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Assessment of Nicaragua's Seed Sector

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CHAPTER ONE
INTRODUCTION

1.1 Purpose and Scope of Report

The purpose of this report is to assess the opportunities and constraints to the development of Nicaragua's seed sector. The report describes the historical development of the seed sector, focusing on basic grains (maize, beans, rice, and sorghum) and, to a lesser extent, oilseed crops (soybeans, sesame, and peanuts). Intended for non-technical readers without experience in Nicaragua or its seed industry, the report includes a discussion of the general state of affairs in Nicaraguan agriculture to provide a context for understanding seed industry issues. Since international seed trade is important to this context, the report also discusses Nicaragua's competitive advantages in seed production and trade. Subjects include:

- Importance of seed and seed programs, and definitions of seed categories;
- Historical summary of Nicaraguan agriculture;
- Current issues and constraints to the seed sector (institutional, supply and demand, and policy);
- Analysis of the impact of using certified seed; and
- Conclusions and recommended next steps.

1.2 Importance of Seed and Seed Programs

Seed is more than a planting material used by farmers. As a repository of genetic potential for higher yields and production, it can serve as a trigger for technological change and agricultural development. Reliable supplies of high-quality seed from breeders to multipliers, seed companies, and end users, however, require coordination between stakeholders and appropriate regulatory policies. Beginning in the mid-1990s, the Ministry of Agriculture and Forestry (MAG-FOR) established national policies—including a seed law—and developed plans to stimulate the seed industry by strengthening commercial seed production and marketing systems, and facilitating access to domestic and regional seed markets. Nicaraguan seed companies extended and strengthened their distribution systems to reach more farmers. Most seed sector stakeholders would agree, however, that the use of certified seed of improved varieties remains inadequate.

1.3 Key Components of Seed Programs

MAG-FOR redefined seed policies and modernized production and marketing systems by addressing critical constraints to the national seed system. The principal components of the seed system are discussed below.

1.3.1 Crop Breeding and Testing

MAG-FOR's crop research and extension agency, the National Agricultural Technology Institute (INTA), develops improved varieties and hybrids, and cooperates with international programs to introduce new germplasm into the national stock of genetic resources. Several private seed companies, including regional (Central American) seed companies, also conduct breeding and testing programs that increased the selection of varieties and hybrids available to farmers. These programs involve coordination between farmers and public- and private-sector agricultural specialists of diverse disciplines including plant breeding, agronomy, plant pathology, and entomology.

1.3.2 Parent Seed

Crop research centers maintain the genetic purity of parent seed (genetic, breeder, and basic seed) used for multiplication into commercial seed categories. Subsequent multiplications to produce registered and certified seed are part of commercial seed systems involving seed companies and contract production.

1.3.3 Seed Companies

Importing seed is the quickest way to introduce new varieties to farmers, but seed companies need to produce some varieties domestically, either because they are unavailable from foreign suppliers or because domestic seed is cheaper than imported seed. Nicaraguan suppliers of certified seed include family-operated companies, partnerships, cooperatives, and distributors for multinational seed companies.

1.3.4 Seed Quality

To minimize genetic variation between one generation and another, seed companies carefully follow quality control procedures. Public regulatory agencies also test for seed quality, including eligibility of varieties for certification, verification of seed sources, field inspections, post-harvest seed sampling and testing against official standards, seed bag labeling, variety-purity "grow-out" plots, and technical education.

1.3.5 Certified Seed

Certified seed results from a supervised process of multiplication, processing, and storage. The process involves plant breeders, seed companies, producers, and certification agencies. Certification is an official guarantee of high germination, genetically uniform, disease-free seed. The rate of adoption of certified seed in Nicaragua is affected by factors such as MAG-FOR's seed promotion policies, INTA's supply of parent seed, donor seed procurement policies, variety demonstrations, promotion campaigns, and clearly superior, well-adapted, new improved varieties.

1.4 Seed Types and Quality Categories

The seed industry uses a variety of loosely defined terms. Since this report is for non-technical readers, it is appropriate to define some of these terms and explain how they are used.

1.4.1 Seed Types

Seed. Biologically, a seed is a mature ovule consisting of an embryonic plant, a store of food, and a protective coat. Functionally, seeds are agricultural, silvicultural, and horticultural planting materials, as opposed to grain used for consumption or ersatz seed.

Improved variety. This term is used for varieties that have undergone a breeding and selection process to express desirable characteristics and ensure appropriate levels of genetic purity. In practice, however, the term is often used synonymously with "certified seed."

Open-pollinated varieties. Open-pollinated varieties are produced using either self-pollination or wind-blown cross-pollination (as distinct from hybrid seed produced using controlled cross-pollination). Open-pollinated varieties include improved varieties, developed by plant breeders and produced in isolated fields, and traditional varieties selected by farmers, also known as "farm-saved seed." In the seed trade, the terms "improved variety" and "open-pollinated variety" are often used synonymously.

Hybrid seed. Hybrid seed is produced by controlled cross-pollination of two or more distinct parent lines. Hybrid combinations include two or more inbred lines, an inbred line with an open-pollinated variety, a single-cross hybrid with an open-pollinated variety, or two different varieties. The first generation that results from these processes is sold as hybrid seed. Farmers use hybrid seed to produce the second, "F2" generation for commercial grain. The genetic uniformity and vigor, known as "heterosis," of hybrid seed quickly degenerate in F2 and subsequent generations, which are not regarded as hybrid seed.

1.4.2 Seed Categories

Genetic seed. Plant breeders supervise the production of genetic seed, also known as "breeder seed," used as parent seed to produce basic seed.

Basic seed. A class of seed produced by crop breeding programs, basic seed is the parent seed used to produce registered seed for commercial seed production.

Registered seed. National research centers and seed companies produce registered seed to use as parent seed for commercial production of certified seed.

Certified seed. Seed produced by seed multipliers and seed companies. In general, certified seed includes all classes of seed—breeder, basic, or certified—produced under the supervision of authorized experts in order to maintain high levels of seed health, vigor, and genetic purity. In Nicaragua, certified seed refers to all commercial seed (registered, certified, hybrid, authorized, and *apta*[1]) imported or produced by seed companies and multipliers, and tagged by MAG-FOR's Dirección General de Semillas (DGS).

Authorized seed. Once an official seed category, authorized seed bore a DGS tag and was produced under DGS supervision using certified seed for parent stock. In 2002, MAG-FOR excluded authorized seed from its certification system.

***Apta* seed.** Originally restricted to emergency conditions when certified and authorized seed supplies were insufficient, *apta* seed was produced under DGS supervision and bore its tag. DGS supervision and testing ensured high germination rates, but the parent seed used to produce *apta* was neither registered nor certified; its origins were usually unknown, and its genetic purity was highly variable. In 2002, MAG-FOR excluded the *apta* seed category from its certification system.

Artisanal seed. Although non-certified, artisanal seed plays an important role in virtually all national seed systems. Because sources of parent seed, isolation of production fields, and agronomic practices vary, seed quality is unreliable. INTA, private voluntary organizations (PVOs), and nongovernmental organizations (NGOs) train farmers to collect seed from plants that appear to be vigorous and productive. Artisanal seed production allows farmers to avoid purchasing certified seed and, in some cases, to sell artisanal seed to neighbors and Government of Nicaragua (GON)/donor programs.

