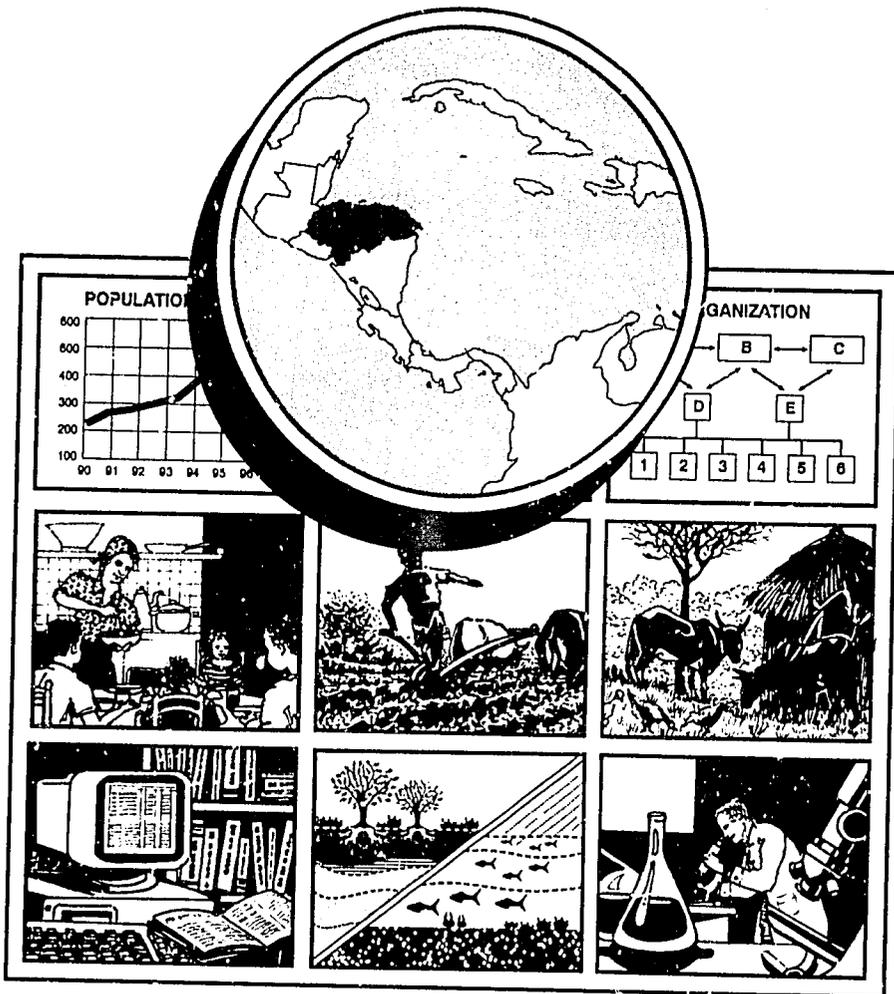


PN-ABN-459
8:227



The Organization of a Small-Country Agricultural Research System with Broad Research Demands: Institutional Diversity in Honduras

Mario Contreras



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 16 centers in the CGIAR system of international centers, ISNAR is the only one that focuses specifically on institutional development within national agricultural research systems.

STUDYPAPER # 4

**The Organization of
a Small-Country
Agricultural Research System
with Broad Research Demands:
Institutional Diversity in Honduras**

Mario Contreras

isnar

**International Service for National Agricultural Research
1992**

Citation:

Contreras, M. 1992. The organization of a small-country agricultural research system with broad research demands: Institutional diversity in Honduras. ISNAR Small-Countries Study Paper No. 4. The Hague: International Service for National Agricultural Research.

AGROVOC Descriptors

case studies; management; organization of research; research; research policies; technology transfer; Honduras

CABI Descriptors

agricultural research; case studies; management; organization of research; research; research policy; technology transfer; Honduras

Contents

ISNAR Small-Country Project	<i>v</i>
Acknowledgements	<i>ix</i>
Abstract	<i>x</i>
Acronyms	<i>xii</i>
Introduction	1
Country Profile	2
Agricultural Sector	3
Profile of Agricultural Research	4
Demand for Agricultural Research	4
Institutional Evolution	5
Scope of Research	7
Issues in the Institutional Research Portfolio of Honduras	9
Institutional Research Components	11
Overview of the National Scale of Research	11
The Banana Industry	12
Research Mandate and Functions	13
Management Structures	13
Scope of Research Activities and Programs	13
Scale of Research	15
Linkages	15
Discussion	16
Ministry of Natural Resources	16
Research Mandate and Functions	17
Management Structures	17
Scope of Research Activities and Programs	19
Scale of Research	21
Linkages	21
Discussion	22
Instituto Hondureño del Café	23
Research Mandate and Functions	23
Management Structures	23
Scope of Research Activities and Programs	24
Scale of Research	25
Linkages	25
Discussion	26
Escuela Agrícola Panamericana	27
Research Mandate and Functions	27
Scope of Research Activities and Programs	27
Scale of Research	27
Linkages	27

Centro Nacional de Investigación Forestal Aplicada	29
Research Mandate and Functions	29
Scope and Scale of Research Activities and Programs	30
Linkages	31
Fundación Hondureña de Investigación Agrícola	31
Research Mandate and Function	32
Management Structures	32
Scope of Research Activities and Programs	33
Scale of Research	35
Linkages	35
Discussion	37
External Linkages	37
Regional Linkages	37
International Linkages	38
Conclusion	39
Research Policy and Planning at the National Level	40
Links to Producers	41
Human Resource Planning in a Small, Complex NARS	41
Implications of the Current National Research Portfolio	41
Bibliography	44

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 policymakers, 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

In 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.

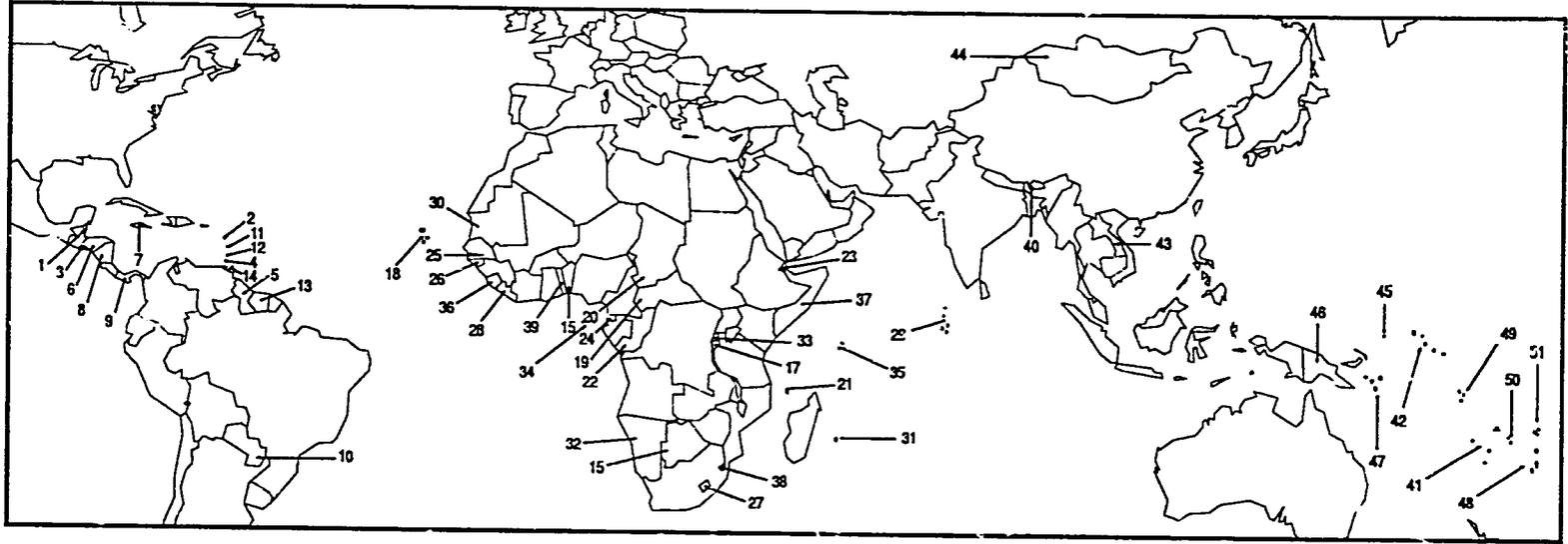
Dissemination of Results

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

Acknowledgements

The author acknowledges and expresses his appreciation to Carlos Zacarías for his invaluable technical inputs and thoughts in developing this study. Pablo Eyzaguirre provided continual support and enlightened guidance during the execution of the study and final preparation of the paper. Peter Ballantyne, Carlos Valverde, Barry Nestel, and César Falconi reviewed and provided useful comments for which I am grateful. Appreciation is extended to the editor, Michelle Marks, and to Lynette Thomas who assisted in editing, layout, and graphics, as well as to Richard Claase who prepared the map. The many people in Honduras who contributed the essential information in this study are acknowledged in the text, and to them I extend my sincere appreciation.

Abstract

This study discusses the institutions that make up the national agricultural research system (NARS) of Honduras. This small developing country has an extensive research capacity comprised of a variety of government, parastatal, university, and private institutions. These include the crop and livestock research departments of the Ministry of Natural Resources and the research units of commodity institutes such as the Instituto Hondureño del Café (IHCAFE), for coffee, and the Centro Nacional de Investigación Forestal Aplicada (CENIFA), for forestry. The private sector plays a crucial role with the participation of the Fundación Hondureña de Investigación Agrícola (FHIA) and the research departments of two private agro-export multinationals. The universities, including the Pan American School of Agriculture (Escuela Agrícola Panamericana — EAP), are increasingly important contributors of research on natural resource management.

The analysis of the research activities of this complex mix of institutions describes a research portfolio covering a broad research scope with limited resources. This study contributes to knowledge on the make-up and management of NARS by showing how a variety of research institutions can be mobilized into one national system. It concludes that while Honduras has a complex but workable research system given the country's size, greater policy coordination is needed to get the most out of the existing portfolio of research institutions and investments and to address emerging issues in natural resource management.

Résumé

Cette étude présente une discussion sur les institutions qui composent le système nationale de recherche agricole (SNRA) d'Honduras. Ce petit pays en voie de développement a une capacité de recherche considérable basée sur une grande variété d'institutions gouvernementales, parastatales et privés, ainsi que des centres universitaires. Inclus dans ce système sont les départements de recherche agronomique et d'élevage du ministère des ressources naturelles, les unités de recherche des Instituts de produits de base tel que l'Instituto Hondureño del Café (IHCAFE), pour le café, et le Centro Nacional de Investigación Forestal Aplicada (CENIFA), pour les forêts. Le secteur privé joue un rôle important avec la participation de la Fundación Hondureña de Investigación Agrícola, une fondation de recherche, et les départements de recherche des deux entreprises multinationales privées d'exportations agricoles. Les universités, y compris l'École Agricole Panaméricain, deviennent de plus en plus importants avec leurs contributions à la recherche sur la gestion des ressources naturelles.

L'analyse des activités de recherche de cet ensemble complexe d'institutions présente un portefeuille de recherche national d'une envergure et portée considérable avec des ressources limitées. Cet étude contribue à la connaissance globale de la composition et de la gestion des SNRA en démontrant comment un ensemble d'institutions de recherche peuvent être mobilisés dans un seul système national de recherche agricole. Les conclusions de l'étude sont que l'Honduras a établi un système de recherche complexe mais fonctionnelle par rapport à sa taille; il le faut une meilleure coordination au niveau des politiques de recherche afin d'optimiser les rendements du portefeuille actuel des institutions de recherche et de répondre aux besoins d'une gestion plus efficace et durable des ressources naturelles.

Resumen

Este estudio se basa en una discusión de las instituciones que forman parte del sistema nacional de investigación agropecuaria (SINIA) de Honduras. Siendo un país pequeño y con recursos limitados, Honduras ha logrado una capacidad nacional de investigación compuesta de una variedad de instituciones gubernamentales, para-estatales, privadas, y centros universitarios. Estos incluyen los departamentos de investigación agrícola y pecuaria del Ministerio de Recursos Naturales además las unidades de investigación de los institutos de las industrias de exportaciones agrícolas como el Instituto Hondureño del Café (IHCAFE) y el Centro Nacional de Investigación Forestal Aplicada (CENIFA). El sector privado juega un papel clave dentro del sistema a través de la participación de la Fundación Hondureña de Investigación Agrícola (FHIA) y los departamentos de investigación de las dos empresas multinacionales de exportaciones agrícolas. Las universidades, incluyendo la Escuela Agrícola Panamericana contribuyen cada vez mas al la investigación sobre el manejo de los recursos naturales.

El análisis de las actividades de investigación de este complejo de diversas instituciones presenta un portafolio que abarca un amplio enfoque con recursos limitados. Este estudio presenta nueva información sobre la composición y manejo de SINIAS indicando como varios tipos de instituciones se pueden movilizar para contribuir a un solo sistema nacional. El estudio concluye que Honduras tiene un sistema complejo pero funcional considerando el tamaño del país; una mejor coordinación es imprescindible para aumentar la productividad de las instituciones de investigación existentes. Un sistema de investigación mas coherente podrá continuar a satisfacer las necesidades de apoyar las industrias de exportaciones agrícolas, responder a las necesidades de la seguridad alimentar, y contribuir al manejo eficiente y sostenible de los recursos nacionales.

Acronyms

CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CENIFA	Centro Nacional de Investigación Forestal Aplicada
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro Internacional de Mejoramiento del Maíz y Trigo
CIP	Centro Internacional de la Papa
COHDEFOR	Corporación Hondureña para el Desarrollo Forestal
COPROFORH	Centro de Utilización y Promoción de Productos Forestales Hondureños
CURLA	Centro Universitario Regional del Litoral Atlántico
DIA	Departamento de Investigación Agrícola
DIP	Departamento de Investigación Pecuaria
DIPESCA	Dirección de Pesca
EAP	Escuela Agrícola Panamericana
ESNACIFOR	Escuela Nacional de Ciencias Forestales
FHIA	Fundación Hondureña de Investigación Agrícola
IARC	international agricultural research center
IHCAFE	Instituto Hondureño del Café
IICA	Instituto Interamericano de Cooperación para la Agricultura
IPM	Integrated pest management
INIBAP	International Network for the Improvement of Banana and Plantain
ITTO	International Tropical Timber Organization
IUFRO	International Union of Forestry Research Organizations
MRN	Ministerio de Recursos Naturales
NARS	national agricultural research system
PCCMCA	Programa Centroamericano para la Cooperación en el Mejoramiento de Cultivos Alimentarios
PROCACAO	Programa Regional Cooperativo de Cacao
PRECODEPA	Programa Regional Cooperativo de Papa
PROMECAFE	Programa Cooperativo para la Protección y Modernización de la Caficultura
ROCAP	Regional Office for Central American Programs (USAID)
STICA	Servicio Técnico Interamericano de Cooperación Agrícola
UFC	United Fruit Company
USAID	United States Agency for International Development
WINBAN	Windward Islands Banana Growers' Association

Introduction

It has been widely asserted that small developing countries, especially those with small populations and low incomes, cannot afford large, comprehensive agricultural research systems. Honduras, a predominantly agricultural country with one of the lowest per capita incomes in Latin America, falls within this category. While its limited resources place a major constraint on the size of research institutions and the scale of the research effort, the demand for information and technology to increase productivity is great.

