fertilization and leaf harvest frequency on sweet potatoes; the effect of hand weeding and herbicide application in the control of weeds in maize; varietal evaluation of maize, sorghum, pearl millet, cowpeas, and groundnuts; crop rotation studies on the soils of upland and river rice terraces; tillage/crop-residue management studies; intercropping studies on maize and

cowpeas alley-cropping studies; and correlations between soil tests and crop response. There has also been emphasis on evaluating advanced lines of crop varieties for suitability in local dishes and developing recipes for mothers and babies using IAR-promoted food crops.

On-farm research forms a major part of the activities of the Agronomy Department of the Bo-Pujehun Rural Development Project, which is supported by GTZ. On-Farm trials and demonstrations to verify improved technologies by researchers also form an important part of the IAR's activities in the zone. During the 1990/91 cropping season, varietal trials involving upland and inland valley swamp rice, maize, cassava, and sweet potatoes were laid out in farmers' fields, as well as demonstrations on fertilizing maize and cassava. Trials on weed competition in rice, evaluation of leguminous trees in sustaining productivity, and the performance of improved cassava and sweet potato varieties in farmers' fields were also done. A number of useful recommendations have come from these studies.

The overall concept, strategy, and approach of the project's agriculture pro-

gram was reviewed prior to the 1990/91 cropping season in light of the country's changing economic, social and ecological environment. The program is presently emphasizing the promotion of a farming system in the region that is both productive and sustainable. The main thrust is the development of tree crops (especially oil palm), groundnuts, and root and tuber crops (including cassava, yams, and sweet potatoes) on the uplands and rice and vegetables in the inland valley swamps.

One of the main problems with which both IAR and RRS have been faced with is taking single-crop technologies to farmers. In many cases, farmers ask for several crops that are not part of the research mandate of the institutes. This shows that local farmers are engaged in complex farming systems involving many crops, as well as livestock, for which research is needed. Farming systems research goes on at IAR, RRS, and the Faculty of Agriculture, but the three programs are not coordinated. There is therefore an urgent need for closer cooperation between the two institutions and the university in farming systems research.

## Natural Resource Management

The role of the Land and Water Development Division is to develop technical data on Sierra Leone's soils, water utilization, and climatology. It evaluates, gives recommendations, and determines the feasibility of producing specific crops at a given location, based on studies of soil and hydrological characteristics. One of the main thrusts of the LWDD program is swamp/lowland development. Although this area comprises less than 15% of the total land mass of Sierra Leone, it has the potential to produce a large quantity of rice. Mapping of these areas by LWDD has indicated that they are well distributed across the country, thus minimizing

transport requirements for the rice that could be produced there. LWDD's second thrust involves increasing their climatological data and developing useful indices for agricultural production, such as timeliness and intervals between rainfall which indicate the wet season.

The Institute of Marine Biology and Oceanography at Fourah Bay College of the University of Sierra Leone undertakes research into fisheries. IMBO's activities have been severely restricted by lack of funds even though it has a cadre of well-qualified and experienced staff. It could easily take over the national responsibility

for fisheries research, working in close collaboration with the Fisheries Division of the Ministry of Agriculture. Recently IMBO established collaborative links with the International Center for Living Aquatic Resources Management (ICLARM) and will expand the scope of its research on coastal fisheries to focus on technology and management of artisanal fisheries. The Fisheries Division of MANRF focuses more on inland fisheries and estuaries but it has no full-time research staff at present.

The Njala University College Department of Agricultural Engineering, with the support of donor agencies, has developed low-

cost equipment for postharvest processing and storage of crops and simple machinery for irrigation. RRS and the Faculty of Engineering at Fourah Bay College are also engaged in postharvest studies and rural engineering. Here again, the national effort is fragmented and there is a need for research coordination.

IAR and RRS conduct agroforestry research with the active support of AFNETA. Most of the research has been on-station, but on-farm work began in 1991 at the request of the network. It is doubtful whether there is anything to pass on to local farmers yet.

## **Analysis of the National Research Portfolio**

Looking at the distribution of Sierra Leone's research institutions gives an overview of the national research portfolio (table 8). Several conclusions can be made. First, the global staples and minor food crops of importance to Sierra Leone are well covered; research is making effective use of the external inputs from international centers. But there is a gap in coverage of traditional exports and livestock. The question is whether these areas can be integrated into existing research or whether they would require separate institutional arrangements. The level of investment and type of research that can be sustained for traditional exports and livestock are questions that need careful analysis.