Farm-saved seed. The lowest seed quality category is non-certified, farm-saved seed. In practice, farm-saved seed is grain that farmers select from their fields and use as planting material for subsequent crops. Except for cursory inspections of grain size, appearance, and special care in seed storage, farmers use no quality controls or analyses for seed selection.

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[1] *Apta* (literally, "appropriate") is grain judged by MAG-FOR to be good enough for planting and is, therefore, tagged for sale as commercial seed.

1.5 Seed Use in Nicaragua

Nicaragua's national economy depends heavily on agriculture. The sector, which includes livestock, fishery, forestry, and crops, accounted for 29 percent of gross domestic product (GDP) during 1997-2001. Crop production alone accounted for 19 percent of GDP in 2001 (Table 1).

Table 1: Agriculture's Contribution to Gross Domestic Product

Item	1997	1998	1999	2000	2001
*Total GDP**	*21,494*	*22,368*	*24,015*	*25,330*	*26,102*
Agriculture	6,125	6,338	6,812	7,594	7,828
Crops	3,902	4,101	4,473	4,950	5,064
Livestock	1,813	1,780	1,874	2,121	2,284
Fishery	353	397	403	459	414
Forestry	58	60	62	64	66
Crops' Share of GDP	18%	18%	19%	19%	19%
Agriculture's Share of GDP	28%	28%	28%	30%	30%

Source: Banco Central de Nicaragua Reports, 2001
*Million cordobas, 1980 basis.

Despite the agricultural sector's importance to the national economy, its productivity is low. Average national yields of most basic grains and oilseed crops are consistently among the lowest in Central America.[2] Two of the most important factors limiting agricultural productivity are the low-input management practices used by small farmers and inadequate use of key production inputs, particularly improved seed. Annex A Tables A-1 and A-2 show the relationship between productivity and certified seed use. A primary objective of this report is to focus attention on the need to raise national agricultural productivity by increasing the use of certified seed of improved varieties. Many factors contribute to the low rates of adoption of certified seed. Poor access to technical information, for example, results in farmers knowing little about improved varieties, modern cropping practices, or the payoff from investing in certified seed.

Another important factor involves the strategies farmers use to manage risk. The highest priority of many small farmers is to guarantee household food security. Without insurance or financial resources to absorb the risks of potential crop failures, however, they are reluctant to invest in new crops, production methods, or inputs like certified seed. Most small farmers use farm-saved seed of traditional, *criollo* varieties, saving a portion of each grain crop to plant in subsequent seasons, resulting in low germination rates, high disease transmission, low yields, and poor grain quality.

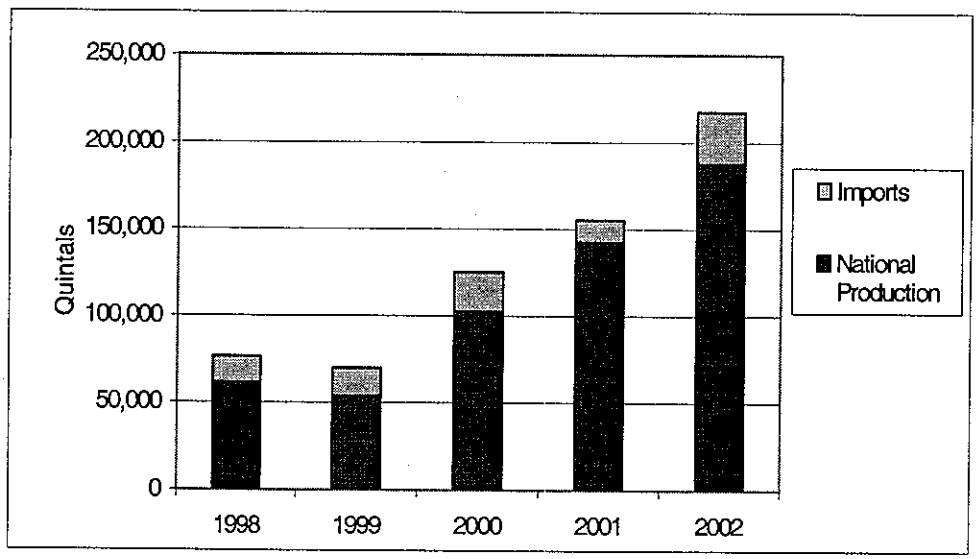
Properly used, certified seed of improved varieties can reduce production risks. When farmers use certified seed as part of a package of complementary production inputs and management practices, yields tend to be high. The use of certified seed—without other, complementary inputs—can increase yields by about 10-20 percent, which justifies

[2] Grain sorghum is an exception. Because of the relatively high yields of industrialized sorghum, produced using modern technology, average national sorghum yields were the highest in the region during 1996-2000.

investments in seed. Farmers who apply fertilizers and crop protection chemicals, but continue to use low-quality farm-saved seed, also increase yields by 10-20 percent, although at higher cost. When certified seed is combined with complementary inputs such as fertilizer and crop protection chemicals, however, yield increases are dramatic, typically 50 percent or higher. In the Jalapa valley, for example, farmers plant 60 percent of the 7,000 manzanas of maize cultivated annually with hybrids and certified seed of open-pollinated improved varieties. Consequently, Jalapa's average maize yields are 60 quintals per manzana, more than three times the national average. Other equally well-endowed areas such as Quilali, where farmers use little certified seed, produce average yields of only 30 quintals.

Annex A Figure A-1 and Annex Table A-3 show the relationship between certified seed and national average yields.[3] In 1997, the use of certified maize seed in Nicaragua was the lowest in Central America. Nicaragua also had the lowest maize yields in Central America. Since 1998, seed imports doubled and certified seed use tripled (Figure 1). The volume of seed imports doubled and the use of certified seed tripled. In 2001/02, farmers planted certified seed on 14 percent of the maize area, 4 percent of the bean area, 10 percent of the upland rice area, 60 percent of the "industrial" sorghum area, and 80 percent of the soybean area. Overall, farmers plant about 15 percent of Nicaragua's grain and oilseed production area with certified seed. Compared with other countries, however, the use of certified seed remains alarmingly low.

Figure 1: Use of Certified Seed of Basic Grains and Oilseed Crops, 1998-2002



[3] Yields are measured in quintals per manzana (QQ/Mz). One quintal is equivalent to 100 pounds, and one manzana is equivalent to 0.702 hectares.

CHAPTER TWO
NATIONAL AND REGIONAL AGRICULTURAL CONDITIONS

2.1 Nicaragua's Agricultural Sector

Before attempting to analyze the opportunities and constraints of the national seed sector, it is useful to examine conditions in Nicaragua's agricultural sector as a whole and the technical, economic, and policy problems that affect it. A recent World Bank policy paper (2001) on Nicaraguan agriculture summarized some of these problems, as follows.

2.1.1 Agricultural Production

The average per capita gross national product (GNP) in Nicaragua is only $430, one of the lowest levels in the region. Poverty is particularly pervasive in rural areas. According to the World Bank, 68 percent of rural Nicaraguans lived in poverty in 1998 (Table 2). Seventy percent of rural households live in poverty, compared with 30 percent in urban areas. The economy is highly dependent upon agriculture, which generates 30 percent of GDP and 40 percent of employment but is highly inefficient. Incentives to raise agricultural labor productivity are weak because of stagnant or declining agricultural wages which, at about $80 per month, are approximately half the level of non-agricultural wages. Nicaragua's highly skewed distribution of resources creates a dualistic agricultural system in which 72 percent of all rural households live on 16 percent of the land, mostly on farms of less than five hectares.