Honduras has an extremely varied natural environment that produces a wide range of agricultural products, including traditional exports that are the country's principal source of foreign exchange. Its natural resource base, which includes temperate mountain forests, tropical rain forests, a variety of soils, and coral reefs, is rapidly being depleted. The need to improve rural incomes and decrease dependence on a few export crops through diversification has led to efforts to find new crops and products that can be integrated into existing production systems as well as making better use of underutilized resources and regions. Thus, with very little money and few people to devote to finding research-based solutions, Honduras has a pressing need for research to cover a wide scope of topics. Managing the contradiction between the limited scale of the research system and the broad scope of research that is needed is the central problem for the managers of this national agricultural research system (NARS).

Given the limited capacity of government to fund agricultural research, the importance of export crops, and the need for research to address basic resource man-

agement issues, this study examines the evolution of the various institutions comprising the national agricultural research system and assesses ways in which their performance can be optimized to meet national goals. The major finding of this study is that Honduras has limited opportunities to build large research institutions capable of covering a broad scope of research in the public, private, or parastatal sectors. It must instead consider the diversity of its research institutions as an asset. There is a need, however, to coordinate the existing research components and institutions around a national research policy that meets the needs of producers and development.

Many analyses of research look at fractions of the national research effort and propose organizational models that build the NARS on a single stem, be it public, private, or parastatal. This study, however, examines all of the components that contribute to the scale of Honduras's agricultural research effort and it identifies the comparative advantages of different types of research institutions to conduct research in distinct domains.

Since not all the demands for technology and advice can be met by research in the country, Honduras must find efficient ways of making use of the research results and technology developed both in the region and further afield. It must scan knowledge and technology sources, develop a thorough understanding of the farming systems and environments where technologies are needed, and screen and adapt technologies for local suitability. In these activities, the involvement of Honduras in regional research and development efforts is a critical factor.

ment is promoting export diversity, including such high-value, nontraditional commodities as vegetables, fruits, nuts, spices, and shrimp.

Although the economically active agricultural population is about 800,000, only 20% of these are fully employed. Land

tenure patterns in Honduras show a preponderance of small farmers. About 125,000 farms (63% of the total) occupy 239,000 ha of land — an average size holding is about 1.9 ha. A further 170 farms, with 1000 ha or more, occupy a total of 400,000 ha.

Agricultural Sector

An estimated 22%, or 2.4 million ha, of the country's total land mass has the potential to sustain intensive or permanent cropping. An additional 16% (1.8 million ha) is suitable for tree crops and pastures. The rest of the country is best suited for permanent forests and wilderness (COHDEFOR 1979; Stover 1989).

Most agriculture is rainfed. Only some 70,000 ha are under permanent irrigation. Some of the irrigated land is used for bananas (20,000 ha) and sugarcane (10,000 ha). The rest is used for small public-sector irrigation districts and small farm systems (Proyecto Nacional de Riego y Drenaje 1988). Most of the rainfed land is used to produce pulses and staple food grains — maize, field beans, rice, and sorghum. Their production is left mostly to small- and medium-sized farms. Production technology is traditional and yields tend to be low and erratic.

About 350,000 ha are under maize, with an average national yield of only 1.2 mt/ha. Yields of nearly double that are attained on the better soils using improved crop management. Honduras is currently a net importer of maize. Field beans are the second most important staple food crop. Beans are grown on 70,000 ha, yielding an average 600-700 kg/ha. Low prices and pest problems have contributed to a steady decline in yield and production of this traditional staple. Rice, on the other hand, has shown a considerable expansion in cultivated area, with average yields increasing to 2.5 mt/ha on

about 16,000 hectares. Another increasingly important cereal is sorghum which is planted on about 40,000 ha as a subsistence crop in the dry south. Yields average about 200 kg/ha and it is used both for human and animal consumption.

Bananas are the country's most valuable crop, with annual production and export of close to 50 million boxes (1 million mt). Production is carried out on technically sophisticated farms occupying about 20,000 ha in northern Honduras. The banana industry is largely in the hands of transnational corporations, although an increasing number of local investors and farmers are becoming involved. Honduras exports over 150,000 mt of coffee per year, but in contrast to bananas, coffee is produced on about 60,000 small- and medium-sized farms (Gonzales 1990). Other important food, industrial, and export crops are sugarcane (40,000 ha), citrus (30,000 ha), oil palm (15,000 ha), plantain (10,000 ha), and vegetables (10,000 ha). Tobacco, cotton, and minor food crops are produced for local consumption.

Livestock accounts for 25% of the total agricultural gross domestic product with about 2.3 million ha (20%) under pasture. Honduras exports beef cattle but imports powdered milk. Most cattle production is dual purpose (beef and milk) and farms tend to use low-input production technologies. There is a well-developed poultry industry, made up of both large and small broiler and egg production farms. The swine industry is much less developed.

In recent years, cultivated shrimp production has emerged as a growing and profitable export enterprise, especially in the Pacific coastal mangrove zones. Exports were valued at US\$150 million in 1989, third only to bananas and coffee as foreign exchange earners.

Honduras has an estimated 7.4 million ha of forest. Of this, some 5 million ha are still productive, while the remainder have been depleted by poor management, graz-

ing, fire, and shifting agriculture. In areas with high population pressure, lands that should be under forests or conservation management are used for crops and extensive cattle production. There is also a significant increase in the use of firewood for household fuel. Because Honduras has few readily available sources of energy, production systems that make efficient use of natural resources need to be identified and promoted.

Profile of Agricultural Research

Demand for Agricultural Research

Given the current low yields of the major staple food crops, there is great potential for improving the productivity of Honduran agriculture. Coupled with the need to diversify exports is the need to continue research on traditional export crops to maintain quality, conserve market share, and prevent the spread of catastrophic disease and pests. Given the depletion of the country's forest resources, the apparent potential for marine aquaculture, and the need to protect the coastal environments, there is an urgent need for research to inform national policies on the environment and to identify sustainable ways of exploiting the country's remaining forests and marine resources. For some development objectives, such as diversification and conservation, socioeconomic research on marketing, inputs, and ways of integrating new crops into existing production systems is essential.

While the fiscal capacity of government is very limited and the institutional development of the economy is weak, particularly in agriculture, the demand for agricultural research is broad. Among the coun-

try's needed research objectives are the following:

- increase the productivity of staple food crops;
- maintain the productivity and competitiveness of traditional exports, coffee and bananas;
- include the minor horticultural crops that are crucial to the balanced nutrition of the population;
- improve the efficiency of livestock production;
- identify new high-value export crops;
- provide information and techniques to manage the natural resource base in a sustainable way;
- conduct studies on socioeconomic factors, marketing, inputs, infrastructure, and policies that are essential for growth.

This study looks at ways in which Honduras has mobilized its existing institutions

as well as external resources to meet these broad demands for research.

Institutional Evolution

The present system of agricultural research in Honduras is comprised of a mixture of public-sector, private-sector, parastatal, and academic institutions and organizations. Table 1 identifies the major research institutions and components.

Initially, the agricultural research system developed from the activities of transnational companies with traditional export crops. In the mid-1920s the Honduran banana industry had to face production and disease problems. The yellow sigatoka and Panama diseases forced banana companies to establish vigorous research programs. Until the 1950s, banana research was the main agricultural research activity in Honduras.

The United Fruit Company (UFC) consolidated its research operations in its Tropical Research Center at La Lima in 1933-34, which later became the foremost applied research center for banana in the world (Sierra 1989). Its research programs fulfilled the needs of the trade, but in the meantime, other research demands emerged as a result of population growth and the modernization and institutional development of the public sector. This included the establishment of a government agricultural service program for extension, education, and research. To this effect, Honduras became a signatory of the Servicio Técnico Interamericano de Cooperación Agrícola (STICA), a US-sponsored program designed to assist the de-

Table 1. Institutional Profile of NARS in Honduras, 1992

Institution	Type of Organization	Parent Body
Departamento de Investigación Agrícola (DIA)	Government research organization	Ministry of Natural Resources
Departamento de Investigación Pecuaria (DIP)	Government research organization	Ministry of Natural Resources
Centro Nacional de Investigación Forestal Aplicada (CENIFA)	Parastatal, university-based research center	Escuela Nacional de Ciencias Forestales (ESNACIFOR), Corporación Hondureña de Desarrollo Forestal (COHDEFOR)
Departamento de Investigación y Servicios Técnicos, Instituto Hondureño del Café (IHCAFE)	Parastatal, commodity board	IHCAFE is an autonomous statutory organization created by the Government of Honduras
Fundación Hondureña de Investigación Agrícola (FHIA)	Private, nonprofit foundation	FHIA has an independent board of trustees
Escuela Agrícola Panamericana (EAP)	Private agricultural university	EAP has an independent board of trustees
Research Department, Standard Fruit Company	Transnational corporation	Standard Brands, subsidiary of Castle & Cook, USA
Technical Services Department, Chiquita Brands	Transnational corporation	Chiquita Brands Corp. formerly United Fruit Co., USA

velopment and strengthening of public agricultural services in the region.

The STICA program initiated adaptive research on staple food crops and livestock in the 1950s. It introduced and tested improved maize, bean, and rice varieties, as well as livestock, in the important agricultural zones of the country. Honduran professionals were trained both in-service and abroad, supported by expatriates where needed. The program was administratively independent of the central government, with joint participation and decision making by Honduran and US directors (Zacarias 1990). From 1953 to 1962 the STICA program was given the necessary flexibility and efficiency to run its field operations smoothly. Although small (about 10 researchers and 35 extension agents), the program was very effective in introducing food crop varieties and improved livestock. The impact was notable due in part to the low technical level of farm management at that time.

In 1962 the Honduran government reorganized its Ministry of Agriculture, and a new research department was created in the Directorate for Rural Development. This department developed a network of experimental farms in the major agricultural regions of the country, it trained and recruited Honduran professionals to run its crop and animal research programs, and it developed linkages to regional and international programs and centers. Later, crop and livestock research were separated and placed in the Departments of Agriculture and Livestock, respectively. Their mandates still focus mainly on staple crop and livestock commodities. Some work is dedicated to crop diversification.

Coffee research is conducted by the Instituto Hondureño del Café (IHCAFE), an autonomous and administratively decentralized organization dedicated to the promotion, marketing, regulation, and technical production assistance of coffee. IHCAFE is supported directly by producers through a tax levied on coffee exports

(Villatoro 1990). The IHCAFE research program has recently embarked on work to diversify coffee farms by including other crops and activities compatible with the coffee production system. Apart from research, IHCAFE's central experiment station is also used for training farmers and extension agents.

Support for diversification was enhanced in 1984 when the Fundación Hondureña de Investigación Agrícola (FHIA) was created through the joint action of the Ministry of Agriculture, the United States Agency for International Development (USAID) and the United Brands Company (formerly United Fruit Co., now known as Chiquita Brands). FHIA was set up to support agricultural exports and diversification through research, communication, and technical services oriented to producers and investors in the country. FHIA represents an innovative model, given its private organization and management and its public and open service orientation with regard to its products.

The Pan American Agricultural School (Escuela Agrícola Panamericana — EAP) was established in 1943 and has since developed into an outstanding international college for tropical agriculture. The school has intermittently carried out adaptive research projects, which have resulted from individual initiatives from staff members and occasional collaborative projects with different donors and organizations. EAP owns an extensive and well-managed land and laboratory infrastructure that permits sound research to be carried out, for semi-dry and dry areas, in particular. Since 1983, EAP has managed an integrated pest management (IPM) research and extension program focused on staple food and export crops. Moreover, students are often required to carry out production research and present results as part of the EAP baccalaureate program.

The Faculty of Agriculture of the Universidad Nacional Autónoma de Hondu-

ras trains agronomists but does not conduct organized applied or adaptive research programs in crop and livestock research. However, an effort has been underway to organize research on forest management, seed improvement, and wood products (Guevara 1989). Activities have centered on the Escuela Nacional de Ciencias Forestales (ESNACIFOR) at Siguatepeque. This technical school trains high school graduates in basic forest management and has provided the bulk of technical field staff for its parent organization, the Corporación Hondureña de Desarrollo Forestal (COHDEFOR). It is also directly responsible for the maintenance and improvement of the Lancetilla Botanical Garden in northern Honduras. In addition to the ESNACIFOR, the Centro

Universitario Regional del Litoral Atlántico (CURLA) is also a focal point for forestry research and training. Forestry research has recently been consolidated in the Centro Nacional de Investigación Forestal Aplicada (CENIFA), which is based within ESNACIFOR. These institutional developments may allow for an increase in the scale and scope of forestry research in the years to come.

These historical developments illustrate the major trends in the evolution of the Honduran NARS. The research capacity has not been created by mandate; rather, it has arisen from a variety of organizations addressing research problems in the various domains of the national research portfolio.

Scope of Research

If all the Honduran research institutions were brought together into one national system, it would encompass a fairly broad scope. It would be difficult to limit the scope of the coverage given national priorities and the demand for technologies and information. The analysis of the research portfolio in this study is based on a classification of research topics and agrotechnologies into seven groups for which the conditions of technology supply are roughly similar (table 2). These classes have been grouped according to the existing network of technology sources and flows, as well as availability and distribution. They are listed below:

- *Global staples:* major food crops with a global distribution, often the focus of work for international centers, the private sector, and most national systems. Information is widely available.
- *Traditional exports:* crops produced for the global market, with research often coming from the private sector and in-

formation readily available within restricted channels.

- *Minor food crops:* crops important to the local food producing sector but "orphans" in international trade and research. Access to information is often difficult.
- *High-input nontraditional exports:* crops grown for export to market niches, often tightly integrated in research, production, processing, and marketing through private-sector channels.
- *Natural resource management:* aimed at managing an existing resource; often location specific at the applied level and involving nongovernmental organizations but requiring strategic research at a scale that may need a transnational effort. Some of this research is long term and information based and is conducted in universities.

Table 2. Categories of Research Topics and Subjects

Global Staple	Traditional Export	Minor Food Crop	High-Input, Non-traditional Export	Livestock	Socioeconomics & Rural Engr.	Natural Resource Management
Bananas	Cashew nuts	Apples	Asparagus	SMALL RUMINANTS:	Farm production & management	Agroforestry
Beans	Cinnamon	Barley	Broccoli	Goats	Farm structures	Fisheries (fresh-water/marine)
Cassava	Cloves	Breadfruit	Brussels sprouts	Sheep	Farming systems research	Forestry
Cowpeas	Cocoa	Broad & mung beans	Cardamom	LARGE ANIMALS:	Marketing research	Pests, diseases, weed control and management
Groundnuts	Coconuts	Cabbage	Citrus	Cattle	Postharvest and storage	Plant genetic resources
Maize	Coffee	Carrots	Flowers/ornamentals	Horses	Machinery/tools/power irrigation	Range/pasture management
Potatoes	Cotton	Castor beans	Fruits	Camels	Rural engineering	Seed technology
Pulses	Oil palm	Chick peas	Ginger	Donkeys		Soil (fertility/erosion/conservation)
Rice	Rubber	Citrus fruits	Grapes	POULTRY/SWINE:		Irrigation/water management
Sorghum	Sisal	Date palms	Grapcfruit	Chickens		
Soya	Sugar	Figs	High-value vegetables	Ducks		
Wheat	Tea	Fruits (local use)	Jojoba	Turkeys		
	Tobacco	Garlic	Kava	Swine		
		Lentils	Mangoes	Animal traction		
		Melons	Papaya	Dairy technology		
		Millet (<i>Eleusine, Digitaria</i>)	Passionfruit	Diseases and pests		
		Mustard (seed)	Peaches	Husbandry and management		
		Nectarines	Pineapples	Nutrition/fodder/forage		
		Oats	Plums	Zootechnology		
		Okra	Pyrethrum			
		Onions	Quinquina			
		Pandanus	Ramie (textile fiber)			
		Peas (garden-)	Sour sop			
		Pears	Strawberries			
		Peppers	Sunflowers			
		Pigeon peas	Vanilla			
		Plantain	Ylang-Ylang			
		Radishes				
		Safflower (oilseed)				
		Sesame				
		Soya				
		Sunflowers				
		Sweet potatoes				
		Swiss chard				
		Taro (<i>Xanthosoma, Colocassia</i>)				
		Tomatoes				
		Triticale				
		Turnips				
		Vegetables (local use)				
		Yams (<i>Dioscorea</i>)				

- **Livestock:** research on all aspects of animal production and health, often coming from international research centers and veterinary research in more developed countries because of the scale and time required for successful outcomes.
- **Socioeconomics and rural engineering:** includes policy analysis, socioeconomic analysis of farmers' choices, production constraints, postharvest technology, marketing research, and farm structure; country-specific research employing widely applicable methodologies.