The gap in livestock research is difficult to justify on several grounds. First, there is a need to focus on local breeds and production systems. The potential is there to make dramatic increases in productivity, and livestock forms an essential part of the country's farming systems. Finally, some technology is available within the West African region on Ndama cattle and livestock production systems which could be adapted by local researchers.

Careful consideration is needed before investing in research on traditional export crops. There is already a great deal of research being done in West Africa on coffee and cocoa. Partnerships and linkages might allow Sierra Leone to benefit without a major investment of scientists, time, and facilities. The proposal to include these traditional exports within farmers' production systems seems more realistic than having them covered by full-fledged commodity programs or institutes.

The gap in research coverage for the high-value nontraditional exports may be justified, however, given the poor transport and marketing infrastructure. Nontraditional exports such as shrimp have been adequately covered by the private sector. Some research-based monitoring of the impact of the fisheries and aquaculture industries may be necessary, but it should be a component of the increased national capacity for research on natural resource management.

Socioeconomics/rural engineering and natural resource management appear to be well covered; however, this is deceptive.

**Table 8. National Research Portfolio of Sierra Leone**

| Institutions  | Global staples   | Traditional export crops | Minor food crops  | High-input, nontraditional export crops | Livestock                              | Socioeconomics and rural engineering   | Natural resource management   |
|---|--|--------------------------|---|---|--|--|---|
| <b>NARS Institutions</b>  |  |                          |   |   |  |  |   |
| 1. Rokupr Rice Research Station   | Rice   |                          | Findo ( <i>Digitaria exilis</i> )<br>Millet ( <i>Pennisetum</i> ) |   |  | Rice-based farming systems research  | Management of riverine and swamp ecologies, grasslands, hydromorphic soils  |
| 2. Institute of Agricultural Research, Njala  | Cassava<br>Cowpeas<br>Groundnuts<br>Maize<br>Potatoes<br>Sorghum |                          | Sweet potatoes<br>Yams ( <i>Dioscora</i> )                        |   | Pasture improvement (limited research) | Farm structures<br>Postharvest studies<br>Farming systems<br>Socioeconomic studies | Soil management (agroforestry)  |
| <b>Other Institutions</b>   |  |                          |   |   |  |  |   |
| 1. Institute of Marine Biology & Oceanography, Fourah Bay College, University of Sierra Leone |  |                          |   |   |  |  | Plant genetic resources: identification and evaluation of local crop varieties, indigenous plants and trees,<br>Plant pathology |
| 2. Faculty of Agriculture, Njala University College, University of Sierra Leone               |  |                          |   |   |  | Farming systems<br>Postharvest & storage<br>Socioeconomics<br>Marketing of staples | Data collection and analysis on soil & water utilization, including climatology & hydrological studies                          |
| 3. Land & Water Development Division (MANRF)  |  |                          |   |   |  |  |   |
| 4. Planting, Evaluating, Monitoring, Services Division (MANRF)                                |  |                          |   |   |  | Research impact<br>Evaluation<br>Marketing research                                |   |

In fact, these activities are often sporadic and not well integrated into other R&D efforts. Fisheries research is aimed at sustainable exploitation of this crucial resource, and the development of aquaculture is embryonic. IMBO could play a larger role in supporting the regulatory functions of the Fisheries Division by providing better information on marine and coastal resources and the trends therein. The economic importance of fisheries in Sierra Leone would certainly justify greater investment.

In the management of land and water resources, the work of LWDD could be better integrated with agricultural research. Similarly, the socioeconomic research done at the University and PEMSD could also be more closely linked to other existing agricultural research institutions. For these two areas, improved linkages and coordination could go a long way to increasing research output with minimal increases in investment.

## **Increasing Research Productivity**

The most significant contribution research has made in increasing food production is the introduction of improved high-yielding, disease-resistant crop varieties. RRS has released several varieties for the various rice areas which have been widely adopted by farmers. Economic fertilizer recommendations have also been made for each rice area.

In 1978, RRS also released three improved varieties each of cassava and sweet potatoes, and in subsequent years Njala University College has done the same. In the field of maize research, NUC has identified and released several improved varieties and has recommended optimum rates of fertilization for the crop.