Table 2: Poverty in Nicaragua (percentage of population), 1993-1998

	Extreme Poverty			Poverty		
Area	1993	1998	Change	1993	1998	Change
National	19.4	17.3	-2.1	50.3	47.9	-2.4
Urban	7.3	7.6	+0.3	31.9	30.5	-1.4
Rural	36.3	28.9	-7.4	76.1	68.5	-7.6

Source: World Bank, 2001

Nicaragua is subject to natural disasters from droughts, floods, and earthquakes. It is also subject to shocks caused by abrupt changes in international commodity markets. Recent events that buffeted the economy include rising oil prices (1996-1999), falling coffee prices (late 1990s), and natural disasters such as El Niño (1996-1998), Hurricane Mitch (1998), and droughts (1999-2001). Agricultural risk-management tools (crop insurance, commodity support prices, warehouse receipts, and agricultural credit) are essentially absent, thereby increasing the country's vulnerability to exogenous shocks and jeopardizing economic growth.

Land and labor are concentrated in food and coffee production, and the high concentration of export earnings in a few commodities increases economic vulnerability. Farmers who grow

export crops (coffee, sesame, sugar, tobacco, and peanuts) provide about 50 percent of agricultural GDP, on approximately 20 percent of the cultivated land, compared to 5-10 percent for livestock and less than 5 percent for horticultural crops. Coffee accounts for two-thirds of Nicaragua's agricultural exports, which represent 50-70 percent of total exports. The coffee industry employs 32 percent of the population, providing full- or part-time employment to more than 150,000 households. In the 1990s, coffee represented about 5 percent of GDP, but the abrupt fall in international coffee prices in the late 1990s, combined with low yields resulting from poor management practices, failed to meet the rising costs of production.

Farmers use 80 percent of the cultivated land to produce basic grains (maize, beans, rice, and sorghum). The low productivity of grain production is due to factors including erratic rainfall, low soil fertility, and poor management practices. Technical information, credit, and market access are scarce. Agricultural extension services reach less than 10 percent of farmers, resulting in slow technology transfer and crop yields that are among the lowest in Latin America. Market inefficiencies and environmental problems—poor watershed management resulting in erosion and increased risks of droughts and floods—also contribute to the poor performance of the sector. To maintain production, farmers abandon marginally productive lands and clear forests in "frontier" areas. The potential for forestry and tourism to generate employment and raise national income is threatened, therefore, not only by weak private incentives to conserve natural resources and the public sector's inability to regulate resource use but also by the encroachment of basic grain production.

2.1.2 Policy Environment

Compared with its Central American neighbors, Nicaragua is poorly positioned for economic growth. The national economy is dependent on an agricultural sector which, because of unskilled labor and low use of capital equipment and production inputs (fertilizer, machinery, and seed) is inefficient. A series of policy-induced bottlenecks, including a national debt of $6.6 billion in 2000, undermine agricultural growth in Nicaragua. Some monetary and trade policies discourage agricultural exports. Inefficient factor and goods markets reduce competitiveness by increasing production and market transaction costs. Multiple sources of risk and inadequate risk-management methods limit technology adoption and crop diversification, and increase the vulnerability of poor rural households to exogenous shocks from foreign commodity markets and natural disasters.

2.2 Agriculture in Central America

Nicaragua is one of the poorest countries in Central America. It has one of the highest average per capita areas of grain production, an indicator of low average yields. According to the Centro Internacional para el Mejoramiento del Maíz y del Trigo (CIMMYT), 76 percent of the population lived in poverty in 1998 (Table 3). Average per capita daily consumption of calories is 2,208, one of the lowest in the region.

Table 3: Poverty in Central America

Country	Population (millions)	Area Planted to Basic Grains (ha/000 persons)	Poverty Level (%)*	Calories/ Person/Day
Nicaragua	5.1	100.1	76	2,208
Costa Rica	4.0	34.9	19**	2,781
El Salvador	6.3	89.6	56	2,522
Guatemala	11.4	74.0	53	2,159
Honduras	6.5	102.4	47**	2,343
Panama	2.9	65.5	26**	2,476

Source: CIMMYT, 2000
*Percent of the rural population below the poverty line, according to surveys conducted during the early 1990s.
**Percent of the entire population living on $1 per day or less.

Nicaragua is heavily dependent on agriculture products for economic growth. Between 1985 and 1999, Nicaraguan agriculture represented a higher proportion of GDP (30-35 percent) than any other country in Central America (Table 4).

Table 4: Agriculture's Share of GDP in Central American Countries, 1985-1999

	Agricultural GDP/Total GDP				
Country	1985	1990	1995	1999	Average
Nicaragua	30.0	31.1	33.8	34.7	32.4
El Salvador	18.6	17.1	13.6	12.8	15.5
Guatemala	23.0	23.0	21.4	20.4	21.9
Honduras	22.1	22.4	21.8	19.1	21.3
Costa Rica	15.5	15.8	14.9	13.1	14.8
Panama	8.8	9.5	8.2	7.6	8.5
Central America	21.2	20.7	19.1	17.9	19.7

Source: CEPAL, Dic. 2000, Preliminary Data, Agricultural GDP (agriculture, livestock, forestry, fishery)

Considering its strategic importance to the national economy, it is alarming to consider agriculture's inefficiency, compared with other countries in the region. Nicaragua's low agricultural labor productivity is due, in part, to the low use of fertilizer and agricultural machinery (Table 5).

Table 5: Indices for Labor, Fertilizer, and Agricultural Machinery in Select Latin American Countries, 1995-1997

Country	Agricultural Labor Productivity	Fertilizer Consumption	Agricultural Machinery
Nicaragua	1,407	147	11
Argentina	13,833	254	112
Brazil	3,931	898	142
Costa Rica	4,627	3,636	246
Mexico	1,690	538	71

Source: World Bank (see Annex A Table A-4)

Another reason for inefficiency in Nicaraguan agriculture, and weak economic growth in general, is the low rate of adoption of certified seed. In the mid-1990s, the use of improved varieties and hybrids in Nicaragua was lower than their use in most neighboring countries

(Table 6). In 1997, for example, Nicaragua ranked lowest in the use of improved maize varieties and hybrids. In 1996, it ranked second lowest in the used of improved bean varieties.

Table 6: Percentage of Maize and Bean Production Area Planted with Certified Seed, 1996-1997

Country	Percentage of Area Planted with Improved Varieties and Hybrids	
	Maize (1997)	Beans (1996)
Nicaragua	7	30
Guatemala	17	40
El Salvador	48	25
Honduras	16	46
Costa Rica	43	85
Panama	N/A	40
Average	26	44

Sources: CIMMYT Maize Impact Survey, 1997; PROFRIJOL, 1997

CHAPTER THREE
OVERVIEW OF NICARAGUA'S SEED SECTOR

3.1 Historical Development

3.1.1 1940s to 1970s: Pre-Sandinista Period

In the early 1940s, the U.S. Department of Agriculture's (USDA's) Office for Foreign Agriculture Relations tried to modernize Nicaragua's agricultural sector. It developed programs to increase production of agricultural commodities needed for the U.S. war effort. By the mid-1940s, farmers producing export crops had access to inexpensive credit, resulting in increased consumption of imported agricultural inputs, including seed of improved varieties, used in export crop production. While large farmers producing export crops prospered, small farms producing staple crops were largely unaffected by these programs and did not import seed of improved varieties.