No one organization can marshal sufficient resources to cover the full agenda. However, by segmenting the national scope of research into a portfolio of activities and investments, a variety of organizations, most with fewer than 50 researchers can address the areas in which they have a comparative advantage. The result will be an institutionally complex but workable system requiring greater capacity to provide policy guidance and coordination at the national level.

Issues in the Institutional Research Portfolio of Honduras

Table 3 shows the distribution of Honduras's research institutions across the national research portfolio and provides the basis for considering the institutions' individual comparative advantages for research in their respective domains. Issues in the policy and technological environments arise from the national research portfolio and affect the comparative advantages of the research institutions.

Traditional exports, high-value non-traditional exports, and diversification. Research in Honduras arose from the private sector's concern to protect its market share of the country's traditional export crops. While banana research remains strategic to the national economy, it has wisely remained in private hands.

It is harder for companies to get a return to investments in the more upstream research on bananas, so this research has been transferred to a private, nonprofit foundation; research on production is still done by the companies. Research on new high-value export crops is also done by the private and parastatal sectors. Coffee is another traditional export that has a strategic place in the economy, but unlike bananas, it is produced on small- and medium-sized farms. No single private organization is large enough to bear the costs of coffee research as is done in the banana industry. Here there is a parastatal board to channel funds from coffee sales into research and development.

To support agricultural diversification, research can either identify new and promising crops for introduction or find new uses and markets for some of the minor traditional food crops (plantain or cassava). Research on diversification within the coffee production system is one way to stabilize the incomes of coffee farmers and maintain the quality of the crop. Research is also needed to monitor the pests and diseases that inevitably arise after a new crop has been established. The issue facing the Honduran NARS is how this research will be different from the industrial research that has been institutionalized to support the banana export sector. For high-value nontraditional crops, a high-risk, high-return, limited-investment strategy may be most appropriate. It may be best to emphasize socioeconomic and postharvest research, including market intelligence and plant protection, with flexible institutional arrangements in situations where the private sector can play a leading role.

Global staples, livestock, and food security issues. Food security is essential for the development and stability of a country. But this type of research does not yield short-term profits, and private-sector companies are not interested in it because it is difficult for them to appropriate benefits from it when there are

Table 3. Honduras: Research Components and Research Scope, 1990

NARS Institutions	Global Staples	Traditional Export Crops	Minor Food Crops	High-Input, Nontrad. Export Crops	Livestock	Socioecon. and Rural Engineering	Natural Resource Management
1. Ministry of Natural Resources a. DIA ¹	Beans Maize Potatoes Rice Sorghum						
b. DIP ²					Beef Cattle Dairying Feeds & Nutr. Pastures		Range Management
2. EAP ³	Sorghum			Melons		Farming Systems Research	Integrated Pest Management
3. IHCAFE ⁴		Coffee				Marketing	
4. a. Standard Fruit		Bananas		Pineapples Grapefruit			
b. Chiquita Brands		Bananas Oil Palm					
5. FHIA ⁵		Bananas Cocoa	Onions Peppers Plantain Tomatoes	Black Pepper High-Value Vegetables Mangoes		Marketing Socioecon.	
6. CENIFA ⁶						Social Forestry Studies Wood Uses	Forestry

1. DIA: Departamento de Investigación Agrícola.

2. DIP: Departamento de Investigación Pecuaría.

3. EAP: Escuela Agrícola Panamericana

4. IHCAFE: Instituto Hondureño de Café.

5. FHIA: Fundación Hondureña de Investigación Agrícola.

6. CENIFA: Centro Nacional de Investigación Forestal Aplicada.

many small, low-income producers. Therefore, the Ministry of Natural Resources has assumed responsibility for research on staple food crops and livestock. A key question is how the crop and livestock research departments can benefit from the many sources of technology and information that are available, to allow research efforts to concentration on those areas where technology is either not available or not suitable. Minor food crops are essential staples of the large community of small farmers. Information or technology on these crops may not be readily available and some research may be required to meet the needs of small farmers who produce a diverse range of crops.

Also, some minor food crops may eventually develop into high-value crops, depending on market opportunities. Some research capacity at the scanning and screening level is therefore needed.

Natural resource management. One issue that emerges clearly is the growing demand for research on the natural resource base. Forests and coastal resources are increasingly important to the economy, as they are becoming increasingly threatened by poor management. There is a gap in the research portfolio in natural resource management (NRM). Public-oriented research of this sort is done by a combination of university-

based research programs and centers, with some inputs from the crop and livestock departments. Institutionalized national forestry research is less than 10 years old and research on coastal marine resources is only just beginning to confront the many issues related to the increasing commercial use of this resource by the fisheries and shrimp industries. NRM research, while it is distinct in orientation, cuts across agriculture, livestock, forestry, and fisheries. Commodity research on food and export crops is increasingly tied to natural resource management issues which will expand the range of research partnerships to include nongovernment organizations (NGOs) and university-based research. Placing NRM research centrally within the NARS will require clear policies and coordination at the national level.

Increased contributions from socioeconomic and postharvest research. Many of the issues facing the NARS in Honduras will require greater inputs from research on markets, postharvest technologies,

farming systems, and national policies on natural resource use and management. This will be the case in diversification to nontraditional high-value exports and natural resource management, as well as in making more efficient use of information and technologies generated outside the country. The current analysis of the research portfolio shows a weakness in these areas and lays the basis for future discussions on how and where to establish a capacity for policy, socioeconomic, and postharvest research.

The following sections review the institutional components and research portfolio of Honduras. They explain in greater detail how institutional diversity has enabled a small, poor country to achieve a sufficient scale of research to cover the major domains of its national research portfolio. The analysis will also indicate a need for improved management and policy coordination to maximize the comparative advantages of the research institutions and increase the efficiency of the NARS as a whole.

Institutional Research Components

Overview of the National Scale of Research

A brief overview of the institutional components of the NARS in Honduras shows that the scale of the research system as a whole is not insignificant for a small, low-income developing country. For the seven organizations and the university-based research program that are part of the NARS, the total investment in research averaged about US\$8 million for the years

1989 to 1990. There were over 170 full-time research professionals employed by the various units within the research system. Table 4 shows the size of the research system in 1990. The following discussions analyze how the various institutions address the national scope of research and establish their comparative advantage within the national research portfolio.

Table 4. Resources and Expenditures in NARS Institutions, Honduras, 1990

Institutions	Researchers						Expenditures	
	Year	Total	PhD	MSc	BSc	Tech	Year	Amount
Departamento de Investigación Agrícola, Ministry of Natural Resources	1990	69 ^b	2	12	55	—	1990	US\$690,000 ^a (3,037,000 Lempira)
Departamento de Investigación Pecuaria, Ministry of Natural Resources						—		
Fundación Hondureña de Investigación Agrícola (FHIA)	1990	29	9	9	11	11	1990	US\$1,900,000 ^a (7,672,000 Lempira)
Research Department, Standard Fruit Company	1990	4	—	—	—	9	1990	US\$2,800,000
Research & Technical Department, Chiquita Brands	1990	5	—	—	—	7		
Centro Nacional de Investigación Forestal Aplicada (CENIFA)	1990	35	2	15	18	15	1989	US \$1,629,550
Research Department, Instituto Hondureño de Café (IHCAFE)	1990	21	0	5	16	6	1990	US \$310,000 ^a (1,278,000 Lempira)
Other Institutions								
Escuela Agrícola Panamericana (EAP) (Integrated Pest Management Program)	1990	30 ^d	5	9	16	—	1990	US\$590,000 ^c
Total		193	18	50	116	48		US\$8,048,550

a. Only approximate, based on average exchange rate in that period.

b. Seems to include nonresearch staff of the ministry as well.

c. Funding of the Integrated Pest Management Program only.

d. Includes all professional staff. Full-time equivalents in research estimated at seven person-years.

The Banana Industry

There are two major banana enterprises in Honduras: Chiquita Brands, which took over the former United Fruit Company, and the Standard Fruit Company, a subsidiary of Castle and Cook, USA. The former United Fruit Company began its research activities in the 1920s and established its Tropical Research Center at

La Lima in 1934. This outstanding tropical research program functioned uninterrupted until 1984, when it was transferred to the newly created Fundación Hondureña de Investigación Agrícola. Thereafter, the Banana Technical Services Department of Chiquita Brands assumed the research functions related to

current production practices, leaving the upstream and breeding research to the Foundation (Sierra 1989). Since the 1950s, the Standard Fruit Company has maintained a research department at its headquarters in La Ceiba, Honduras. Given the similarities in the nature and mandate of both research organizations, they are treated jointly where appropriate.

Research Mandate and Functions

Both research organizations are privately funded and supported by their parent companies. In consequence, they have proprietary rights over their research products. This is understandable in face of the extremely competitive nature of the world banana trade. The prime task of both organizations is to develop scientifically based technology for the benefit of their corporate operations, particularly in bananas. In addition, both research units provide support to the production of other complementary commodities of interest to their companies. In both programs, the potential profit derived from developed or adapted technology is the measure used for evaluating research output and the eventual technology adoption. Generally speaking, both research groups have three main functions within their parent organizations: first, to provide technology through research to overcome current production and postharvest constraints and to reduce costs; second, to foresee and prevent potential production limitations in their long-term operations; third, to explore the technical viability of new export commodities and systems. This encompasses both production and postharvest practices, i.e., from variety testing, agronomy, plant protection, and irrigation to harvesting, packaging, quality control, and product transportation.

Management Structures

Both research groups are organized as departments in their respective companies. In the case of Chiquita Brands, its Banana Technical Services reports to a

vice-president for research and development. The research unit is managed by a scientific research director headquartered at La Lima. The research director interacts closely with both the general managers and the production managers of the Honduras division, which facilitates prompt awareness among research staff of production and technical problems. Previously organized along disciplinary lines into several departments, Banana Technical Services staff is currently made up of a small interdisciplinary research group with considerable accumulated knowledge and experience. Some of this knowledge was inherited from the former departmental organization. The scientists are supported by highly skilled technical staff.

Both corporations have made successful and extensive use of highly trained non-professional technical staff over the years. This has helped to lower the operational cost of their research programs, while assuring excellent outputs from a small number of scientists.

Both organizations are allocated specific research budgets from their parent companies. Management is generally more concerned with programming, organizing, and implementing research activities than with procuring funds. In addition, given the extensive production operations, both organizations are able to test and validate technology within the context of a large and realistic commercial framework. Thus, technology is adapted to the needs of the regular production programs. In addition, these research groups serve as consultants for the banana industry in Honduras and the region as a whole.

Scope of Research Activities and Programs

Banana production and research in Honduras are conducted in the northern humid tropical zones of the country near the Atlantic coast. Production systems

have been geared to high yields, quality products, price competitiveness, and sustained production. The technical levels achieved in banana production and postharvest management are among the best in the world. Some farms have produced high banana yields continuously for the past 50 years.

The two companies have followed different production strategies, with Chiquita Brands continuing to focus on its banana operations while Standard Fruit has diversified its production base. In addition to bananas and oil palm, Standard Fruit also grows grapefruit, coconuts, and pineapples. In general, both companies use high-technology production systems with vertical integration to the market. Their two research services have traditionally maintained a very focused, problem-solving orientation, and their effectiveness has led their corporations to develop sophisticated and efficient agricultural production and marketing operations. Through research and modern management, banana production in Honduras has been transformed from an extensive and laborious activity to a more mechanized and less labor-demanding endeavor. The area under crop or fallow has been significantly reduced while yields have increased steadily. Yields of over 2200 export-quality boxes per hectare are common. Research has also provided improved technologies: under-tree and drip irrigation, as well as improved postharvest practices, including the now industry-standard boxing of bananas. Major technological achievements have prevented operations from collapsing. A good example is the way research was able to provide technologies to control fusarium wilt or panama disease that forced the abandonment of tens of thousands of hectares of fertile banana land in other parts of tropical America in the 1950s.

Research is generally applied and adaptive in nature. Basic research is contracted out to universities when needed. Field research is carried out in the ecolog-

ical context of production, by selecting experimental blocks in established commercial plantations. This allows research to maintain some practical relevance to the problem or opportunity under investigation. The disciplinary mix of both organizations closely follows the commodities of interest and their production practices. Agronomy, plant pathology, and postharvest technology have ranked high among disciplinary inputs to research. At the height of the black sigatoka foliar disease crisis of the early 1970s, United Fruit alone employed a team of 10 plant pathologists to address the problem. Presently, it only keeps one plant pathologist to monitor, forecast, and conduct more advanced research on this now controllable fungal disease. Both research groups make extensive use of qualified consultants, which widens the breadth of their potential technical contributions without high recurrent costs. Table 5 summarizes the current research programs of the two banana companies.

Another important contribution to banana and plantain research was the United Fruit banana breeding program in Honduras. This began with extensive collections of *Musa* species in Asia from 1957 to 1959 (Rowe and Richardson 1975). The program significantly improved the breeding of banana and plantain by selecting outstanding parental lines with good agronomic characteristics and resistance to disease. It also provided the base for genetic improvement of plantain that continues today as part of FHIA's activities.

The banana industry's research services have also made major contributions to agricultural production and export in other commodities. The African oil palm was introduced into Honduras by the banana companies in the mid-1950s and now covers about 20,000 ha, much of which is managed by Honduran nationals outside the banana industry. Similar introductions of melons, pineapples, grapefruit, soybeans, and ornamentals demonstrate that the activities and technological

Table 5. Banana Industry: Research Programs and Focus, 1990

Company/Commodity	Program	Focus
Chiquita Brands		
Bananas	Crop protection Fertilization	Sigatoka, lower costs Sustain yields
African palm oil	Fertilization	Sustain yields
Standard Fruit		
Bananas	Crop protection Soil fertility	Foliar disease, lower costs Sustain yields
Pineapples	Variety selection Pest management Fertilization	
Grapefruit	Pest management	Yield, fruit quality

Source: Standard Brands and Chiquita Brands Annual Research Reports (1989-1990).

products of these private research and development programs can spill over and become available to the general producer in the course of time.

Scale of Research

Both companies maintain minimal research facilities and staff. Table 6 shows the number of scientists and research technicians working full time in the banana industry in 1980, 1985, and 1990. The scale of the present research operation is modest compared to that of the recent past, although this could change as the world market expands, new technical problems are encountered, or diversification of the production base occurs. The combined investment of the two companies in banana research approached

US\$3 million in 1990, an increase from less than US\$2 million in 1985 but a significant reduction in both absolute and relative terms from the US\$4 million spent in 1980. And it is well below the annual expenditures of the sixties and seventies. It appears, however, that with the present level of effort both companies could maintain production levels indefinitely.