IAR has released and popularized several cassava and sweet potato clones. Active

research is also being undertaken on grain legumes, mainly groundnuts and cowpeas. There are also socioeconomic studies on farmers' preferences, postharvest technology and uses, nutrition, and gender issues.

In the future, more work will be needed on natural resource management and livestock. An increased research investment in fisheries can surely be justified to ensure the sustained productivity of this important source of foreign exchange and strategic national resource. It is hoped that through improved coordination, through more efficient linkages to external sources of knowledge, technology, and funding, and by deepening close links to producers, Sierra Leone can manage its research scope to include these crucial research domains.

# Research Linkages

## Managing Linkages, a Core Function in a Small NARS

Linkages to producers are key to determining the focus and type of research to be done. Furthermore, in most areas, with the exception of some key commodities such as rice and sweet potatoes, the NARS institutions conduct adaptive research. This means that linkages to external sources of technology and information are crucial to research operations, and managing the linkages to producers and external sources are core functions of the research system.

### *Functioning at the Research-Extension Interface*

For a long time, research was not conducted in consultation with the farmer. Moreover, there was no workable link between research and extension, which meant total chaos in the process of technology development and transfer. Lately, however, with the on-farm approach, which strongly emphasizes farmers' perceptions and participation, this trend is gradually being reversed. The close links that have now been established between research, extension, and farmers have increased the impact of adaptive research. The incorporation of technology-transfer agents and farmers into the research system has been a major factor behind the system's continuing productivity. IAR has played a leading role in this approach and now RRS is moving in the same direction with more of its staff stationed outside its headquarters at Rokupr.

The present research institutions have specialists who have been highly trained but who do not have much contact with

extension. There is therefore a need for a cadre of people trained in technical disciplines who also have an extension orientation. This would allow for better communication with extension workers and farmers. These workers would be instrumental in identifying farmers' constraints, and they would be able to convey the latest research information to extension personnel. One way that IAR promotes this type of continuous interaction among researchers, extension personnel, and small farmers is by basing researchers on farming systems in each of its operational zones. These researchers are trained in technical disciplines but also have considerable exposure to extension. Thus, they have the technical background to work as researchers and also have an extension orientation, which facilitates easy communication among researchers, extension personnel, and small farmers.

This approach to research has been necessary partly because of the weak national extension service. The direct researcher-farmer interaction has also proved to be very beneficial in quickly bringing field problems to the attention of on-station researchers. However, a lot of resources have to go into transportation and other logistic support for field operations. The question therefore arises as to how much extension work should be undertaken by national researchers.

Ideally, Sierra Leone should have an effective extension system alongside the research system. The main aim of research should be the development of technologies that are adapted to local conditions

and are within the grasp of farmers, while extension should communicate research results to farmers. There should be close cooperation between research and extension because research that cannot transfer its results to extension is of no practical value. In the current situation, research has assumed some of the functions of extension and benefitted from the experience. However, it has been costly in staff time and logistical resources.

While it may be true that in a small NARS it becomes more difficult to separate research from technology-transfer and linkage functions, there is still a need for the NARS to group specific sets of research activities into programs that it can execute and monitor. This is a bit more difficult in Sierra Leone at the moment, where the research institutions are attempting to do both research and extension.

### *The Research-to-Farmer Continuum*

Sierra Leone has access to wide range of technologies and research information from international sources. These come via the international agricultural research centers and increasingly from the numerous nongovernmental organizations (NGOs) that are active in the country. As the examples of cassava and other crops have illustrated, a considerable amount of time and effort is required to screen and adapt these crops to local conditions — which can overwhelm Sierra Leone's national research capacity, given the size of the NARS institutions and the meager funds available.

One way to narrow the screening required is to begin with farmers' preferences and conditions and, then, once these are understood and analyzed, begin to test those varieties and technologies that meet local preferences and fit within local production systems. The cassava program at IAR has begun to work more with farmers' preferences as the starting point. For ex-

ample, before adaptive research and trials are begun, the varieties are first screened for cooking quality and local taste preferences. This screening also takes into account the local uses that a crop may have. In the case of cassava, the plant can be eaten as a fresh tuber, used as a leafy vegetable, or used to produce a grain-like starch. Each use has different implications for the selection and improvement program. In Sierra Leone, the fresh tuber and leafy vegetable are what consumers prefer. By beginning with these criteria, it is possible to screen and test more efficiently.