In 1950, the Nicaraguan Ministry of Agriculture (MAG) established the National Agricultural Technical Service (STAN), a research and extension program under the stewardship of the U.S. International Cooperative Administration. STAN was designed to conduct research on food crops, consistent with USDA policy at that time. In practice, however, instead of focusing on research, STAN emphasized extension activities that helped farmers take advantage of technologies already available. STAN research eventually focused on export crops, particularly cotton, rather than on food crops, as initially intended. In 1958, USDA ended its support to STAN, withdrew its researchers and extension personnel, and turned the program over to the MAG. Under MAG management, the quality of extension activities deteriorated, and STAN became a vehicle for political patronage, eroding public confidence in the program. By 1964, both research and extension activities for basic grains and seed improvement programs had declined significantly.

Nicaragua's agricultural sector grew faster than any other country in Latin America during 1950-1964. In the mid-1960s, agriculture grew 14 percent per year, contributing to GNP growth rates of 9.9 percent per year (Bathrick, 1981). Cotton and coffee production fueled growth in the agricultural sector. Basic grain production did not share in this growth. The large numbers of small farmers producing food crops in resource-poor areas contributed to the decline in agricultural growth rates in the early 1970s.

In the aftermath of the 1972 earthquake, Nicaraguan seed markets grew, albeit slowly. Multinational seed companies, including Pioneer and DeKalb, produced hybrid seed in Nicaragua for domestic and international markets, but inefficient markets for complementary production inputs and farm products depressed domestic demand. Agricultural research programs remained underfunded and inefficient, and continued to focus on export crops, primarily cotton. In the early 1970s, the International Center for Tropical Agriculture (CIAT) began introducing improved bean varieties to Nicaragua. CIAT established germplasm banks

in the major bean production areas. Unfortunately, the programs to promote new varieties were inadequately organized and funded. Consequently, only a few of the new varieties were widely adopted by small farmers.

In the mid-1970s, a rural sector analysis conducted by USAID concluded that a comprehensive, publicly funded rural development program was needed, focusing on basic grain producers who make up the majority of the rural poor. USAID support of GON activities increased considerably. In 1975, the GON established the Institute of Peasant Welfare (INVIERNO), a development program funded by USAID. INVIERNO was designed to provide small farmers with credit, extension services, marketing facilities, and improved market access. One of the major contributions of the program was to require farmers to use certified seed in order to qualify for credit. By the late 1970s, however, INVIERNO had failed to reach the target number of farmers and was abandoned.

3.1.2 1980s: Sandinista Period

In the early 1980s, there was a resurgence of interest in certified seed. The Sandinista government established a public seed production and distribution system. Agricultural research centers introduced new varieties of maize and beans. The public Seed Production Company (EMPROSEM), responsible for seed imports and domestic seed production and distribution, provided certified seed to newly formed farm cooperatives and collectives confiscated from absentee owners. State agricultural banks required borrowers to use certified seed. The demand for certified seed grew rapidly.

The National Seed Program (PNS), begun in 1988, created MAG-FOR's Direccion General de Semillas, responsible for releasing new varieties commercially and supervising certified seed production, processing, and marketing. Many new varieties of beans, rice, sorghum, and soybeans were introduced into the national seed system during this period. Several factors limited the effectiveness of DGS efforts to organize the national seed sector and stimulate demand for certified seed. These included ongoing civil unrest, a trade embargo imposed by the United States, market failures caused by inefficient central planning, and inadequate investment in the agricultural research needed to help farmers compete in free markets.

3.1.3 1990s: Post-Sandinista Period

In the early 1990s, the GON discontinued its initiatives to promote the use of improved varieties, and the demand for certified seed declined. Civil unrest and warfare had resulted in a massive de-capitalization of Nicaragua's rural sector. More than 1.8 million hectares of Nicaragua's most productive agricultural land, expropriated during the 1980s and redistributed without sufficient regard for farm needs, lacked basic production and marketing infrastructure. Agricultural productivity fell.

The United States lifted its trade embargo against Nicaragua in the early 1990s, but the economic crisis continued to deepen. Budget cuts in agricultural research and extension

services accompanied the transition from a planned to a market economy. Subsidies for agricultural production inputs disappeared, raising farm costs and reducing certified seed demand. As input costs rose, farmgate prices for basic grains fell, reducing the "derived demand" for certified seed. Seed demand fell even further when the Unidad de Credito Rural, part of the Banco Nacional de Desarollo, closed in the mid-1990s, reducing access to credit for basic grain production. In 1995, MAG-FOR developed a five-year national seed plan, which was never fully implemented because of financial constraints and competing budgetary demands from other sectors. Nevertheless, it resulted in the passage of the Law on the Production and Commercialization of Seed (Law 280) in 1998, which remains in effect.

When EMPROSEM closed, the GON expected the private sector to fill the gap in the seed market. Instead, private seed companies remained cautious. The same credit and market constraints that affected other industries of the new market economy affected the seed sector. The Nicaraguan Association of Agro-Chemical Formulators and Distributors (ANIFODA), an association of agricultural input importers, maintained distribution channels for imported seed and other production inputs. Because of deteriorating economic conditions and inadequate marketing expertise, however, these importers did not aggressively promote new varieties. Ineffective marketing resulted in large seed inventories and long storage periods, raising costs and lowering seed quality. Unreliable germination rates and low genetic uniformity resulted in poor yields and eroded consumer confidence in certified seed. In the late 1990s, ANIFODA members changed their distribution channels to reach more small farmers who had an increasing share of credit for agricultural production. Instead of maintaining regional offices, input importers established networks of small, rural farm supply stores known as *agroservicios, expendios,* or *concesionarios.* Most rural retailers did not provide credit or technical services, or actively promote seed products. Nevertheless, they represented an important and sustainable link in the seed distribution systems supplying small farmers.

The low use of certified seed in the 1990s resulted in low average national yields and a generation of Nicaraguan farmers unfamiliar with hybrids, improved varieties, or certified seed. Small-scale farmers who did not use improved varieties and other inputs resorted to extensive production methods. Grain production increases during the 1990s were primarily due to low-input, extensive cultivation of previously abandoned farmland and forests cleared for hillside agriculture. Extensive production pushed the agricultural frontier into areas prone to soil erosion and watersheds susceptible to flooding and mudslides. Low-input farming methods in environmentally fragile areas resulted in widespread damage when Hurricane Mitch hit in 1998.

3.1.4 Late 1990s to Present: Hurricane Mitch Response

Donor-funded PVOs and NGOs became increasingly important players in the national seed sector during the 1990s. Some produced and distributed seed, primarily *criollo* varieties, while others provided credit for seed and other complementary production inputs. Some donors were skeptical of certified seed, however, arguing that it was too expensive and

management intensive for small farmers, and that investment in certified seed increased overall production risks.