Linkages

Banana industry research services are corporate components of larger entities and have strong functional linkages to production programs. Technology is validated under semicommercial and commercial conditions and promptly adopted, if it is shown to give short- or long-term market advantages or economic gains.

Table 6. Banana Industry: Staffing for Research, in Person-Years

Company	Year		
	1980	1985	1990
Chiquita Brands			
Scientific	7	3	5
Technical	15	6	7
Standard Fruit			
Scientific	5	4	4
Technical	7	7	9

Source: Standard Brands and Chiquita Brands Annual Research Reports (1989-1990).

Linkages to industry, including agrochemical suppliers, are strong because their critical inputs to production are recognized. Conversely, banana companies are also important clients for the agricultural input industry. However, other than keeping research up to date on new agrochemicals, there is little commercial advantage in these linkages, since new products are available to all banana producers and are universally adopted when proven effective. The research services establish and maintain linkages with university research groups abroad and with specialized technical services, subscribing to scientific journals on agricultural research and other related subjects.

Discussion

The scope and scale in these "industrial-type" research programs is fine-tuned to market demand and profit share. The banana industry has faced both overproduction and a market glut during the past decade, largely as a result of more efficient research and production management within the industry. In consequence, there is little urgency or pressure for improved technology, but this may change as new markets develop.

Given the vulnerability of tropical perennial crops, such as bananas, one could question the wisdom of not maintaining a large permanent research staff to anticipate production problems or to accelerate technology change. However, previous experience in more upstream and long-term banana research showed that it was difficult for companies to recover the propri-

etary benefits of their research. The level of participation and investment in research by the banana industry is largely determined by the ability of the companies to appropriate the results of their research. In the past, United Fruit carried the greater cost of developing technology for the banana industry, assuming that it could recover the investment through its share of the world market (estimated at 60% to 70% during the 1950s and 1960s). This has changed in the last 20 years and the company has lost some of the economic drive to invest in research. The relative ease with which new production technologies in bananas can be appropriated by other private-sector competitors has been a critical factor in this decision.

The types of long-term investments made by the banana industry to maintain world-class applied-research facilities in Honduras is no longer justified because of the increasing number of producers on the market and the difficulty that companies have in preventing new technologies from spilling over to the industry as a whole. There is still a need for more upstream applied research, but it will increasingly be shifted into the public domain through mechanisms such as FHIA and the international centers. While there will be important benefits to Honduras from the industry's continuing research on production and postharvest problems in traditional export crops such as bananas, the industry is unlikely to invest in long-term research capacity that can be used for anything outside the immediate needs of the banana export sector.

Ministry of Natural Resources

Agricultural research within the ministry is organized into two distinct departments for crops and livestock: the Departamento de Investigación Agrícola (DIA) and the Departamento de Investigación Pecuaria (DIP). These gov-

ernment research units have their roots in the United States-sponsored STICA regional collaborative program of the 1950s discussed above. Contrary to most other government research services in the region, public-sector agricultural research

has remained as an administratively centralized program or department throughout its existence. The departments are public, development-oriented, agricultural service units. They are specialized technical departments within the Ministry of Natural Resources. As government administrative units, they are subject to many political and administrative influences. Totally supported by public funds, they are influenced (often negatively) by financial instability and recurrent managerial changes within the government.

Research Mandate and Functions

These two units are charged with providing research and technical support for national food security. They focus primarily on the development, adaptation, and testing of agricultural technology for cattle and for staple food grains and pulses, including maize, rice, sorghum, and field beans. In addition, they define national research goals and, to some extent, coordinate and supervise research conducted in Honduras by other groups.

First and foremost, these units plan, organize, implement, supervise, evaluate, and communicate the results associated with their research activities. Research programs and projects are based on the adaptation or testing of technologies oriented to production. They also provide technical recommendations and provide technical advice on plant and animal introductions and dissemination in the country. In addition, they train extension agents and farm leaders.

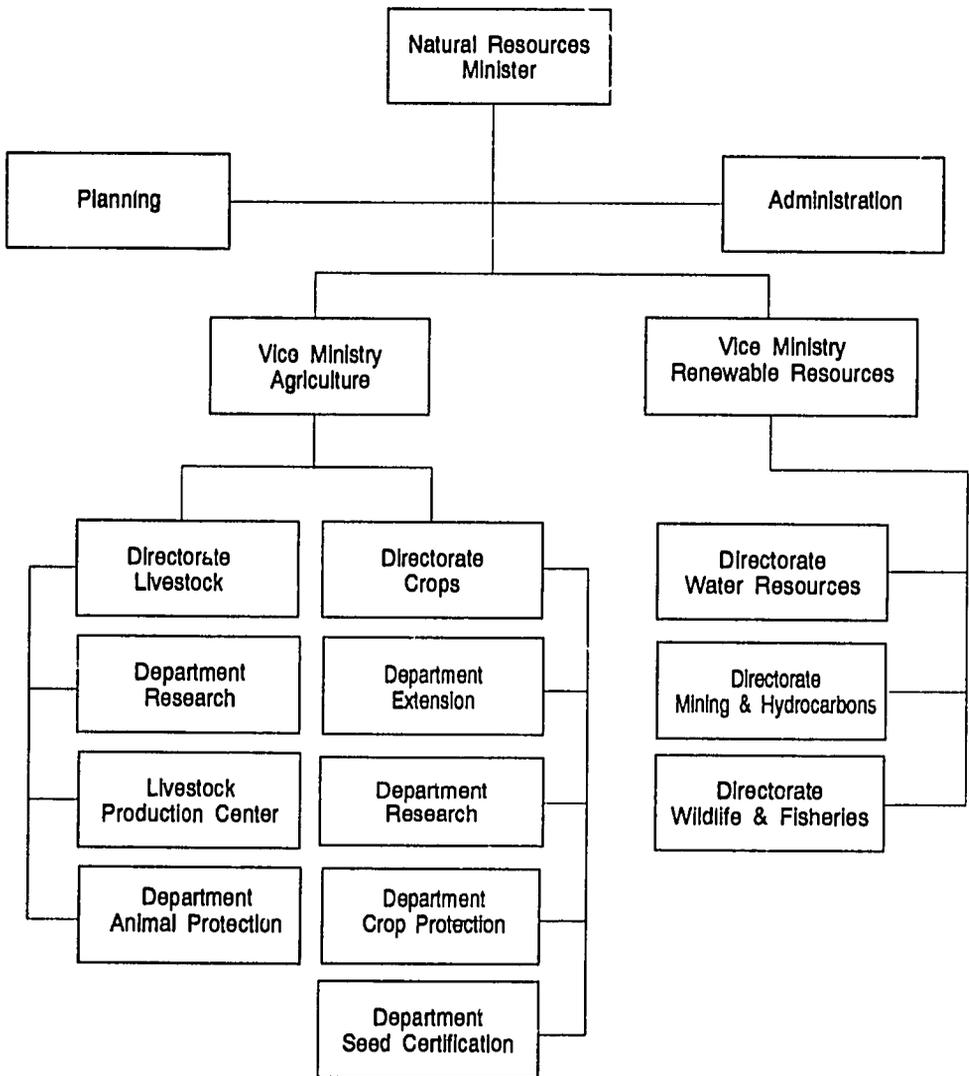
These government research services have had similar organizational structures for a number of years. In spite of attempts to separate and decentralize them from the civil service (by creating an autonomous research institute, for example), they have remained centralized within the government. At times the crop and livestock research programs have been integrated under a single structure. They are presently independent units (figure 2).

Management Structures

Both units are directed by department heads appointed by the directors general of agriculture and livestock, with the approval of the minister of natural resources. Until recently, the heads of research had only a limited planning and monitoring function, as the regionalized structure of the ministry left all research operations under the control of regional directors for agriculture. These regional directors were hierarchically directly under the minister of natural resources. Recently, the heads of research have been given more authority to direct and control their programs. Coordination with the regional directorates and operational support is still required, but the units have gained more control over yearly activities and budgets. Managerial functions now include the procurement of funds from central government sources. This is occasionally complemented with project funds obtained from external agencies.

DIA maintains a network of regional research coordinators, experiment stations, and sites in the major agricultural regions of Honduras. The regional research coordinators fulfill administrative functions, including regional planning, fund procurement and budgeting, supervision, coordination with other regional programs, and reporting of activities. In addition to regional coordinators, there are a number of program heads who direct and coordinate research on specific crops at the national level. The current structure of the crop research department is illustrated in figure 3.

DIP, the livestock research department, is much smaller but has the same structure. Its department head is responsible to the director general for livestock. He is supported by two assistants to help coordinate research activities. Longer-term research is conducted at the National Livestock Center, a large production and research station in the Comayagua region. In addition, a central veterinary lab-



Source: Ministry of Natural Resources, Honduras (1990).

Figure 2. Main organizational components of the Ministry of Natural Resources, Honduras, 1990

oratory located in Tegucigalpa, the capital of the country, conducts diagnostic activities and limited research on animal health in ruminants and minor species.

Although both services have invested heavily in further training and specialization of their scientific and technical personnel, high staff turnover has undermined this effort. These research units

have traditionally supplied trained personnel to other ministry departments and programs as well as to other government agencies and the private sector. The net result is that although these services keep their structures fairly stable, they are permanently short of experienced professionals, which limits their impact.

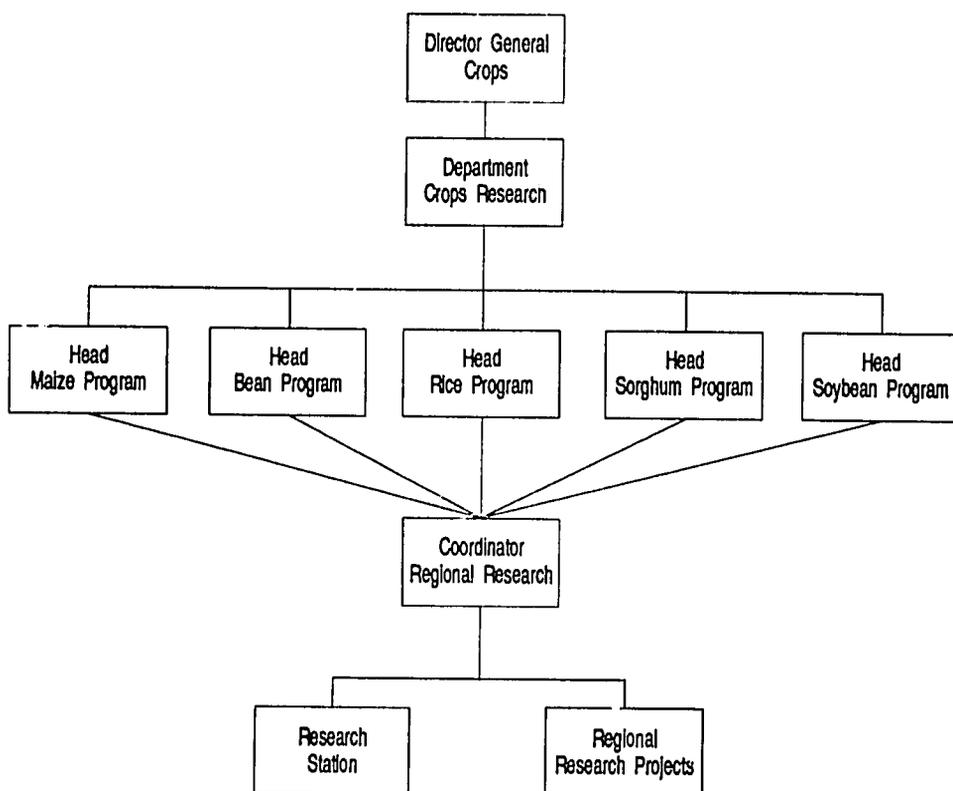


Figure 3. Main organizational components of the Crop Research Department, Ministry of Natural Resources, Honduras, 1990

Scope of Research Activities and Programs

The two research services have traditionally focused on staple food commodities. Lately, some activities have been oriented to nontraditional crops. Generally speaking, past efforts have been spread too thinly and have accomplished only modest results. Commodity research programs and projects have included work on maize, rice, field beans, sorghum, vegetables (tomatoes, onions, peppers, cucumbers, broccoli), soybeans, potatoes, table grapes, pastures, and cattle. Most of the testing and adaptive research has been oriented towards varietal improvement, population densities, cropping systems, and chemical control of diseases and pests. In addition to the research carried

out on experiment stations, these programs have conducted on-farm research since the late 1970s when an effort was made to conduct crop research beyond experiment station boundaries (Galt 1982). This eventually led to a more balanced operation and gave more opportunity for collaborative work with extension agents. Commodity research has been strongly influenced by external programs such as those at Centro Internacional de Agricultura Tropical (CIAT) and Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT).

Adaptive livestock research has been oriented towards animal nutrition and includes improved fodder, adaptation of pasture species, and range management. Attempts have been made in the past to

integrate animal and crop research and to focus holistically on farm-level production systems. Table 7 shows the 1990 work plan of the Crop Research Department. Because of funding shortages, many activities were small in scale and confined to experiment stations.

The contribution of the ministry's research services to agricultural production and sustainability in Honduras has been relatively modest. Most of it has involved the selection and provision of staple food crop varieties and a few vegetables. These have had varied success in being adopted by farmers. Improved maize and rice cultivars have tended to be adopted in zones with favorable environmental conditions and higher-input farm management. Otherwise, traditional maize and bean selections still predominate.

It has been relatively easy to obtain germplasm from Colombia and Asia of rice cultivars and lines that are suited to Honduran conditions. Blast-resistant rice cultivars have been successfully adapted to local conditions and have replaced older varieties. Sorghum is a subsistence food crop widely used in southern Honduras. Tall, photoperiod-sensitive, white-grained varieties have been produced locally for many decades. These have been used for the past 10 years to breed more productive and disease- and insect-resistant cultivars. Introductions from abroad have not been successful as they were appropriate neither to the predominant maize-sorghum production systems nor to local food preferences.

Honduran consumers prefer red field beans, but these are more susceptible to disease and they yield less than black beans. International agricultural research centers have not provided the most suitable varieties for local use. The DIA has done research that led to some improvements in the local cultivars. However, adoption has been very limited and farmers have reverted to using their own bean seeds. An additional problem in bean production has been the recent introduction and spread of slugs. This devastating pest reduced the area under field bean production drastically during 1982-1986. By 1987 appropriate management and control practices were developed by the Pan American School's integrated pest management program, and the adoption of these practices has led to renewed bean production (Proyecto Manejo Integrado de Plagas 1990).

A more general and determining factor that has constrained the adoption of new technologies in staple food crops is an economic one. Except for rice, none of the other crops have been profitable enough to be produced commercially. This is because of government-imposed market price controls, coupled with increasingly expensive production inputs. Consequently, only subsistence-level and small farmers have been involved in producing staple food crops.