Research has had to move closer to the farmer in order to understand the systems and knowledge needed to direct research into areas where it can have more impact. With the resources available, Sierra Leonean institutions can not afford to do work that will not reach farmers within a short time, no matter how scientifically valuable the research. The challenge is to maintain scientific excellence as research moves increasingly closer to the farmer.

### *Linkages with the University*

Another important factor that helps maintain the scientific character and purpose of Sierra Leone's research institutions is the close link with the university. This link provides a model for the conditions of service and management structure that are appropriate to research in general. In addition, NARS institutes have the opportunity to tap into the scientific staff at the university by appointing them associate scientists. IAR is particularly favored in that it is located on the campus of Njala University. Faculty members doing research on projects that are in line with IAR's priorities and programs are given the status of associate scientists. Their research projects are then conducted and supported by IAR.

## Nongovernmental Organizations

Another important linkage function involves the participation of other agents such as NGOs in the national research portfolio. The number of NGOs involved in the introduction and development of technology within the agriculture and natural resource sector has increased dramatically in the last five years. The scope of their work in research and related technology development has also increased. Research organizations in Sierra Leone can not hope to provide the research and technical services in crops, livestock, and natural resources that are provided by many NGOs and donor projects, but the national institutions do have important policy and linkage functions to perform.

NGOs have mainly been involved in agricultural research through importing germplasm. In some cases, this germplasm has not been adequately screened before being given to farmers. There are obvious dangers to this practice, such as the introduction of insects and diseases; indeed, there is a strong suspicion that the sweet potato scab was introduced into the country by an NGO.

The national research institutes have accepted the fact that a significant amount of rural R&D will be in the hands of NGOs. This is particularly the case in the south of the country where many NGOs are active in restoring the land that was hydraulically mined for rutile (titanium oxide) and in testing new crops and farming practices for the resettled farmers.

It is important, however, for the NARS to understand the implications of the growing involvement of NGOs in agricultural R&D. The national research institutions will be affected in two ways. One is the potential drain on its human resources as staff are lured away by the salaries and benefits that NGOs provide. The other is the demand placed on the coordination and monitoring functions of the NARS. Fortunately, the revitalization of NARCC provides an apt forum and mechanism for the coordination and monitoring of research and technology-transfer activities by projects and organizations outside the national research institutions.

## External Linkages to Technology and Information Sources

The agricultural research system in Sierra Leone, with its limited material and human resources, cannot generate all the technologies needed for the improvement of the present low level of farming. The system therefore needs to rely primarily on the international agricultural research centers, other national research institutions within the subregion, and networks for much-needed technologies. Indeed, the system in Sierra Leone has for many years worked closely with such international centers as IITA, ICRISAT, and the

International Rice Research Institute (IRRI), which have supplied crop germplasm for evaluation under local conditions.

Since Sierra Leone's agricultural research system is relatively small, it has been argued that its primary responsibility should be the testing of technologies developed elsewhere for adaptation to local conditions. In many cases such materials have performed well locally and have been widely adopted by farmers. In other cases, crop varieties have been rejected by farm-

ers even though they have done well under local conditions.

A good case in point is the cassava varieties that were selected from genetic material obtained from IITA during the early 1980s. The improved cassava varieties were generally higher yielding than local cultivars but farmers refused to accept them for several reasons. Sierra Leoneans have a preference for cassava plants with red petioles and pink tuber skin, which the new varieties did not have. The new cultivars did not become soft after boiling, whereas the local people cherish soft boiled cassava. The new clones had dense canopies that gave too much shade to other crops in the intercrop. And the new clones did not perform well when planted on hydromorphic soils, a practice that is widespread in the country during the dry season.

It is therefore essential that the research system should have the capacity to adequately screen new materials coming from international centers and other sources. If this is not done extensively and researchers continue to release varieties to farmers that do not meet local consumer standards, farmers may soon lose faith in the researchers' ability to satisfy their demands. There have even been cases in which some of the international centers have asked that their germplasm be tried at farm level without going

through any screening procedure at the experiment station level. And often international scientists have placed too much emphasis on yield without paying any attention to consumer preferences or other characteristics. Food preferences vary from one nation to another and the international centers cannot satisfy all the diverse national demands. It is for this reason that IAR has a Nutrition Unit that among other things, evaluates new and promising crop varieties for characteristics such as cooking quality, cooking time, etc. It is an essential component of the NARS's capacity to screen technologies for local adoption.