In October 1998, Hurricane Mitch devastated Nicaragua, reducing the country's GDP by an estimated 50 percent and killing more than 3,000 people. Overall, economic losses were $1.5 billion, according to official estimates. Floods damaged approximately 25 percent of the cropland. Erosion and sedimentation destroyed the productivity of more than 16,000 manzanas of agricultural land. The storm wiped out seed production in Postrera. Small farmers, who make up the majority of Nicaragua's population, were the hardest hit. Several donors launched programs to replace their lost seed stock. Ignoring variety introduction requirements and bypassing the commercial seed sector, some programs imported and distributed new, untested varieties. Seed of poorly adapted varieties resulted in low yields and high per-unit costs, undermining the development of the national seed industry.

Emergency donor assistance, such as that provided by USAID's Hurricane Mitch Reconstruction Program, had a major impact on the recovery of the agricultural sector. More than half of the $103 million spent on the Reconstruction Program was used for agriculture, restoring the economic livelihoods of an estimated 100,000 rural households and promoting sustainable farming methods that protect the environment. One of USAID's assistance projects initiated in 1998 was the Seed Production Improvement Project (PROMESA), designed to develop a market-driven national seed system. Its objectives were to increase agricultural production, farm income, and food security by introducing improved varieties and increasing the use of certified seed by small- and medium-scale farmers. It advocated for market-oriented policies to stimulate seed sector investment, promoted new varieties, and strengthened private seed companies to increase the supply of certified seed to small farmers.

PROMESA played an important role in USAID's disaster assistance to small farmers and agricultural recovery programs in Mitch-affected areas. Because many farmers lost their seed stocks during the hurricane, PROMESA imported more than 2,000 quintals of hybrid maize seed and contracted small farmers in Nicaragua to produce 6,000 quintals of bean seed. Most of these hybrids and varieties were already registered in Nicaragua, but three new varieties were introduced and distributed to farmers through PVOs and NGOs. During Primera 1999, approximately 10,000 farmers planted hybrid maize and certified bean seed. Subsequent surveys showed that average maize yields in Mitch-affected areas increased by about 15 percent, thanks in part to certified seed, and average bean yields increased 7 percent. Anecdotal evidence suggests that hybrid seed increased maize yields by 50 percent, on average, compared to traditional varieties, and certified bean seed increased yields by 30 percent.

3.2 Cropping Seasons

Nicaragua has four primary cropping seasons: Primera (May-August), Postrera (August-November), Apante (November-February), and Verano (February-May). Planting dates vary by crop, region, and availability of irrigation. Farmers schedule planting so that harvests occur during low-rainfall periods. Only irrigated farmers grow crops during the dry Verano

season. MAG-FOR organizes Nicaraguan agricultural statistics by crop seasons. The agricultural year begins in Primera (May) and ends in Verano (April) of the following calendar year. Therefore, annual statistics aggregate the cycles beginning in May of one year and extending through April of the next.

3.3 Agricultural Regions

Maldidier and Marchetti (1996) use agro-ecological and socioeconomic variables to identify six distinct agricultural regions in Nicaragua (Annex A Figures A-2 and A-3). Agro-ecological variables, including geomorphology, soil characteristics, rainfall patterns, vegetation, and land use, are described in Annex A Table A-5 and depicted graphically in Annex A Figure A-2. Socioeconomic variables include land distribution, social structure, rural population density, urban development, transportation infrastructure, market access, agricultural production systems, and nonagricultural activities. Annex A Table A-6 provides descriptions of these regions and Annex A Figure A-3 shows them graphically. The following section describes each of the six agricultural regions based on agro-ecological and socioeconomic variables. (See map in Annex A Figure A-4.)

Atlantic and New Agricultural Frontier. The Atlantic and New Agricultural Frontier (NAF) is a humid, tropical region containing 40 percent of the national territory, but with a population of only about 15,000 (1996). There is minimal transportation infrastructure and poor access to regional and national markets. Most crop production occurs on subsistence farms. Some large ranches use extensive livestock production methods. High rainfall makes the NAF well suited for rice production in Primera, maize production in Postrera, and bean production in Apante.

Old Agricultural Frontier. The Old Agricultural Frontier (OAF) includes 10,000 square kilometers and 80,000 rural households. Transportation infrastructure is better than in the Atlantic region, but access to markets nevertheless constrains economic development. The Old Agricultural Frontier is divided into two subregions: the Old Coffee Agricultural Frontier and the Old Livestock Agricultural Frontier. Basic grains such as maize and beans are cultivated in both subregions. Rainfall in the Old Livestock Agricultural Frontier makes it well suited for rice production in Primera, maize production in Postrera, and bean production in Apante. The Old Coffee Agricultural Frontier has little rice production and is typically planted with maize and beans. Infrastructure and market access are generally poor but slightly better than in the NAF.

Large Coffee and Livestock Estates. Located in the central part of the country, this region includes 20,000 square kilometers and 50,000 rural households. It consists of two subregions: northern areas with higher elevations, cool temperatures, and abundant rainfall, and lower elevations with less rainfall. Some northern areas produce vegetables and fruits, while low-rainfall, low-elevation southern areas produce mostly livestock. As its name implies, the primary agricultural products of this region are coffee and livestock. It also produces basic grains, particularly in valleys.

Dry Region. This area has a dry to semi-arid climate, covering 16,000 square kilometers. It supports basic grain and livestock production by 60,000 rural households. Small farms produce basic grains in the *campesina* subregion, whereas large ranches produce cattle in the *latifundio ganadero* subregion. Average annual rainfall is only 1,200 millimeters, distributed during Primera and Postrera, with droughts frequently occurring at the end of the rainy season. The short duration of the rainy season limits some areas to only one crop per year. Market access is variable. The Pan-American Highway bisects this region from north to south, providing excellent access to adjacent areas, but many outlying areas are isolated, with inadequate access to markets.

Pacific Plateaus. The Pacific Plateau region has the most productive farmland and highly developed infrastructure in Nicaragua. Its 6,000 square kilometers include the largest urban centers: León, Chinandega, Granada, Masaya, and Managua. It has a rural population of 50,000 households producing mostly basic grains and horticultural crops. It produces sugar, banana, soybeans, peanuts, sesame, sorghum, and rice and uses more agricultural machinery and technology than other areas. The region has fertile soils, skilled farmers, adequate infrastructure, and good market access. Its greatest shortcoming as a production area is frequent droughts. Until the 1990s, it also produced high-quality cotton. After farmers abandoned cotton production as unprofitable, they searched for alternatives. Soybeans and sesame became popular substitutes, but recently their acreage has declined. Only the peanut production area has steadily increased in recent years. Most of Nicaragua's agribusiness sector is concentrated in the Pacific plateau region, and the seed market in this area has great growth potential.

Suburban Small Farms. These are relatively small areas surrounding major urban centers in the Pacific plateaus. With an area of less than 1,000 square kilometers, this region has a high population density, ranging from 160 to 300 inhabitants per square kilometer. Like the Pacific plateaus, the region is subject to frequent droughts. Soils are similar in quality but not as deep as in the Pacific plateaus. Farms in this region tend to be highly diversified, producing basic grains, tubers, fruit, and flowers and representing a potentially attractive market for certified seed. Most farmers use small plots of land for multiple cropping. They have good market access because of the proximity to cities such as Managua, Masaya, and Granada.