From 1977 to 1982, a concerted effort was made to define research methods and priorities on the basis of objectively defined farmer and production needs. This in-

Table 7. Crops Research in the Ministry of Natural Resources: Scope, 1990

Commodity	Activities
Maize	Genetic improvement; Crop nutrition; Plant protection; Crop management; Economic evaluation
Rice	Genetic improvement; Weed control; Crop nutrition
Beans	Crop nutrition; Crop management; Varietal improvement; Plant protection
Sorghum	Genetic improvement; Plant protection; Crop nutrition; Crop management

Source: Ministry of Natural Resources, Honduras (1990).

involved collaborative work with farmers in their own environments, testing and validation of the proposed technologies by the farmers themselves, and a gradual increase in the complexity of the technologies suggested for adoption. These activities were complemented by an effective in-service training program for young new research personnel, geared to establishing a service philosophy and practicing applied research for agricultural development. Facilitating networking with farmers, extension personnel and other research groups and scientists was also included (Galt 1982).

Scale of Research

Research personnel in both programs are trained to the level of the bachelor's degree. Table 8 shows the size and staff composition in the two departments in 1990. Although the present network of experiment stations and sites covers most agricultural regions, these facilities are understaffed and logistically deficient. There is insufficient transport, and what exists is poorly maintained. Farm equipment is also scant and poorly maintained. Funds for agrochemicals and other research inputs are limited and often delayed. Yearly budgetary allocations often exceed the actual funds available, and funds often dry up by October and are not renewed until the following March. At 1980 values, the current research budget is lower than that of a decade ago. Table 9 gives an indication of budgetary appropriations for crop research between 1987 and 1991. If livestock were to be included, the figures would increase by 15% to 20%.

About 90% of the budget goes to pay staff and little is left for operational costs.

It should also be noted that the national currency (the lempira) was devalued from 2.00 to 4.30/US\$ in 1990.

An estimated gross economic value for the main staple commodities covered by crop research is L 1000 million/year. Direct research investment by government thus only amounts to about 0.3% of that value.

Linkages

In 1964-65 the Ministry of Natural Resources regionalized its services, including research. Although this provided some operational flexibility, it left the head of research with relatively little control over staff, budget, and programs. This led to strained relations at times between the research head and the agricultural regional directors (Galt 1982). Technical linkages among different program members were not, and are still not, facilitated by having the crop program heads based operationally at the regional level. Linkages to extension have been difficult to organize in the country. A whole program and structure was devised to functionally link research and extension at the regional and farm levels.

A formal and generally stable relationship has been established with the faculty of agriculture of the national university. And the research-extension Technical Linkage Program has been relatively successful in those regions where regional agriculture directors and regional research and ex-

Table 8. Personnel in the Crop and Livestock Research Department, Ministry of Natural Resources, Honduras, 1990

Level	Number	Average Number of Years in Service	Position
PhD	2	10	Administration/Research
MSc	12	10	Research
BSc	55	15	Research

Source: Ministry of Natural Resources, Honduras, 1990

Table 9. Budgetary Allocations for Crop Research Department, Ministry of Natural Resources, Honduras, 1987-1991

Item	Year				
	1987	1988	1989	1990	1991
Personnel	2,680	2,711	2,652	2,774	2,771
Travel	41	45	27	30	38
Equipment	—	—	—	—	121
Infrastructure	—	—	—	—	—
Other	91	169	142	233	171
Total	2,810	2,925	2,821	3,037	3,101
Total Real Terms ^a	2,810	2,812	2,519	2,266	1,935

Note: Values given in thousands of Honduras Lempira.
Source: Ministry of Natural Resources, Honduras (1990).
a. GDP Deflator (1987 = 100).

tension coordinators have worked cooperatively. The problem is, however, that with nine different regional groups, the Technical Linkage Program is bound to run into operational difficulties.

Linkages with agencies outside the country, such as international and regional research groups, have been numerous and central to the operation of the crop and livestock research programs. These linkages provide access to information and germplasm, as well as opportunities for in-service training. They also give researchers an opportunity to present their results to peers from the whole region, at the annual meetings of the Central American Cooperative Program for Food Crops Improvement (PCCMCA), for example.

The crop research program has linkages with CIMMYT, CIAT, and the Centro Internacional de la Papa (CIP). Many agronomists have been trained at CIMMYT and CIAT, to head and support research on maize, field beans, and rice varietal improvement. But the turnover of those professionals has been very high, negatively affecting the networks.

CIP has been involved in a regional potato improvement project (PRECODEPA) for the past 10 years. It is a collaborative re-

search network in which each participating country is responsible for an activity of regional interest and in which the country has a comparative advantage. In Honduras, potato storage methods and structures have been tested and successfully adapted to Honduran conditions. This is an interesting concept because of its efficiency in resource use and its potential for the wider application of technologies.

The Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) was involved in farming-systems and pasture-improvement research in Honduras, but collaboration with the national system has been marginal.

Discussion

These public research organizations have a very difficult responsibility. Often unfavorably compared with private-sector or parastatal institutions, they have greater difficulty securing investments for their segment of the national research portfolio, and it is more difficult to manage. They address staple food crops and some traditional, minor food crops, produced mostly by subsistence-level and small farmers, within an economic environment that favors industry and the urban population. In addition, effective research manage-

ment and implementation within the centralized and politicized government structure is practically impossible, and technological output tends to be less than desirable. Unlike bananas or coffee, which can be financed by private industry or from export profits, government has the principal responsibility as part of its own development strategy to meet the food security needs of the country and the economic needs of the large agricultural population.

The departments are small and will have to rely on linkages to international centers and regional programs for information, technology, and training. However, their size makes their participation in regional and collaborative programs fragile and difficult to manage since the national pro-

grams lack depth. In small research organizations, the departure of one scientist can disrupt the essential network linkages for an entire program. This is an even more serious problem when there is high staff attrition. Conditions of service and administrative management procedures that do not provide an environment conducive to scientific research and development contribute to this.

These government research services will have to play a greater role in providing policy guidance and coordination for the research components in Honduras. It remains a question of whether their current status as two separate units at a middle level of the administrative structure will allow them to play a more active role in research policy and coordination.

Instituto Hondureño del Café

IHCAFE was established in 1971 as a decentralized government service organization to support the production and organization of marketing this important crop. It is funded through an export tax on coffee (L 6.00/bag in 1990), which brings in L 12–14 million yearly. Roughly L 1 million from this goes to support the coffee research department that was established in 1977 (Villatoro 1990).

Research Mandate and Functions

The IHCAFE research department conducts applied research within the larger coffee commodity organization, providing administrative flexibility and timely logistical support. Although technically a government organization, it has parastatal status and is relatively free of political interference at the operational level, so its technical staff has remained fairly stable and staff turnover has been limited.

The objective of this commodity research service is to help improve the lot of the

coffee farmer and family through the development, testing, and adaptation of technologies directed to increasing the productivity and economic sustainability of the coffee farm and overall industry. As such, it plans, organizes, conducts, supervises, evaluates, and reports on research conducted in its experiment station and on farmers' fields. In addition, the research department disseminates research results to extension agents and farmer leaders. Honduras, in addition to producing in excess of its traditional quota for the international coffee market, has been confronted with depressed and variable coffee prices, resulting in increased attention being given to diversified production on the coffee farm.

Management Structures

The head of the coffee research department reports to the crop production division chief (figure 4). This officer, as well as the chief of the marketing division, reports to the general manager of the institute.

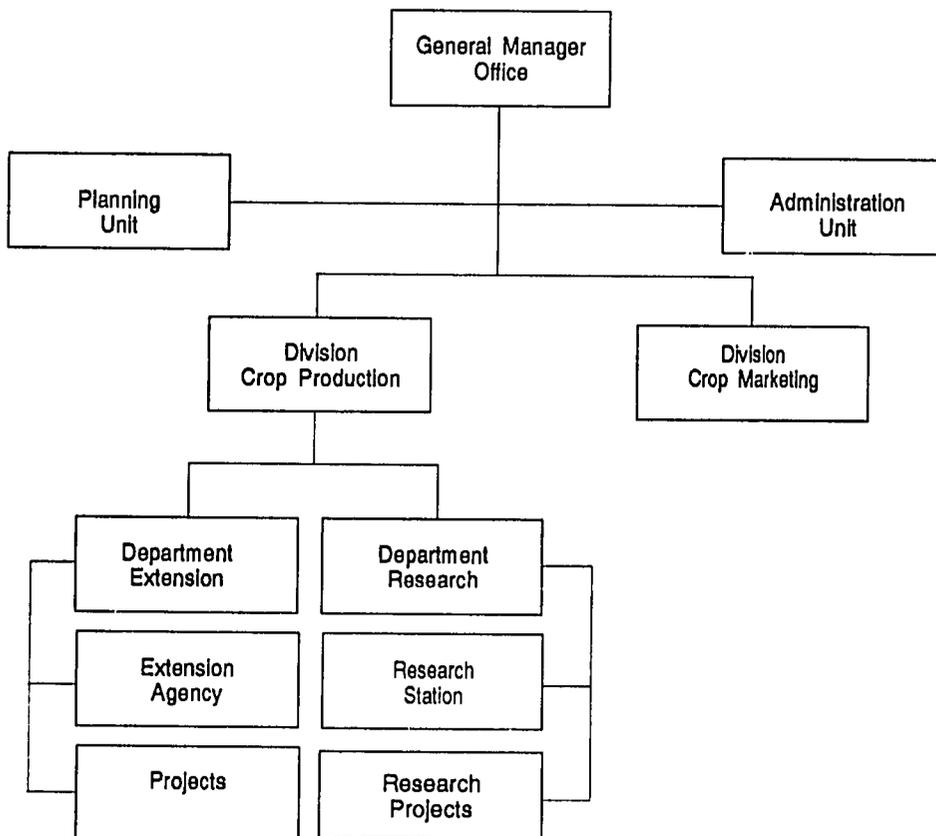
The head of the research department directs research projects implemented by a group of agricultural professionals stationed at La Fe Central Experiment Station and smaller experiment fields located in the coffee-producing regions of the country. Figure 4 shows the current organization of the research department. Management functions include preparing annual work plans, allocating budgets, and developing linkages to regional coffee programs and to other research groups (Gonzales 1990; Villatoro 1990).

Scope of Research Activities and Programs

Like the banana industry, early efforts were concentrated on production and

marketing, and it was the advent of serious disease problems (coffee rust in 1979 and the coffee borer in 1983) that forced IHCAFE to increase research efforts. Current research includes variety testing, plant nutrition, crop management, plant protection, and coffee bean quality improvement (table 10).

The institute has a crop diversification program intended to provide additional income and generate employment for the coffee farmer and his family. The diversification effort attempts to complement and stabilize the incomes of farmers by introducing crops and production activities that fit the coffee production cycle. Activities have included research on spices (allspice and cardamom), cocoa, macada-



Source: IHCAFE (1990).

Figure 4. Main organizational components of IHCAFE's research department, Honduras, 1990

Table 10. Research Activities at IHCAFE, 1990

Activities	Number	Activities	Number
Genetic improvement	1	Plant protection	3
Crop nutrition	2	Postharvest quality	1
Crop management	2	Socioeconomic studies	2

Source: IHCAFE (1990).

mla nuts, and fruits (Informe Técnico 1989; Villatoro 1990; Wyeth 1989).

Scale of Research

IHCAFE employs 21 researchers (table 11), located at a central experiment station. Their qualifications are relatively low but probably appropriate for the current testing and adaptive programs. There is also ample support from regional collaborative programs such as the PROMECAFE network, which provides expertise to supplement local efforts. This regional program provides new varieties and lines, plant-protection technology, plant-nutrition references, training, etc. Several experiments are performed under this program (Informe Técnico 1989; Osorto 1989).

Resources for the institute are derived from a tax on coffee production, and allo-

cations for research have been relatively stable, as indicated in table 12.

These allocations represent 0.1% to 0.2% of the value of the export crop, which is a very low investment for such an important crop. The proportion of the budget allocated to salaries (estimated at around 70%) suggests only moderate operating support to the programs. It should also be noted that with the devaluation of the national currency in 1990, the budget for 1991 represents a considerable decrease.

Linkages

The principal national linkages are with the coffee growers' associations. Coffee producers are organized into large provincial and national cooperatives that maintain close and sometimes conflictive relations with the institute. Producer in-

Table 11. Research Personnel at IHCAFE, 1990

Level	Number	Years in Service	Level	Number	Years in Service
PhD	—	—	BSc	16	5–15
MSc	5	3–10	Technicians	6	5–15

Source: IHCAFE (1990).

Table 12. Budgetary Allocations for Research at IHCAFE, 1985–1990

Research Budget	Year					
	1986	1987	1988	1989	1990	1991
Total	1,140	1,024	926	946	1,278	1,234
Total Real Terms ^a	1,188	1,024	890	845	954	771

Note: Amounts are in thousands of Honduras Lempiras.

Source: IHCAFE (1990).

a. GDP Deflator (1987 = 100).

terests at one time dominated the institute's board of directors. Since 1978, however, the government has maintained control of the board and ensures that national policy objectives are reflected in the institute's activities.

New varieties and technologies are disseminated through cooperatives and extension, often in association with credit programs. This is no small task, since, as pointed out earlier, coffee production in Honduras is in the hands of about 60,000 families, with the average coffee holding only 1.5 ha. To support this large group, IHCAFE has 105 extension agents employed in all the coffee growing zones. Researchers maintain close links with extension, and experiments are often set up with their participation.

At the regional and international levels, there are ample opportunities for researchers to obtain and adapt coffee technologies from many different sources. Larger coffee farmers and cooperatives also obtain technologies directly from more advanced countries and through consultants.

The PROMECAFE coffee improvement program for the Central American region has been operating since 1984 with support from the Inter-American Institute for Cooperation on Agriculture (IICA). Its contribution to the national coffee research service has been substantial and useful. PROMECAFE provides an efficient network among coffee-producing countries in the region (Mexico, Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica). CATIE, a regional research institute, is also an active participant in the network, engaging in more upstream research in areas such as tissue culture. PROMECAFE also facilitates broad international links with other coffee research centers.

Discussion

The major issues facing research in the coffee industry are regional cooperation

and diversification within the industry. Coffee research has been relatively efficient and has had a major impact because it operates under an autonomous structure and is closely linked with and responsive to producers. There has, however, been little interaction with other research units in the country. The emerging work on crop diversification within the coffee farming system will require closer collaboration with other institutions such as FHIA, which is also working on export crop diversification, and the farming systems research within the Ministry and the Escuela Agrícola Panamericana. As the scope of institutionalized coffee research broadens, there will be a great need for policy coordination at the national level.

Coffee is a competitive industry and all the neighboring countries in Central America have coffee research and development institutes and competing for similar markets. There is, however, a growing basis for regional cooperation. This is facilitated by the five following factors:

- the relatively small size of each country's exports means that no single country can hope to dominate the market at the expense of its neighbors;
- stable market demands in the coffee industry tend to facilitate exchange since the NARS do not perceive each other as competitive threats;
- disease control at the regional level to prevent reoccurrence;
- the region's common cultural background;
- the short supply of technology;
- support of external agencies stimulates collaboration.

Regional collaboration in coffee research is a good example of promoting technology and information flows within a restricted channel of a single industry. Whether it

can be used as a model for high-value nontraditional crops, which have more

volatile market conditions, is a question to be considered.

Escuela Agrícola Panamericana

EAP is a private, international, agricultural university established in Honduras in 1943. The college has carried out applied research on food crops and livestock over the years. Its extensive production fields, wide range of crop and animal species, and well-trained student body provide an ideal infrastructure for research activities. Until recently, however, there was no formal structure for a research program. Research activities were the result of individual initiatives by faculty members or an occasional collaborative project with donor support.