The NARS of Sierra Leone has one advantage in gaining access to external knowledge: that is its close link to the university. A lot of new scientific information enters the country via the university. Having access to its library promotes the flow of this useful basic knowledge, as does the exchange of personnel between the university and the research institutes. Agricultural researchers in IAR and RRS are also active in many networks which provide the NARS with useful short-term and applied information. The two knowledge sources are complementary, but more could be done to improve the management of scientific information in the agricultural research components in order to cope with the ever-increasing flow of scientific information.

## **Networks and Collaborative Research: Costs and Benefits**

Collaborative networks for tackling common problems within the continent and the subregion have been growing fast. Among the networks in which national institutions and individual scientists are participating are the African Biosciences Network, the African Rural Social Sciences Research Networks, the West Afri-

can Technology Policy Studies Network, the Mangrove Swamp Rice Research Network, AFNETA, the West African Farming Systems Research Network, Conference de Responsable par la Recherche Agricole en Afrique (for manioc), and the West African Work Oxen Research Network.

These networks vary considerably in their scope and mode of operation. Some deal directly with individual scientists while others have formal ties with research institutions and pass their funds through them. In several cases where funds are passed through local institutions, researchers have complained that the processes through which the researcher has to go to obtain the funds are very cumbersome and unduly delay the project. On the other hand, there have been cases of misuse of project funds by individual scientists when such funds were paid to them directly.

There is no disputing that effective collaborative regional research networks in specific areas could be most beneficial to Sierra Leone. Such networks could undertake well-defined projects that provide solutions to specific production and utilization problems of national and regional importance. These might include germplasm collection, postharvest technology, exchange of information, collaborative meetings, regional workshops, and training at technician and graduate levels. However, the operation of the networks has not been absolutely satisfactory. Networks working on similar research agendas but sponsored by different countries, international agricultural research cen-

ters, and other donor agencies have often competed with each other for the allegiance of the national system's scientists. Since the country's national program does not have many scientists working on a particular crop or discipline, scientists tend to be overstretched working with different networks. Organizations that sponsor networks have ignored this problem; in most cases networks tend to recruit individual scientists without paying due attention to the needs and priorities of the national institution.

The kinds of networks that appear to be most beneficial to the Sierra Leone national research system are those with well-defined but limited scope, unlike some of the present networks, which have very wide scope. Another area of concern is the fact that most of the network projects are not well integrated into a national program, thus resulting in the collapse of such projects when network funding ends.

NARS managers will have to take a more active role in decisions about which networks to participate in and what level of participation is most appropriate. The formulation of national priorities under NARCC would provide a sound basis for decisions on network participation.

## Leadership Role within the Region

Should a small NARS play a leadership role globally or regionally in research into a particular crop or problem? In the case of rice, Sierra Leone has been a contributor of technology and information to international rice research. In other areas, the national system has been able to select superior cultivars that are performing well under local conditions. Sweet potatoes are one example where new varieties have been adopted by farmers throughout the country and the crop has become an important cash crop in many areas. The

varieties have also been distributed to several countries in the subregion. Research problems facing the sweet potato in the region, such as scab disease, rapid propagation techniques, and leaf harvest frequency for optimum root yield can best be addressed nationally. The international centers, however, may not consider these problems important enough globally to warrant sustained work.

The recent experience with sweet potatoes suggests that the national system can

indeed play a leadership role in specific areas. IITA no longer has the mandate for research on sweet potatoes, and since this mandate was transferred to Centro Internacional de la Papa (CIP), there has been practically no collaboration in sweet potato research between the Sierra Leone research system and any international agricultural research center. There is not much sweet potato research being done in West Africa, but because of its importance to the national diet, Sierra Leone has conducted applied research on its own, and IAR has released several varieties that have been widely adopted in the country.

As can be seen from the resource allocations within the national research portfolio, the bulk of national resources are in rice research. This is one way this small country could make claim to leadership within a regional system of rice research. However, it still remains to be seen if this concentration of resources on a single crop can be maintained at the national level. Technology generation on a single

commodity is difficult for a small country if it is to cope with an ever-expanding research agenda. If the beneficiaries of Sierra Leone's rice research are regional as well as national, it is not unreasonable to expect external support for a research institution that has benefitted many rice farmers throughout West Africa.