MAG-FOR categorizes these six regions into four areas—Pacific, Managua, Central, and Atlantic—as the basis for GON agricultural statistics. Table 7 shows how these four relate to the six previously described agricultural regions described by Maldidier and Marchetti and depicted in Annex A Figure A-4.

Table 7: Terminology Used to Designate Nicaragua's Agricultural Regions

	Pacific	Managua	Central	Atlantic
Atlantic and NAF				X
Old Agricultural Frontier			X	
Dry Region	X		X	
Pacific Plateaus	X	X		
Suburban Small Farms	X	X		
Large Coffee and Livestock Estates			X	

Source: PROMESA, 2002

3.4 Production of Basic Grains and Oilseed Crops

The following section provides selected production information, including cropping seasons and the use of certified seed, for each of Nicaragua's four major basic grain crops and, to a lesser extent, three oilseed crops. Annex A Table A-7 summarizes the cultivated areas, production volumes, and yields of basic grains and oilseed crops during 1996-2002. Annex A Figures A-5 through A-11 show production areas and yields.

3.4.1 Maize

More than 65 percent of the maize production area is located in the Central region. Low yields resulting from erratic rainfall and high irrigation costs reduced maize production in the Pacific region. Maize production in the Atlantic region, on the other hand, grew 44 percent during 1993-1998 (Table 8).

Table 8: Maize Production and Growth by Region, 1993-1998

	Pacific	Managua	Central	Atlantic
Percent of National Production	7.1	1.1	65.7	26.2
Percent Growth during 1993-1998	-16.0	0.1	-1.6	43.6

Source: Annex A Table A-8

During 1996-2001/02, farmers planted most of the maize area (57 percent) in Primera, compared with 24 percent in Apante and 19 percent in Postrera. Average maize yields ranged between 12 quintals per manzana in Apante, 17 quintals in Postrera, and 20 quintals in Primera, with an annual average of 18 quintals per manzana (Table 9). Seasonal yield differences were due to rainfall patterns and the use of different production technologies. Much of the maize in Postrera and Apante was grown in humid tropical regions where farmers used little fertilizer or certified seed. In other areas, the duration of the rainy season was insufficient to complete the growth cycle of the medium-season maize varieties and hybrids available in commercial seed markets. Farmers lost about 25 percent of the maize

area planted in Primera and Postrera and 33 percent in Apante, primarily because of drought. On average, 27 percent of the planted area was lost during 1996-2000.

Table 9: Maize Production by Season, 1996-2000

	Primera	Postrera	Apante	Average
1996/1997				
% Annual Production Area	57	19	24	100
% Planted Area Harvested	79	97	74	81
Yield (QQ/Mz)	19	21	12	18
1997/1998				
% Annual Production Area	58	19	23	100
% Planted Area Harvested	79	67	16	63
Yield (QQ/Mz)	20	11	10	17
1998/1999				
% Annual Production Area	61	11	28	100
% Planted Area Harvested	79	64	89	80
Yield (QQ/Mz)	21	13	15	18
1999/2000				
% Annual Production Area	58	19	23	100
% Planted Area Harvested	61	68	88	69
Yield (QQ/Mz)	21	18	11	18
2001/2002				
% Annual Production Area	58	26	16	100
% Planted Area Harvested	79	94	99	86
Average Yield (QQ/Mz)	21	23	14	20
Average: 1996-2001/2002				
% Annual Production Area	57	20	23	100
% Planted Area Harvested	76	80	77	78
Average Yield (QQ/Mz)	21	18	13	187

Source: MAG-FOR (see Annex A Table A-9)

During 1997-2001/02, national maize production grew 58 percent, from 5.8 million to 9.2 million quintals annually thanks, in large part, to expansion of the cultivated area along the agricultural frontier and in fields abandoned during the 1980s. Unfortunately, slash-and-burn methods and the low use of certified seed diluted the impact of this expansion on national maize production. Nevertheless, the use of certified maize seed increased more than 100 percent during this period, from 7,340 to 16,250 quintals, with a temporary surge to 24,130 quintals in 1999/2000 because of imports by relief agencies after Hurricane Mitch. Average yields increased from 17 to 20 quintals per manzana (Table 10). The area planted with certified seed, normally about 5 to 8 percent of national maize production, rose to 10 percent.

Table 10: Maize Production, Yields, and Certified Seed Use, 1997-2001

	National Maize Production (million QQ)	Avg. Yield of Harvested Area (QQ/Mz)	Certified Seed Use (QQ)	Area Planted with Certified Seed (% of total area)
1997/1998	5.8	17	7,430	5%
1998/1999	6.6	18	24,810	18%
1999/2000	6.4	18	10,460	7%
2000/2001	9.1	19	13,560	8%
2001/2002	9.2	20	16,250	10%

Source: MAG-FOR (see Annex A Tables A-2, A-9, A-16)

Compared with other Central American countries, Nicaraguan maize yields are low. In 1998, average maize yields in Central America were 25 quintals per manzana, ranging from 19 quintals in Nicaragua to 31 quintals in Guatemala and El Salvador (Table 11). Although it had a larger area of maize production than Costa Rica and Panama, Nicaragua had the lowest yields in the region.

Table 11: Maize Production and Yields in Central America, 1998

Country	Annual Production (thousand tons)	Average Yield (QQ/Mz)
Nicaragua	273	19
El Salvador	293	31
Guatemala	566	31
Honduras	402	25
Costa Rica	17	25
Panama	65	22
Central America	1,583	25

Sources: CEPAL Report, 2000; CIMMYT World Facts and Trends, 1997/1998

3.4.2 Beans

During 1993-1998, bean production shifted from the Managua and Pacific regions to areas with better rainfall distribution, the Central and Atlantic regions where the production area grew 11.4 and 16.5 percent, respectively (Table 12). Like maize, most bean production area is now in the Central (72 percent) and Atlantic (23 percent) regions.

Table 12: Bean Production and Growth by Region, 1993-1998

	Pacific	Managua	Central	Atlantic
Percent of National Production	4.2	0.6	72.0	23.2
Percent Growth during 1993-1998	-20.2	-16.3	11.4	16.5

Source: Annex A Table A-8

The potential for certified seed to increase bean yields is greatest in Apante, when most of the beans are grown and the largest proportion of the planted area is lost. Farmers plant about 50 percent of bean area in Apante, 21 percent in Primera, and 31 percent in Postrera (Table 13). On average, 25 percent of the bean production area is lost, primarily because of drought. Drought losses reached 74 percent in Apante of 1997/1998 because of El Niño and 59 percent in Postrera of 1998/99 because of Hurricane Mitch. Bean yields were consistently low, averaging 9-10 quintals per manzana.