Research Mandate and Functions

It was not until the early 1980s that a more concerted effort was organized at this college, through its IPM research program. This donor-supported project is included here because of its present and potential contribution to research and agricultural development in the country. The program is intended to develop and adapt technologies to reduce crop losses in staple food grains on small farms. The IPM program is organized as a special unit within the plant protection department. The department head acts as project director as well and is responsible to the school's dean and director (figure 5).

Scope of Research Activities and Programs

Research scope encompasses staple food crops (maize, beans), minor food crops (cabbage, tomatoes, bell peppers), and more recently an effort to include melons for export. Specific research programs include studies of the biological cycles of pests (insects, pathogens, and weeds), biological and chemical control, crop and

pest management, and important socioeconomic factors. This comprehensive approach provides a thorough understanding of farmer's conditions and production systems, and technologies can be tailored to farmer's needs and economic potential. Table 13 illustrates the range of activities of the program.

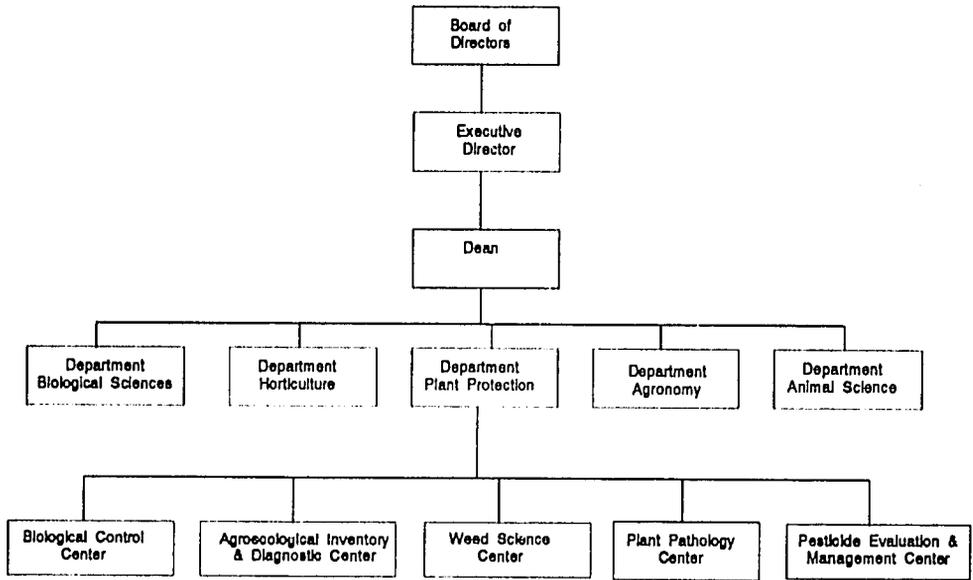
Scale of Research

There are seven senior plant protection professionals engaged permanently in the program, although they also have other teaching responsibilities. On average, 10 to 15 experiments are set up on the school facilities, with many more in the different production zones. Table 14 presents staff evolution in the program. Many Hondurans have been trained in agricultural research and IPM through this program, and this represents a major contribution to the national research system.

Resources invested in the program amount to about US\$0.5 million annually, mostly from external donor funds (table 15). Sources of operational resources are USAID and the school itself. The scale and scope of the effort is thus conditioned by the availability of external resources, which represents a critical issue for the long-term sustainability of the program.

Linkages

The IPM project maintains close links with target farmers. Regional research staff live in the production zones and work with farmers directly. Communications are enhanced through the extensive use of visual aids, meetings, experiments, demonstrations, and surveys. Government extension agents are trained and



Source: EAP (1990)

Figure 5. Main organizational components of the Escuela Agrícola Panamericana, Honduras, 1990

Table 13. Research Activities in the Integrated Pest Management Program, 1984–1990

Crop/Discipline	Activity
Malze	Whorl worm biology and control
Beans	Slug biology and control
Cabbage	Diamond back moth biology and control
Melons	Virus/vector control
Extension	Communication products
Training	Courses, workshops, seminars, etc.

Source: EAP (1990).

Table 14. Staffing in the Integrated Pest Management Program, 1984–1990

Level	Year					
	1985	1986	1987	1988	1989	1990
PhD	2	2	2	3	5	5
MSc	2	2	2	4	7	9
BSc	4	5	5	9	11	16

Source: IPM Program, EAP, Honduras.

Table 15. Costs of Integrated Pest Management Program, 1987-1991

Item	Year				
	1987	1988	1989	1990	1991
Personnel	525	471	736	754	1558
Travel	375	296	457	521	1193
Equipment	—	—	—	—	—
Infrastructure	—	—	—	148	48
Other	363	256	213	256	535
Total	1263	1023	1046	1679	3334
Total Real Terms ^a	1263	984	934	1253	2083
Total (US \$,000)	445	380	535	590	629

Note: Amounts are in thousands of Honduras lempiras.

Source: EAP (1990).

a. GDP Deflator (1987 = 100).

provided with pest management information. The program also trains and provides teaching materials to other agricultural schools in Honduras and the region.

Among the more important external linkages are the scientific links with other universities, such as the University of Florida in the USA and the USAID regional program, which has provided the major funding for research work.

Centro Nacional de Investigación Forestal Aplicada

Institutionalized forestry research in Honduras has only recently begun. However, the first forestry research efforts date as far back as 1926 when an arboretum was established by the private sector at Lancetilla on the Atlantic coast. One of the arboretum activities was to identify temperate and tropical forest species suitable for Central America. The goal was to establish commercial plantations. As a result of this private-sector initiative, close to 1000 species from all over the world were introduced and planted between 1926 and 1946. Experimental and demonstration plantations were established with exotic as well as native species.

As is the case with other research on natural resource management in Hondu-

ras, schools of higher education provide the institutional basis for forestry research. The government established two national forestry schools in 1969: CURLA, which is a branch of the National Autonomous University of Honduras, located at La Celba in the lowland tropics, and ESNACIFOR, located at Siguatepeque in the temperate central highlands.

Research Mandate and Functions

Growing concern over the inappropriate utilization of the country's forestry resources led government to create COHDEFOR in 1974 as a semi-autonomous institution, with the responsibility for the proper management, conservation, and utilization of all the country's forests, as

well as monitoring timber sales and direct marketing of all Honduran wood. Part of COHDEFOR's mandate also included coordinating forestry research in Honduras. During that same year (1974) the national forestry school, ESNACIFOR was moved under the jurisdiction of COHDEFOR, which led to the first organized forestry research program. In 1977 a genetic pine improvement program was initiated under this new organizational scheme.

In 1984 legislation was enacted whereby all forestry research would be planned and coordinated by the national forestry school. A specialized research unit of ESNACIFOR, CENIFA, was established for this purpose. CENIFA now has the only national mandate for forestry research.

Scope and Scale of Research Activities and Programs

Under CENIFA's direction, 48 full-time scientists (table 16) are conducting applied research in in both coniferous and hardwood forests on the following fields: forest seeds, nurseries, planting densities, reforestation, prescribed burning, stand growth and management, propagation of indigenous species, entomology, wood properties and use, utilization of lumber and pulp residues, and social forestry studies. CENIFA has been endowed with an appropriate research infrastructure. It

operates specialized laboratories dealing with forest entomology, wood properties, seed technology, photo interpretation, species identification, saw doctoring, and bioenergy generation.

CENIFA operates four specialized forest experiment stations located at Siguatepeque, Lancetilla, Comayagua, and Choluteca. It has organized a seed bank from which it is presently exporting plants to Venezuela, Brazil, and Africa. From this seed bank CENIFA provides numerous plants that are utilized in the protection and conservation of watersheds. In some communities special programs have been organized whereby CENIFA provides local municipalities with plants to protect their main water supply systems.

Table 17 shows expenditures on forestry research in real and nominal terms. Honduras has begun to make major commitments to support the sustained development and conservation of the forestry sector. The average annual rate of growth of forestry research expenditures is around 30% in real terms. Despite the fact that external sources account for nearly half the annual expenditure in forestry research, government has matched the overall rate of growth.

In 1992, CENIFA conducted a total of 49 trials in resource management, conserva-

Table 16. Number of Researchers and Technicians in Forestry Research in Honduras Since 1984

Highest Degree	Year					
	1984	1985	1986	1987	1988	1989
PhD	2	3	3	2	2	2
MSc	7	7	8	10	12	15
BSc or Forestry Engineer	15	16	18	18	17	18
Dasónomo ^a	8	10	10	11	13	13
Total	32	36	39	41	44	48

Note: Forestry research scientists are drawn from the faculties of ESNACIFOR and CURLA.

Source: Guevara Moncada (1989).

a. Persons having a three-year, university-based forestry degree.

Table 17. Expenditures on Forestry Research in CENIFA/ESNACIFOR since 1983

Year	Nominal Lempras	Real Lempras	Total (US\$)
1983	723	841	345,090
1984	697	783	355,560
1985	1,042	1,120	474,510
1986	1,434	1,463	585,980
1987	4,133	4,133	1,456,748
1988	4,386	4,217	1,629,550

Note: This excludes funds spent by one joint project between ESNACIFOR's parent corporation and CATIE which averaged US\$250,000 per year. Amounts given for lempiras are in thousands. GDP Deflator (1987 = 100).

Source: Guevara Moncada (1989).

tion, and use. It publishes a scientific journal called "El Tatascan" where most research results are published. An annual conference, where research results are presented, is promoted by CENIFA and held at CURLA.

In 1990, COHDEFOR, with the assistance of the University of Oxford in Great Britain, organized the Forest Production Utilization Center (CUPROFORH), which deals primarily with wood manufacturers and assists the Honduran wood user. The activities conducted by this new organization are also coordinated by CENIFA.

Linkages

Forestry research in Honduras benefits from valuable technical and financial assistance from the United States, Finland, and Great Britain. International organizations such as FAO, IUFRO, and ITTO are

also assisting Honduras in this area. As is the case with forestry research worldwide, the private sector does most of the research on forest products and silviculture, and universities do much of the research on the management of forest resources.

The parastatal, university-based structure of forestry research in Honduras enables CENIFA to maintain valuable linkages with other research institutions in the field. Universities outside the country have been particularly active in supporting forestry research programs. Special agreements to provide postgraduate training to graduates in forestry science from CURLA and ESNACIFOR have been developed with the universities of Idaho, North Carolina, Arizona, West Virginia, Washington State, Montana, and Illinois, as well as Oxford University.

Fundación Hondureña de Investigación Agrícola

A USAID initiative to organize a private research organization to support agricultural development in Honduras was strongly endorsed by the Ministry of Natural Resources and United Brands. Preliminary deliberations took place in 1983 and FHIA was founded the fifteenth of

April of the following year. This development has added a new institutional dimension to the NARS in Honduras and serves as a promising model for more effective ways of conducting agricultural research and development. At the same time, it presents issues that must be ad-

dressed and resolved if this approach is to be truly successful.

Research Mandate and Function

FHIA was organized in 1984 as a non-political, private, scientific agricultural research organization. These characteristics provided the potential for more flexible and cost-effective management, for freedom from politics, and for wider support, with easier and more extensive linkages to client groups, extension, investors, and the scientific community.

United Brands donated its Tropical Research Center facilities at La Lima to the foundation, including its distinguished banana breeding program. USAID provided a 10-year development grant of US\$20 million. The Government of Honduras provided legal support for the creation of the foundation and funds in local currency for operations.

FHIA was initially mandated to support diversification and to strengthen the current base of agricultural commodity exports from Honduras. This was to be done through the development and adaptation of appropriate production and postharvest technologies. Technology transfer to producers and investors was to be done through different communication forms. The mandate also calls for technical support of the government food crop research programs. FHIA also provides specialized services to the agricultural sector on a partial cost basis, including chemical, soil, and foliar tissue analysis and pesticide residue assessment (Informes Anuales 1985-1989).

The administrative transition to the new organization, program, and service occurred during the second semester of 1984 and 1985, under the stewardship of Mr. G. C. Millensted, former director of the Tropical Research Center. The best available Honduran professionals were then recruited and complemented with expatriate personnel where necessary. By the

end of 1986, the basic experiment station network had been established in selected production zones.

Management Structures

FHIA's general assembly is its top policy and regulatory body. It is composed of 30 members, classified in different categories, including founding members, funding members, honorary members, and other. They have different voting rights, although all can assist in formal assembly activities, such as the annual meeting. The FHIA bylaws originally prescribed a maximum number of government representatives in this important policy body, with the specific intention of limiting government intervention. The Minister of Natural Resources, however, was given the permanent position of president of the assembly to ensure that FHIA would work towards goals consistent with national agricultural development policy.

A board of directors is selected from the general assembly, with the responsibility of overseeing and supporting the implementation of approved research and budgetary programs throughout the year. This board is made up of seven assembly members and includes representatives from national and international production, government, educational, and agricultural development organizations. Originally, the Minister of Natural Resources was to preside during the first four years of institutional life. Thereafter, the assembly would select the board president among other members if deemed convenient. This was changed in 1988, since now the Minister of Natural Resources automatically presides. This situation tends to increase the influence of government and weaken the private nature of the organization.

Although FHIA is a private organization, assembly and board membership implies *representation* of different groups rather than corporate ownership. This affects the formulation of institutional policy,

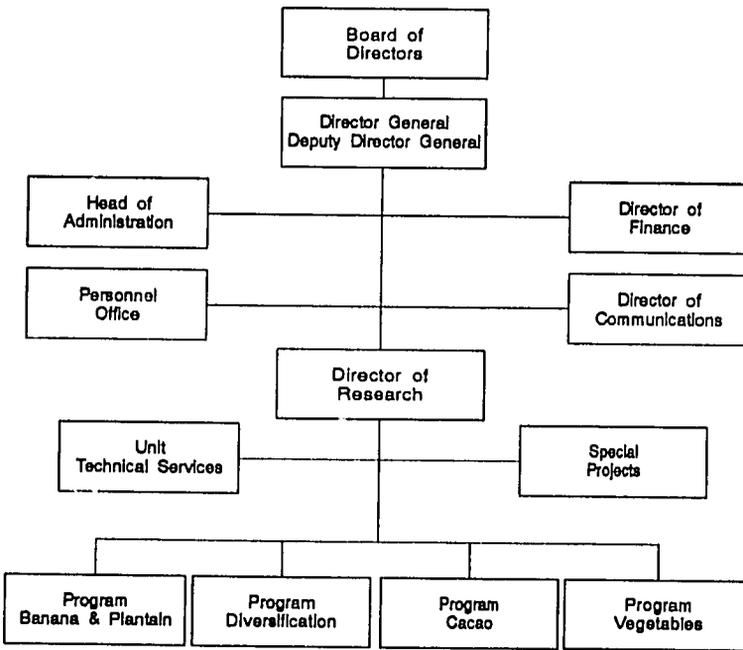
since most members have their own interests and agendas to follow and protect. Furthermore, most members would not normally risk group interests by antagonizing the Minister of Natural Resources, even at the cost of FHIA's own interests. Lack of a sense of FHIA ownership is consequently ingrained in the policy and regulatory frame of the institution.

Long-term economic sustainability is the single most important institutional issue in the organization. Thus, a primary institutional function is raising funds to support operations. In line with its original conception of being a privately based research foundation for national interests, it has reorganized its board of directors to incorporate several new members from the private sector. Local financial support and participation has been stimulated by promoting different categories of paid membership in the general assembly.

The director general is the top executive officer and ultimately responsible for the operational, programming, representation, and fund-raising capabilities and activities of the organization. Daily operations are managed by him in conjunction with a deputy director general and directors and heads for research, finance, communications, technical services, and administration. Program and project leaders, as well as service-unit heads and support personnel complement the structure. Figure 6 presents the main components in FHIA's organizational structure.