Given the unique place that sweet potatoes and fresh cassava have in the national diet, Sierra Leone could also maintain a research program in tubers, aimed at generating technologies of benefit to several West African countries.

However, maintaining two or more programs for technology generation is already straining the country's human and financial resources. The future of Sierra Leone's leadership in these areas depends on the mechanisms that emerge to establish a division of labor among West African NARS and to provide external support to national programs.

## Human Resource Factors in Research Linkages

The national research system has been able to work closely at the farm level partly because of the comparatively high number of well-qualified scientific staff. The experience in Sierra Leone has shown that scanning and evaluating new technologies for transfer or adaptation to local conditions is also a complex task that requires sophisticated scientific understanding and good access to external sources of knowledge. Again, highly trained staff who can assume broad responsibilities for research and technology development are essential. Despite the turmoil, stress, and turnover in the public sector and the economy, the NARS institutions have been able to cling to the minimum standards that are essential.

The establishment of a single research career structure under NARCC has helped

maintain standards that are comparable across institutions. There are still many small teams of scientists operating in several departments and in isolated locations, but now there is the promise of professional stability and a link to the national scientific and development community.

Researchers with Bachelor's degrees are appointed research assistants and should obtain their Master's degree before being promoted to assistant research officers. After two years of work as assistant research officers, they are eligible for promotion to the level of research officer. There are openings for promotion to the grade of senior research officer for individuals who have served for a minimum of five years as a research officer and have a good publication record. There are also

openings for appointment as principal and chief research officers, which are equivalent to associate professor and professor in the university. The criteria for appointment to these positions are a minimum of seven years' service in research, a very good publication record, and having had one's papers assessed by three scientists of senior rank from outside the country who are specialists in the subject areas of the prospective appointee.

The high standard of qualifications demanded for researchers in the national system may appear stringent, but it is only by having such standards that good-quality research work can come out of the research system. The emphasis on high qualifications, good-quality research, and the involvement of researchers at the farm level is a good example to other small NARS with financial and manpower constraints.

## Consolidating the Agricultural Research System

Although there has been a relatively long history of agricultural research in Sierra Leone, there has been no consolidated system for national agricultural research. In the period before independence, this could be attributed to the regional character of agricultural research in the country. The regional institutes tended to interact with other countries in the region rather than with the specialist institutions within the country. It would be safe to conclude that, from a national viewpoint, the research system was inadequately coordinated, directed, and funded until recently, and the mechanisms for disseminating research results were inadequate. Recent improvements in these areas have largely resulted from the creation of NARCC and the establishment of IAR. The areas where there is still room for improvement are discussed below.

- **Research policy.** Only recently have steps been taken to provide a unifying policy and systematic communication between fragmented research institutions. There is still an appreciable amount of duplication of effort and some unproductive rivalry which the country can ill afford in its present

economic crisis. A body to coordinate research and to link research with extension is critical for the future of Sierra Leonean agriculture.

- **Coordination.** NARCC was relatively inactive after its establishment, until 1989 when it started receiving government funding. Since then it has taken actions in the area of research policy and coordination that are beginning to define a more coherent national system. One of NARCC's first steps was to increase its own autonomy so as to be able to function outside the civil-service bureaucracy and to secure high-level support from the government. The NARCC's present membership of highly qualified and influential professionals and research leaders is appropriate to its mandate; however, the embryonic staff is not adequate to the coordination, monitoring and evaluation, information, and development tasks that it is supposed to perform. At the implementation level, the two institutions under its umbrella, RRS and IAR have qualified and motivated staff to assure the realization of its objectives. However, other institutional components involved in research may need to be

linked under NARCC. This could improve the effectiveness of the NARS as a whole.