Table 13: Bean Production by Season, 1996-2000

	Primera	Postrera	Apante	Average
1996/1997				
Percent of Annual Production Area	21	32	47	100
Percent of Planted Area Harvested	85	60	48	60
Yield (QQ/Mz)	9	10	10	10
1997/1998				
Percent of Annual Production Area	20	33	48	100
Percent of Planted Area Harvested	76	92	26	58
Yield (QQ/Mz)	9	8	7	8
1998/1999				
Percent of Annual Production Area	20	30	50	100
Percent of Planted Area Harvested	89	41	92	76
Yield (QQ/Mz)	12	6	14	12
1999/2000				
Percent of Annual Production Area	21	29	50	100
Percent of Planted Area Harvested	80	95	82	85
Yield (QQ/Mz)	10	10	10	10
2000/2001				
Percent of Annual Production Area	19	27	54	100
Percent of Planted Area Harvested	73	87	92	87
Average Yield	10	11	13	12
2001/2002				
Percent of Annual Production Area	21	30	49	100
Percent of Planted Area Harvested	62	90	94	82
Average Yield (QQ/Mz)	10	11	13	12
Average: 1996-2001				
Percent of Annual Production Area	20	30	50	100
Percent of Planted Area Harvested	77	77	72	76
Average Yield (QQ/Mz)	10	9	11	10

Source: MAG-FOR (see Annex A Table A-10)

National bean production grew from 1.6 million quintals in 1997/1998 to 3.9 million in 2001/2002 (Table 14). The use of certified seed grew from 0.2 percent of the bean production area in 1997/98 to 6.7 percent in 2000/2001. Yields increased 50 percent, from 8 to 12 quintals per manzana, in part because of the increased use of certified seed. (Unusually high yields in 1998/1999 resulted from favorable growing conditions in Apante and the large area of bean production area abandoned in Postrera 1998 after Hurricane Mitch. MAG-FOR ignored these abandoned areas when calculating average national yields.)

Table 14: Bean Production, Yields, and Use of Certified Seed, 1997-2001

	National Bean Production (million QQ)	Yield of Harvested Area Yield (QQ/Mz)	Certified Seed Use (domestic and imported, QQ)	Area Planted with Certified Seed (percentage of total)
1997/1998	1.6	8	490	0.2
1998/1999	3.3	12	2,920	1.1
1999/2000	3.0	10	11,300	4.4
2000/2001	4.0	12	10,860	3.9
2001/2002	3.9	12	19,390	6.7

Source: MAG-FOR (see Annex A Tables A-2, A-10, A-16)

Nicaragua produces more beans and has higher yields than most Central American countries. At 10.8 tons per hectare, Nicaraguan bean yields are typical of the Central American region. Only Panama and Honduras, with much smaller bean areas, have higher yields (Table 15).

Table 15: Bean Production and Yields in Central America, 1998

	Annual Production (million QQ)	Average Yield (QQ/Mz)
Nicaragua	3.4	10.8
El Salvador	1.7	9.2
Guatemala	2.7	10.8
Honduras	1.7	18.5
Costa Rica	0.8	6.2
Panama	0.2	21.6
Central America	10.5	10.8

Source: CEPAL Report, 2000; CIMMYT World Facts and Trends, 1997/1998

3.4.3 Upland Rice

Farmers produce almost half of Nicaragua's upland rice in the Atlantic region, where the production area grew 25 percent during 1993-1998 (Table 16). The area of upland rice production in the Pacific region fell 12 percent during this period. In the Central region, representing about 33 percent of the national area, the upland rice area remained constant. Almost all (95 percent) of upland rice is grown in Primera, with average yields of 28 quintals per manzana during 1996-2000 (Table 17). Average crop losses, primarily the result of drought, were 17 percent of the planted area.

Large rice farmers in the Sebaco and Malacatoya valleys produce half of Nicaragua's rice. Using modern cropping systems, including irrigation, their average yields are 60 quintals per manzana. Small farmers in the Atlantic region plant most of the remainder of the rice. Low-level production technology results in average yields of 10 quintals per manzana. National rice consumption exceeds production, resulting in imports of more than 1 million quintals annually.

Table 16: Upland Rice Production and Growth by Region, 1993-1998

	Pacific	Managua	Central	Atlantic
Percent of National Production	17.2%	0%	33.0%	49.7%
Percent Growth during 1993-1998	-12.4%	0%	0.2%	25.4%

Source: Annex A Table A-8

In 2001, MIFIC, the National Association of Rice Growers (ANAR), MAG-FOR, and rice importers reached an agreement to promote national rice production. Under this agreement, rice traders purchasing from national producers can import an equal amount of rice without paying import taxes. Traders offered price premiums for national rice that met international standards, thereby increasing the demand for high quality, certified seed. The use of certified seed grew from 2.4 percent of the rice production area in 1997 to 17.5 percent in 2001/02 (Table 18).

The use of certified seed increased dramatically during 1997-2001 from 3,000 quintals to 23,000 quintals, but its impact on average yields was weak. Certified seed adoption remained low during the early years of this period, despite promotion efforts by ANAR and INTA, and much of the certified seed was low-quality, *apta* category seed. Improvements in the quality of certified seed in 2002/2003 will raise yields, production, and demand for certified seed.

Table 17: Upland Rice Production by Season, 1996-2000

Year	Primera	Postrera	Apante	Average
1996/1997				
% Annual Production Area	96%	4%	0	100%
% Planted Area Harvested	84%	98%	0	85%
Yield (QQ/Mz)	27	26	0	27
1997/1998				
% Annual Production Area	94%	6%	0	100%
% Planted Area Harvested	86%	82%	0	85%
Yield (QQ/Mz)	27	28	0	28
1998/1999				
% Annual Production Area	95%	5%	0	100%
% Planted Area Harvested	86%	82%	0	85%
Yield (QQ/Mz)	28	24	0	28
1999/2000				
% Annual Production Area	93%	7%	0	100%
% Planted Area Harvested	40%	100%	0	44%
Yield (QQ/Mz)	29	34	0	30
2000/2001				
% Annual Production Area	95%	5%	0	100%
% Planted Area Harvested	92%	98%	0	95%
Average Yield	24	27	0	24
2001/2002				
% Annual Production Area	94%	6%	0	100%
% Planted Area Harvested	86%	100%	0	93%
Average Yield (QQ/Mz)	20	29	0	25
Average: 1996-2002				
% Annual Production Area	94%	6%	0	100%
% Planted Area Harvested	78%	92%	0	80%
Average Yield	26	28	0	27

Source: MAG-FOR (see Annex A Table A-11)

Table 18: Upland Rice Production, Yields, and Certified Seed Use, 1997-2001

	Total Production (million QQ)	Yield from Harvested Areas (QQ/Mz)	Certified Seed Use (QQ)	% of Area Planted with Certified Seed
1997/1998	1.8	27	2,840	2.4%
1998/1999	2.3	28	3,130	2.2%
1999/2000	1.4	30	12,410	7.7%
2000/2001	2.3	24	19,350	12.7%
2001/2002	1.6	20	23,630	17.5%

Source: MAG-FOR (Annex A Tables A-2, A-11, A-16)

3.4.4 Grain Sorghum

Grain sorghum is primarily grown in the Pacific and Managua regions, although production declined in these areas during 1993-1998 (Table 19). Farmers plant most (63 percent) of the sorghum area in Postrera (Table 20), with the balance grown in Primera. Sorghum production is concentrated in low rainfall areas, sometimes with supplemental irrigation. Although sorghum is more drought-resistant than other basic grains, 13 percent of the planted area is lost due to drought, on average. Average yields during 1996-2000 were 28 quintals per manzana.