Scope of Research Activities and Programs

FHIA's banana breeding program is a continuation of the United Fruit Company's program, which started in the late 1950s (Rowe and Richardson 1975). In addition to seeking high-yielding, disease- and



Source: FHIA (1990).

Figure 6. Main organizational components of the Fundación Hondureño de Investigación Agrícola, 1990

pest-resistant banana cultivars for export, the program broadened its original scope to include plantain. Breeding for bananas and plantain has been primarily confined to the experiment station in La Lima, Honduras.

Limited testing of materials has been done in other environments and under farmers' conditions. The research program today also focuses on a number of nontraditional export commodities (table 18).

The diversification program is the most innovative and wide ranging of all the FHIA research components. Starting with an extensive literature review and economic analysis, a set of commodities (for which Honduras has both the potential for production and the market access) were selected for research. These crops now include black pepper, mangoes, and palm hearts, in addition to several other crops that are monitored closely. Close interaction with investors and producers is maintained, as well as links with international market outlets and trends (Informes Anuales 1985-1989).

FHIA also has a cocoa improvement program, which focuses on crop production and postharvest technology. It draws commercial varieties and clones for testing from other national programs (such as CATIE) and from programs outside the country (Brazil). Field-testing of new im-

proved materials, population density and management, disease control, crop nutrition, intercropping with fruit and wood species, and bean fermentation are among the topics under investigation (FHIA 1985-89). It also has a vigorous outreach activity that involves farmers in Honduras and research and extension programs elsewhere in the region.

FHIA does primarily applied and adaptive research. Crop improvement is oriented towards export, and consequently, production technology seeks higher yields and better-quality products. In its relatively short existence FHIA has successfully adapted and tested a number of technologies appropriate to its clients (table 19).

A technical service unit was organized as an outreach project to the agricultural sector, as well as a way to generate funds through the sale of services. Clients include large export corporations, the public sector, medium-sized farms, and cooperatives. Services are also provided to other countries in the region. The communications unit, another important component of FHIA, participates actively in research planning and implementation, as well as in technology transfer and training by the different programs (Contreras and Young 1988). Because of financial constraints, this activity is presently reduced to a smaller supportive role.

Table 18. Research Programs and Activities in FHIA, 1990

Program/Activity	Research Focus
Banana and plantain program	Crop improvement, breeding, agronomy, pathology, postharvest
Diversification program	Crop selection, plant adaptation, agronomy, postharvest, training
Cacao program	Variety testing, agronomy, pathology, postharvest, communications, training
Technical services	Soils and foliar analysis, pesticide, residue analysis, farm surveys, etc.
Communications	Communication products, training, outreach

Source: FHIA (1990).

Table 19. Selected Technologies and Products Developed and Adapted by FHIA, 1985-1990

Commodity	Technology
Bananas/plantain	Improved black-sigatoka-resistant plantain; fertilization levels for plantain; black sigatoka chemical control program; dwarf plantain cultivars.
Cacao	Production technology package; bean fermentation intervals; fertilization program; hybrid seed production.
Nontraditional crops	Off-season fruiting in mangoes; postharvest program for mangoes; black pepper production program; improved varieties of soybeans; soybean production program; palm-heart production package.

In formulating its research programs and objectives, FHIA seeks to fit its programs and technological outputs to client needs. Field surveys, interviews, and market trends were among the various methods used to increase understanding about market and production parameters in order to define FHIA's research agenda. Before reducing its staff in 1989, FHIA had an extensive communications program. In FHIA's project design, research and communications were seen and treated as equal and interdependent partners. An efficient transfer mechanism is paramount for technology development and adaptation by the organization (Contreras and Young 1988).

Scale of Research

FHIA grew rapidly after its organization in 1984 (tables 20 and 21). Its budgetary support has come almost exclusively from the original USAID US\$20 million grant that launched the project. The original expectations and projections were that the organization would achieve self-sufficiency within 10 years. However, weak fund raising and accelerated expenditures have left FHIA with considerable financial constraints. This raises important issues and questions relating to the

management and financial sustainability of this type of organization.

During 1984-85, FHIA developed recruitment policies and procedures for obtaining the most qualified personnel. Staff grew as programs and services were organized during 1985-86. In 1988-89, FHIA released about one-third of its scientific, technical, and support staff, mostly because of impending budgetary limitations. Lacking a long-term and sustainable economic base such as an endowment, the organization has depended largely on the original project grant, counterpart national currency funding, billable services, and small donations. In the process, it has shifted away from its private-sector orientation to become more subject to government influence. In this context, an institutional policy in favor of in-service training and promoting national staff would help reduce operational costs and contribute to further development of the country's scientific human resources.

Linkages

FHIA has established close linkages with different commodity groups. Experiment stations were developed in the commodity

Table 20. Staffing in FHIA, 1985-1990

Level	Year					
	1985	1986	1987	1988	1989	1990
PhD	6	10	12	13	8	9
MSc	12	16	16	17	10	9
BSc	9	11	16	19	11	11
Technical	9	12	15	15	11	11

Source: FHIA (1990).

Table 21. Annual Costs for FHIA, 1985-1990

Item	Year					
	1985	1986	1987	1988	1989	1990
Salaries	1,964	3,153	3,614	4,005	2,945	4,554
Honoraria	43	46	1,039	90	41	9
Benefits	202	526	807	1,312	894	2,220
Personal Services	58	54	253	171	228	—
Travel	126	220	248	228	166	—
Materials	28	248	441	388	336	—
Maintenance	76	264	172	91	116	—
Other costs	634	1,322	926	1,848	2,759	889
Total	3,131	5,833	7,500	8,133	7,485	7,672
Total real terms ^a	3,296	5,952	7,500	7,820	6,683	5,725

Note: Amounts are in thousands of Honduran lempiras.

Source: FHIA Annual Reports.

a. GDP Deflator (1987 = 100).

production areas. This was intended to facilitate communication with producers and to assist information flow in both directions. Extension agents and related personnel are involved as much as possible in research and communication activities. Linkages with agricultural faculties have also been emphasized, and several hundred agronomy students have participated in workshops and seminars. In addition, a small group of students has performed thesis work under FHIA's direction and support. And the organization has been active in developing linkages at the level of government agricultural development policy. It has hosted and partici-

pated in national policy seminars on agricultural exports and diversification.

FHIA involves producers in crop development by organizing networks in which participant members contribute a fee and receive an orientation technical support, and propagation materials of interest, such as black pepper. As a private service organization, FHIA is expanding its contribution and impact by providing paid technical services. This includes extensive soil and foliar analysis for export and food crops in the region, pesticide residue analysis, soil surveys, and irrigation and drainage system design. The contribution of these services to Honduran agriculture

has been significant in as much as it improves production technology and permits better use of agricultural inputs. Technical services are the immediate and most direct contribution of the organization to the agricultural sector.

FHIA's technical strength in banana, plantain, and cocoa improvement has allowed it to participate in regional commodity networks as a leading institution. This projects the contribution of FHIA beyond Honduras itself and into neighboring countries. Collaborative projects have also been structured and are sought with national and international development agencies. It is currently a major center within the international research network on bananas and plantain managed by the International Network for the Improvement of Banana and Plantain (INIBAP) in Montpellier, France. As such, it is linked to other regional and national banana research institutions such as the Windward Islands Banana Growers' Association (WINBAN).

Discussion

External funding from the original USAID grant is now coming to an end. USAID is giving further assistance to FHIA by supporting the creation of a trust fund in local currency of about US\$20 million. Interest

revenue from this endowment should help cover the organization's recurrent costs. FHIA has yet to achieve a more permanent and independent status. This may take a concerted effort focused around national initiatives, training and support of national talent, and careful management of human and financial resources.

As the national research organization with the best conditions of service and research facilities it will be expected to cover an increasingly broad agenda. At the same time, FHIA fulfills an international role as a center of excellence for banana research. The competing demands of maintaining scientific excellence and preserving its international role while under pressure to provide broader coverage at the level of adaptive research and testing will pose serious problems for the future strategy of the foundation. One strategy may be to adopt a dual mode of operation whereby the foundation can maintain its international reputation in banana research and still meet the needs of the Honduran farm sector. FHIA can adopt a network mode with external support in its "upstream" work on banana breeding and maintain a client and market orientation in its work on diversification in support of rural development.

External Linkages

Regional Linkages

Research linkages in Central America are facilitated by the small size of the countries and their common language, history, and culture. The region has experience with regional economic integration and market development schemes. Donor agencies such as USAID and the European

Economic Community (EEC) have promoted and supported programs that include the generation and transfer of agricultural technology at the regional level. The financial and technical support provided by several donors to CATIE has also supported programs that have bene-

fitted Honduras over the years. Collaboration was most effective when CATIE staff were based in Honduras and shared field-work activities with national staff.

The regional cooperative potato program (PRECODEPA) has been operative since 1982, supported by the Swiss Development Cooperation, with technical support and germplasm provided by CIP. The different national potato research programs provide local infrastructure, staff, and general administrative support. Jointly, they decide regional research agendas, national responsibilities, and linkage activities. All of this is based on country needs, capabilities, and comparative advantages. So far, the program has very effectively provided germplasm, technology, and training to the region.

A network similar to this is PROMECAFE, which was organized in 1984. It links the various regional coffee research groups. IICA provides coordination and administrative support to the network. Funds are provided by the national coffee programs and donor agencies, including USAID and the EEC. Technology, germplasm, and training have moved fairly effectively in

the region, alleviating pest damage and other production constraints. The network also serves as a linkage mechanism to coffee research programs elsewhere.

More recently, a regional cocoa program (PROCACAO) was organized with support from IICA and funding from USAID. CATIE and FHIA provide assistance to less-developed programs in the region in areas of technical expertise. Germplasm, technology, training, and communication products are shared freely within the network.

Finally, any analysis of regional linkages would be incomplete without PCCMCA, which has been in operation since 1962. This is a loose network of regional research staff working or interested in staple food crop technology. Its most visible linkage mechanism is an annual meeting rotated among different countries. Attendance is seldom less than 300 members of research, education, and industry from all over the area. Research activities at different stages of completion are presented and subjected to peer review. Often, coordination for regional research experiments and trials is agreed upon and followed up on during this event.

International Linkages

CIMMYT, CIAT, and CIP have created and maintain operational linkages with national research programs focused on maize, cassava and beans, and potatoes, respectively. A great deal of training and improved germplasm has been acquired. Unfortunately, the high turnover of research personnel within and among government organizations has reduced the effectiveness of these exchanges. Some of the externally generated technologies,

particularly improved varieties, reach the farmer; however, a stronger national research system could make more effective use of these external sources of information and technology. This, of course, is less of a problem with export crops and private and parastatal research organizations in the country (FHIA and IHCAFE). Effective international cooperation requires stability and strength in national institutional research.

Conclusion

The Honduran NARS has evolved as a result of both development and technological needs, as perceived by a variety of different actors, including private export companies, development agencies, government, and agricultural schools. Although Honduras is a small country, the system is comprised of a mixture of several private and public organizations. There are centralized and semiautonomous government programs, parastatal commodity research institutes, private-sector research organizations, research programs in schools of agriculture and universities, and a private national agricultural research foundation. All of these agricultural research units address fairly specific commodities and clients, although overlapping does occur at times. Nevertheless, an interesting situation, as well as a possible weakness of the system, is the lack of an adequate mechanism for orientation and support of the overall NARS.

The scale of agricultural research in Honduras is still modest, although it has expanded considerably during the last 10 years. The agricultural gross domestic product (AgGDP) for 1990 is estimated at L 5,200 million in current values. Public-sector investment in agricultural research for the year is approximately L 22 million, (about US\$5 million). This represents 0.4% of the AgGDP. If we include public, private, and university expenditures on agricultural research, the total averages about US\$8 million in 1989-90 (0.6% AgGDP). Although the Honduran government and donors are the source of most research investment, much of that public

investment is in private and parastatal organizations within the system. Figure 7 illustrates the distribution of financial resources across the various NARS institutions and shows that the greater share of research expenditures is in private and parastatal research organizations. The two research departments of the Ministry of Natural Resources account for about 10% of the total research expenditures, while the banana multinationals and the FHIA account for over half. The two parastatals, CENIFA and IHCAFE, account for nearly 25% of total expenditures. The key to getting the most out of this diversified portfolio of research investments is improved coordination at the policy level.

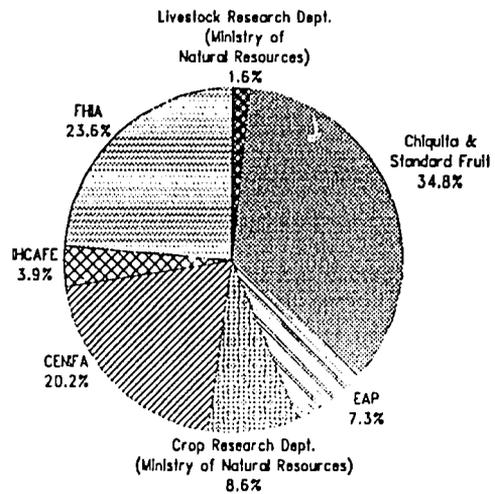


Figure 7. Distribution of financial resources in Honduran NARS

Research Policy and Planning at the National Level

The Ministry of Planning and Budget is the national agency in charge of generating and coordinating development strategies in the country. This includes the agricultural sector, science and technology, food security, and other themes related to agricultural research. In theory, their broad national guidelines are to be followed by the different public and private research and development agencies of the country. This agency is perhaps too removed from the day-to-day problems of agricultural research and development to be able to provide the institutional environment and policy guidance that can improve the efficiency and effectiveness of the organizations that comprise the NARS in Honduras. Other small countries have created national bodies or councils that specifically formulate research policy and coordinate a variety of research actors around common research objectives.

In Honduras, agricultural research as a whole is still not a nationally defined, established, and sustained endeavor. As a matter of fact, current government policies are aimed at privatizing research programs. The rationale is to provide them with better economic, administrative, and institutional environments. The final outcome of this move will depend heavily upon the ability of the private sector to sustain these research programs financially, while fulfilling the responsibility of meeting their original objectives and goals — that is, food security and production technology for small-sized farms. Specific commodities may receive a larger share of the resources, while others may be neglected. Without consistent public support, the country risks losing the human and physical infrastructure that has been built up with difficulty over the last 30 years to address staple food production issues.

In practice, research agendas are defined more at the institutional and program level. There is currently no effective mechanism in Honduras that can establish coherence and complementarity between national agricultural development goals and specific research program agendas. This leads to a duplication of effort and other inefficiencies such as lack of peer review and lack of awareness of related program goals, activities, and products among the research community. To illustrate the point further, as recently as 1985 different research groups were engaged simultaneously in technology adaptation for more than 25 nontraditional commodities. Such a widespread agenda in a small country can lead to diffuse and ineffective research efforts.

There is relatively little interaction among research programs in Honduras. Furthermore, information and materials tend to be lost as research personnel, particularly in government programs, leave or are relocated from one post to another. In general, peer review is weak and publications are limited. Moreover, with the exception of the banana industry's research programs, there is little accountability in terms of appropriate and timely research outputs by the system. On the other hand, there are many highly qualified and productive research professionals in the system who could help in orienting and improving research activities in the country as a whole.