- **Over-sight.** There has increasingly been a need for NARCC to assume a greater role in securing and allocating funds for the various institutions. It should also be more involved in the monitoring and evaluation of research. NARCC should be responsible for overseeing the recurrent personnel and operations costs of research institutions, and it should be able to award the funds it solicits from government and international agencies to agricultural scientists in the research stations, university, and other institutions. The criteria for such awards should be made public, and scientists should be encouraged to submit proposals on topics of high national priority. Performance should be reviewed regularly to ensure that funded proposals do not drift away from the NARCC's objectives.
- **Strategic planning.** NARCC should be able to produce a national policy, priority, and strategy paper for agricultural research and technology diffusion; annual plans for research and technology diffusion; implementation procedures and criteria for evaluating, authorizing, funding, and monitoring agricultural research proposals; as well as journals and bulletins on agricultural research and technology diffusion.
- **Borrowing and adapting.** Agricultural researchers in Sierra Leone should devote a substantial part of their time to adapting the information and genetic material produced locally and in the international centers for the benefit of local resource-poor farmers. It is in this regard that the role of adaptive research could be emphasized. Researchers need to see the smallholder family as a participant in the research and extension process rather than merely as a client for the end product.
- **Linkages.** The present research-extension link in the country is not strong. There is a need for teams of trained professionals working under

the auspices of the research institutions and NARCC who will participate in every stage of the research-extension process. They should be able to undertake diagnostic surveys, assist in problem selection, oversee on-farm trials and demonstrations, organize training for extension personnel, prepare information bulletins, organize field days, and assist in the design and distribution of technological packages. They should be able to provide an invaluable link between farmers and researchers by transmitting farmer's concerns to researchers.

- **Outreach.** NARCC should be active in extending the impact of research by doing such things as organizing field days, workshops, and seminars for farmers and extension agents, as well as producing newsletters, information bulletins, and radio broadcasts. NARCC's communications should address the concerns of resource-poor farmers and should cover such areas as crop production and food processing, storage, and preparation. NARCC should also inform policymakers and research stakeholders of achievements and constraints.
- **External support.** Sierra Leone will require external support for its research system in the short to medium term. NARCC could be a useful means of avoiding duplication of projects and making the most of external resources. At the same time, it could articulate national priorities so that they and not donor preferences guide activities and resource allocations. The major gaps in research can begin to be filled first by improved coordination of existing research capacity. That is a role that belongs to no single institution but to a body like NARCC, which represents the entire system. The prospects for improved policy and coordination offer the hope that Sierra Leone's distinguished research tradition will continue uninterrupted.

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# Annex

## Sierra Leone Government Subvention to Agricultural Research Institutions

| Institution   | Year | Amount<br>(Nominal Leones) | Amount<br>(Constant Leones) | Amount<br>(Constant 1987 US\$) |
|---|------|----------------------------|-----------------------------|--------------------------------|
| Institute of Agricultural<br>Research (Njala)             | 1989 | 3,350,000                  | 156,469                     | 50,852                         |
|   | 1990 | 11,000,000                 | 2,710,027                   | 88,076                         |
|   | 1991 | 66,000,000                 | 8,991,825                   | 292,234                        |
| National Agricultural<br>Research Council                 | 1990 | 4,500,000                  | 1,108,648                   | 36,031                         |
|   | 1991 | 12,520,000                 | 1,705,722                   | 55,436                         |
| Rokupr Rice<br>Research Station                           | 1985 | 1,350,000                  | 5,378,486                   | 174,801                        |
|   | 1986 | 1,350,000                  | 3,375,000                   | 109,688                        |
|   | 1987 | 1,490,000                  | 1,490,000                   | 48,425                         |
|   | 1988 | 4,490,000                  | 3,064,846                   | 99,608                         |
|   | 1989 | 9,100,000                  | 4,250,350                   | 138,136                        |
|   | 1990 | 25,000,000                 | 6,159,153                   | 200,173                        |
|   | 1991 | 75,000,000                 | 10,217,984                  | 332,084                        |
| Land & Water<br>Development Division                      | 1987 | 900,000                    | 900,000                     | 29,250                         |
|   | 1988 | 2,300,000                  | 1,569,966                   | 51,024                         |
|   | 1989 | 3,300,000                  | 1,541,336                   | 50,093                         |
|   | 1990 | 4,600,000                  | 1,133,284                   | 36,832                         |
|   | 1991 | 23,000,000                 | 3,133,515                   | 101,839                        |
| Planning, Evaluation &<br>Monitoring Services<br>Division | 1989 | 1,520,000                  | 709,949                     | 23,073                         |
|   | 1990 | 3,650,000                  | 899,236                     | 29,225                         |
|   | 1991 | 10,000,000                 | 1,362,398                   | 44,278                         |