This absence of national commodity research planning and the lack of any interaction among researchers are both compounded by the absence of a mechanism for fostering a more systematic approach to agricultural research in Honduras. Present operational linkages are built more on individual initiatives than through institutionalized linkage

mechanisms. Development research programs hold regular in-house annual reviews, but participation seldom exceeds their own research staff. Moreover, clients of the research programs are usually absent during planning and program evaluation. Without appropriate mechanisms to evaluate research outputs, the results are often limited in both value and impact.

One measure that might help to promote integration would be to establish a national agricultural research council dedicated to strengthening planning, operational research networks, training, and communication. An added benefit from such a council would be the opportunity to present a unified position to the Honduran people and procure much-needed recognition.

Links to Producers

Honduras, as well other countries in the region, made considerable progress in the 1970s and 1980s in developing and strengthening linkages between research and farmers' needs. Farming systems approaches were adopted by the research programs in staple food crops as early as 1978. Many researchers were trained for on-farm client-oriented research, while maintaining traditional experiment station support capabilities (Galt 1982). Despite this client orientation, linkages to extension and other transfer agents have been weak in the traditional, government-supported, food commodity programs, in spite of national and regional research and extension programs within the Ministry of Natural Resources. Operationally, the various activities have tended to remain distinct.

The more recent participation of private research and educational development organizations, such as FHIA and EAP, may exacerbate this problem. It is unlikely that these private institutions will effectively maintain their own extension programs and also meet all of the national needs. The current drive towards privatizing

these programs poses further issues about research-extension linkages that need to be addressed, particularly when poorer subsistence farmers are involved.

Human Resource Planning in a Small, Complex NARS

The number and quality of national research personnel in the country has increased significantly over the last two decades. However, the government research services have lost many well-trained researchers to nonresearch activities over the years. One major weakness in the overall system is the lack of a policy conducive to effective in-service training and to establishing staff stability in the various research components of the system. Another weakness results from the tendency in the past to concentrate on a few narrow subject areas for higher education, such as plant breeding, while other fields, such as agronomy, pomology, postharvest technologies, and plant and animal physiology, have been neglected. In addition, there has been little opportunity for interdisciplinary training, which often contributes to a disciplinary bias and narrow focus in research endeavors. Research systems in small countries have difficulty making effective use of narrowly trained specialists. They need highly trained scientists with a broad base, able to cover several commodities and change their focus over time.

Implications of the Current National Research Portfolio

In general, the technological needs of the transnational corporations have been addressed effectively by their research programs in Honduras. This includes bananas and other related export commodities of interest to those companies. Their proven ability to adapt to marketing and production conditions points to continued development and adaptation of agricultural technology.

Unfortunately, this is not the case for staple food commodities. Government and, more recently, private research programs have been incapable of adequately meeting the production and postharvest technological constraints of the general farming community. Research for subsistence farmers is unquestionably a far more difficult ecological, economic, and social challenge. The producers of the country's staple foods are mostly composed of poor, illiterate families on small farms spread throughout the country. They are often settled on fragile and marginal farming environments such as hillsides. Furthermore, they have little access to agricultural inputs, such as fertilizers, machinery, favorable marketing channels, and credit. It is still unclear how the demand for technology to meet the objectives of food security and the needs of the majority of poorer farmers is to be satisfied. In this context, any goals for the privatization of research programs must ensure that the national goals of food security and improving the living standards of poorer farmers are preserved and fulfilled. Otherwise, these objectives could be easily ignored, as private programs assign more weight to institutional development and economic survival than serving the poor farmer.

There are also notable gaps in the current national scope of research. Some of these are understandable, given the very limited resources available and the need to concentrate research on those areas where it can make the greatest impact. In Honduras, most government research has traditionally focused on crops, for example, maize, beans, and rice. Relatively little attention has been given to animal production, although a sizable share of agricultural output comes from cattle, poultry, swine, and smaller animals.

There is also very little research done on fish and shrimp culture, which are emerging both as very important food sources and as major high-value exports for the country. Late in 1991, the Dirección Gen-

eral de Pesca y Acuicultura (DIPESCA) was created within the Ministry of Natural Resources to provide technical support, including research, to establish resource management and conservation policies for the Honduran shrimp, lobster, and fish industries (Zacarias 1992). This government department will combine the research and development functions required by the coastal fisheries industry with the long-term natural resource management policies and regulation needed to conserve and sustain the productivity of this vital national resource.

Finally, there is a need for greater input by research on natural resource policy relating to forests. Research must identify or generate technologies for the sustainable exploitation of forest resources in Honduras. As much as three-fourths of the country is mountainous and under some forest cover; there are several zones still covered with the original rainforest. Lumber has, and still is, being extracted in considerable amounts, without due consideration for rational utilization of this important resource. Moreover, crop and animal production activities often lead to greater deforestation and competition within the primary production sector. Honduras must find a balance among agriculture, forestry, and conservation if it is to sustain agricultural and forest productivity into the future.

The model presented by university research programs in integrated pest management at EAP or forestry research in ESNACIFOR may be a useful approach to extending research on natural resource management to include watersheds, wildlife, and environmental policy. As this research is long-term and knowledge-based, universities may provide the most appropriate environment for combining income generation through commercial forestry with the long-term sustainability of Honduras's magnificent and varied natural environment.

In Honduras, as in other small developing countries, it becomes the responsibility of the scientific research community to procure its own political and economic support. This support has not been achieved and stabilized. Agricultural research is still on the second tier in the country's priorities. A more integrated NARS would have a better opportunity for receiving national support and protection. The various research organizations in Honduras have put together the essential blocks. Now they must be placed into a viable structure.

Bibliography

- Alvarado, L., A. Silva and F. O. Osoria. 1986. Investigación agrícola en Honduras. Paper presented at Curso-Taller sobre Administración de la Investigación Agraria, Panamá, 14-25 julio 1986. Tegucigalpa, Honduras: Departamento de Investigación Agrícola.
- Banana Technical Services. Annual report. 1990. La Lima, Honduras: Chiquita Brands.
- Banco Central de Honduras. Informe anual. 1989. Tegucigalpa, Honduras: Banco Central de Honduras.
- Banco Interamericano de Desarrollo. Oficina de Evaluación de las Operaciones. 1990. Experiencia del BID sobre proyectos de investigación y desarrollo agropecuario: Resultados preliminares de cuatro evaluaciones ex-post. In *Retos para la Investigación y la extensión agropecuarias en América Latina y el Caribe, memorias del seminario, Córdoba, Argentina, 29 agosto-1 setiembre 1989*, edited by A. Fernández. San José, Costa Rica: Instituto Interamericano de Cooperación para la Agricultura.
- Bean/Cowpea CRSP. 1989. 1988 annual report: Technical summary. East Lansing, MI: Bean/Cowpea Collaborative Research Support Program, Michigan State University.
- Byrnes, K. J. 1992. From melon patch to market place: How they learned to export a non-traditional crop. Paper presented at the International Workshop on Management Strategies and Policies for Agricultural Research in Small Countries, Réduit, Mauritius, 20 April-2 May, 1992. International Service for National Agricultural Research, The Hague.
- Byrnes, K. J. 1988. Case studies of AID farming systems research and extension (FSR/E) projects: Case study No. 11, Honduras Agricultural Research Project. CDIE Working Paper No. 112. Washington, DC: Center for Development Information and Evaluation, US Agency for International Development.
- Centro de Documentación e Información Agropecuaria. 1983. Directorio de investigaciones agropecuarias en curso de Honduras 1982-1983. Tegucigalpa, Honduras: Secretaría de Recursos Naturales.
- Chin Lin, G. and R. J. Moore. 1989. Privatization in developing countries: Ideal and reality. *International Journal of Public Administration* 12 (1): 137-161.
- Chiquita Brands. 1989-1990. Annual research report. La Lima, Honduras: Chiquita Brands.
- COHDEFOR. 1979. Plan nacional de desarrollo forestal. Tegucigalpa, Honduras: Corporación Hondureña de Desarrollo Forestal.
- CONSUPLANE. 1985. Diagnóstico del sector agropecuario. Tegucigalpa, Honduras: Secretaría Técnica del Consejo Superior de Planificación Económica.
- Contreras, M., J. Cano and C. Young. 1988. Planeamiento institucional de la Fundación Hondureña de Investigación Agrícola. Serie Documentos de Desarrollo Institucional. La Lima, Honduras: Fundación Hondureña de Investigación Agrícola.
- Dickson, J. 1977. Check list and use of plants in the Willson Popenoe Botanical Garden, Lancetilla. La Lima, Honduras: SIATSA, United Brands.

- Dirección de Estadísticas y Censos. 1989. Encuesta demográfica nacional de Honduras. Tegucigalpa, Honduras: Secretaría Técnica del Consejo Superior de Planificación Económica.
- Dirección General de Recursos Hídricos. 1988. Proyecto nacional de riego y drenaje. Tegucigalpa, Honduras: Dirección General de Recursos Hídricos.
- Durand, G. 1989. Política reforma agraria en Honduras: Crisis de un sistema alimentaria. In *Crisis económica en Centro América y el Caribe*, edited by M. Lundahl and W. Pelupessy. San José, Costa Rica: Editorial DEI.
- EAP. 1990. Proyecto manejo integrado de plagas. El Zamo, Honduras: Escuela Agrícola Panamericana.
- Eyzaguirre, P. 1991. The scale and scope of national agricultural research in small developing countries: Concepts and methodology. ISNAR Small-Countries Study Paper No. 1. The Hague: International Service for National Agricultural Research.
- FHIA. 1985-1990. Informe anual/Annual report. La Lima, Honduras: Fundación Hondureña de Investigación Agrícola.
- FHIA. 1984a. Banana and plantain breeding program. La Lima, Honduras: Fundación Hondureña de Investigación Agrícola.
- FHIA. 1984b. Bylaws of the Honduran Foundation for Agricultural Research. San Pedro Sula, Honduras: Fundación Hondureña de Investigación Agrícola.
- Galt, D., et al. 1982. Farming Systems Research (FSR) in Honduras, 1977-81: A case study. Michigan State University International Development Series. Ann Arbor, MI: Michigan State University.
- González, J. 1990. Personal communication. Departamento de Extensión, Instituto Hondureño del Café, Tegucigalpa, Honduras.
- Graham, N. A. and K. L. Edwards. 1984. The Caribbean basin to the year 2000: Demographic, economic, and resource-use trends in seventeen countries — A compendium of statistics and projections. Boulder: Westview.
- Guevara Moncada, R. 1989. Forestry research in Honduras: Experiences and future expectations. In *The management of large-scale forestry research programs and projects*, edited by A. L. Lundgren. Broomall, PA: United States Department of Agriculture, Forest Service, North-eastern Forest Experiment Station.
- Hobgood, H. H. et al. 1930. Central America: Small farmer cropping systems. AID Project Impact Evaluation Report No. 14. Washington, DC: United States Agency for International Development.
- IHCAFE. 1990. Informe anual. Tegucigalpa, Honduras: Instituto Hondureño del Café.
- IHCAFE. 1989a. Informe Técnico. Tegucigalpa, Honduras: Departamento de Extensión Agrícola, Instituto Hondureño del Café.
- IHCAFE. 1989b. Informe técnico. Departamento de Investigación. Instituto Hondureño del Café, Tegucigalpa, Honduras.
- IICA. 1990. Diagnóstico, problemas y políticas de la generación y transferencia de tecnología agropecuaria en Honduras (Borrador para discusión). Tegucigalpa, Honduras: Instituto Interamericano de Cooperación para la Agricultura.
- IICA. 1979. Diagnóstico de la investigación agropecuaria en el Istmo Centroamericano. Guatemala: Instituto Interamericano de Cooperación para la Agricultura.
- ICTA. 1978. Informe final: Primera reunión internacional a nivel regional sobre investigación y producción de papa, Guatemala, 30-31 marzo 1978. Guatemala: Instituto de Ciencia y Tecnología Agrícolas.
- López-Pereira, M. A., et al. 1990. Farming systems and adoption of new agricultural technologies: An economic evaluation of new sorghum cultivars in southern Honduras. *Journal for Farming Systems Research-Extension* 1 (2): 81-103.

- Marcano, L., J. Borgatti and T. Membreño. 1988. Estudio y recomendaciones sobre el sistema de gobierno de la Fundación Hondureña de Investigación Agrícola. Washington, DC: Development Alternatives International.
- Ministry of Natural Resources. 1990. Informe annual. Tegucigalpa, Honduras: Ministry of Natural Resources.
- Ministry of Natural Resources. 1989. Plan operativo programa nacional de granos básicos. Tegucigalpa, Honduras: Ministry of Natural Resources.
- Moeller, G. H. and D. T. Seal. 1984. Technology transfer in forestry. Proceedings of a meeting of the International Union of Forestry Research Organizations, Edinburgh, UK, 25 July–1 August 1983. Forestry Commission Bulletin No. 61. London: HMSO.
- Núñez, O. A. 1987. Supply relations for minor exports from Honduras: Issues in trade and development. PhD. thesis, University of Illinois at Urbana-Champaign. Ann Arbor, MI: University Microfilms International.
- Osorto, J. J. 1989. Personal communication. Programa Mejoramiento del Café, Instituto Interamericano de Cooperación para la Agricultura, Guatemala.
- Pistorius, R. 1990. Biotechnology in Central America and the Caribbean. *Biotechnology and Development Monitor* (2): 12–17.
- Roper, C. and J. Silva. 1983. Science and technology in Latin America. London: Longman.
- Rosales, F. E. 1980. Situación del sistema nacional de investigación agrónómica en Honduras. San José, Costa Rica: Instituto Interamericano de Cooperación para la Agricultura.
- Rowe, P. R. and D. L. Richardson. 1975. SIATSA, Bulletin No. 2. La Lima, Honduras: United Brands.
- Sagar, D. and J. Farrington. 1988. Participatory approaches to technology generation: From the development of methodology to wider-scale implementation. Agricultural Administration (Research and Extension) Network Paper No. 2. London: Overseas Development Institute.
- Segura Bustamante, M. 1978. Algunas consideraciones sobre la investigación agropecuaria en Honduras. In *Diagnóstico de la Investigación agropecuaria en el Istmo Centroamericano*. Guatemala: Instituto Interamericano de Cooperación para la Agricultura.
- Sierra, F. 1989. Personal communication. La Lima, Honduras.
- Standard Brands. 1989–1990. Annual research report. La Ceiba, Honduras: Standard Brands.
- Stover, H. 1989. Sigatoka leaf spot: Thirty years of changing control strategies. In *Proceedings of an international workshop, San José, Costa Rica*. Montpellier: International Network for the Improvement of Banana and Plantain.
- USAID. 1989. Perfil ambiental de Honduras. Tegucigalpa, Honduras: United States Agency for International Development.
- Villatoro, J. 1990. Personal communication. Planning Unit, Instituto Hondureño del Café, Tegucigalpa, Honduras.
- Whyte, W. F. 1983. Towards new systems of agricultural research and development. In *Higher-yielding human systems for agriculture*, edited by W. F. Whyte and D. Boynton. Ithaca, NY: Cornell University Press.
- Wyeth, J. 1989. Diversification: Eight lessons from Honduran experience in the coffee sector. IDS Discussion Paper No. 259. Brighton, UK: Institute of Development Studies.
- Zacarías, C. 1990. Personal communication. ITC/FEPROX, San Pedro Sula, Honduras.
- Zacarías, C. 1992. Agricultural diversification policies, high-value nontraditional exports, and the role of socioeconomic and marketing research in Honduras. Paper presented at the International Workshop on Management Strategies and Policies for Agricultural Research in Small Countries, 20 April–2 May 1992, Réduit, Mauritius. International Service for National Agricultural Research, The Hague.