Table 19: Sorghum Production and Growth by Region, 1993-1998

	Pacific	Managua	Central	Atlantic
Percent of National Production	51	17.5	0.3	0
Percent Growth: 1993-1998	-16.5	-11.9	-1.7	0

Source: Annex A Table A-8

Table 20: Sorghum Production, including "Industrial" Hybrids, Non-industrial, and Criollo Varieties, by Season, 1996-2002

Year	Primera	Postrera	Apante	Average
1996/1997				
% Annual Production Area	39	61	0	100
% Planted Area Harvested	98	84	0	91
Yield (QQ/Mz)	32	38	0	35
1997/1998				
% Annual Production Area	40	60	0	100
% Planted Area Harvested	67	94	0	81
Yield (QQ/Mz)	24	25	0	25
1998/1999				
% Annual Production Area	29	71	0	100
%Planted Area Harvested	73	77	0	76
Yield (QQ/Mz)	26	17	0	22
1999/2000				

Year	Primera	Postrera	Apante	Average
% Annual Production Area	37	63	0	100
% Planted Area Harvested	96	98	0	97
Yield (QQ/Mz)	25	31	0	28
2000/2001				
% Annual Production Area	37	63	0	100
% Planted Area Harvested	84	96	0	90
Avg. Yield (QQ/Mz)	27	25	0	26
2001/2002				
% Annual Production Area	34	66	0	100
% Planted Area Harvested	65	89	0	77
Avg. Yield (QQ/Mz)	27	32	0	30
Average: 1996-2002				
% Annual Production Area	36	64	0	100
% Planted Area Harvested	84	90	0	87
Avg. Yield (QQ/Mz)	27	28	0	28

Source: MAG-FOR (see Annex A Tables A-13, A-14, A-15)

There are three types of sorghum produced in Nicaragua: industrial, non-industrial, and *criollo*. Farmers plant industrial sorghum, representing 62 percent of the total area during 1996-2000, with imported hybrids and certified open-pollinated seed. Most of the grain from hybrids is fed to livestock in the form of poultry and pig feed. Farmers plant non-industrial sorghum, produced on 12 percent of the area, with improved, open-pollinated varieties. Most of the sorghum grown from these white, tortilla-quality varieties, also known as *sorgo blanco,* is used for on-farm consumption. Farmers grow *criollo* sorghum, planted with farm-saved seed of open-pollinated varieties, on 26 percent of the area. Also referred to as *sorgo millon, criollo* sorghum is primarily fed to farmyard animals. Crop losses of 10-15 percent, compared with 25-30 percent for other grains, demonstrate that sorghum is relatively drought tolerant. Areas planted with hybrid seed produced the highest yields and had the lowest rates of crop loss. Table 21 shows national production statistics on these three types of sorghum grown during 1996-2000.

Table 21: Aggregate Production Data for Nicaraguan Sorghum Types, 1996-2000

Year	Hybrid	Non-industrial*	Criollo**
1996/97			
% Harvested	85%	100%	97%
Yield (QQ/Mz)	43	21	23
% Total	62%	9%	37%
1997/98			
% Harvested	88%	97%	70%
Yield (QQ/Mz)	37	14	21
% Total	46%	34%	34%
1998/99			
% Harvested	79%	75%	70%
Yield (QQ/Mz)	21	17	16
% Total	67%	13%	28%
1999/00			
% Harvested	97%	99%	98%

Year	Hybrid	Non-industrial*	Criollo**
Yield (QQ/Mz)	38	20	21
% Total	48%	21%	46%
2000/01			
% Harvested	94%	89%	96%
Yield (QQ/Mz)	30	21	19
% Total	47%	53%	9%
2001/02			
% Harvested	97%	67%	100%
Yield (QQ/Mz)	41	20	26
% Total	53%	46%	9%
Average 1996/97-2001/02			
% Harvested	90%	87%	84%
Yield (QQ/Mz)	35	19	20
% Total	54%	29%	27%

Source: MAG-FOR (see Annex A Tables A-13, A-14, A-15)
* Non-industrial sorghum is produced with farm-saved seed.
** *Criollo* sorghum is produced with INTA's national varieties.

As shown in Table 22, the use of hybrid and certified open-pollinated sorghum seed increased 73 percent during 1997/98-2001/02, from 8,600 to 14,900 quintals annually, and the area planted with certified seed grew from 51 percent to virtually 100 percent in 2001/2002. High rates of certified seed use resulted in a 24 percent increase in average national yields of industrial sorghum.

Table 22: Sorghum* Production, Yields, and Certified Seed Use, 1997-2001

	National Sorghum Production (QQ)	Avg. Yield of Harvested Areas (QQ/Mz)	Certified Seed Used (QQ)	% Total Area Planted with Certified Seed
1997/1998	1,748,600	25	8,600	51%
1998/1999	1,078,500	20	8,300	58%
1999/2000	1,538,000	29	13,800	100%
2000/2001	1,474,700	25	11,400	90%
2001/2002	1,818,400	31	14,900	100%

Source: MAG-FOR (see Annex A Tables A-2, A-13, A-14, A-15, A-16)
* Includes industrial, non-industrial, and *criollo* categories.

3.4.5 Oilseed Crops

This report focuses primarily on basic grains, but the section below also provides limited information on oilseed crops. The most important oilseed crops in Nicaragua are soybeans, sesame, and peanuts. Medium- and large-scale farmers grow most of the soybeans and peanuts. Small farmers produce most of the sesame. Oilseed processing and export trading companies dominate marketing channels. Farmgate prices are determined in international markets, adding another element of risk to production.

The soybean and sesame production area fell during 1996-2001, while the peanut production area grew 163 percent and yields increased 28 percent, from 43 to 55 quintals per manzana. The use of certified peanut seed grew from 38 percent in 1996/97 to virtually 100 percent in 2000/01, subsequently dropping to 76 percent in 2001/02 (Table 24) as producers cut costs in response to declining market prices. Peanut production requires specialized equipment, particularly for harvest, so most of the growth in peanut production during this period was on relatively large, mechanized farms.

Table 23: Oilseed Crop Production, 1996-2001

	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	% Change
Soybeans							
Area (thousand Mz)	14	20	26	13	6	2.4	-82
Total Production (thousand QQ)	479	638	595	433	174	175	-64
Yield (QQ/Mz)	34	33	23	34	29	31	-15
% Area Planted with Certified Seed	100	100	84	100	100	82	-18
Sesame							
Area (thousand Mz)	37	17	11	12	17	16	-56
Total Production (thousand QQ)	223	148	69	90	115	153	-31
Yield (QQ/Mz)	6	9	6	8	7	1	33
% Area Planted with Certified Seed	57	55	84	84	36	35	-38
Peanuts							
Area (thousand Mz)	16	21	21	33	30	26	62
Total Production (thousand QQ)	676	828	672	1,500	1,414	1,450	109
Yield (QQ/Mz)	43	39	32	46	46	55	28
% Area Planted with Certified Seed	38	58	85	92	100	76	100

Source: MAG-FOR

Soybeans. Soybeans were introduced to Nicaragua in 1986 as an alternative to cotton, which was rapidly disappearing from the Pacific region. The first soybean varieties came from Brazil. The first commercially successful Nicaraguan soybean variety—CEA-CH-86—was released in 1992. In 1998/99, farmers in the Occidente grew more than 25,000 manzanas of this variety. Producers were dependent upon international prices, however, which fell below local production costs in the late 1990s. GRACSA, a soybean oil processor that purchased almost all of the national soybean production and had its own breeding and seed production programs, went bankrupt. Certified seed of CEA-CH-86, the only registered soybean variety, grew increasingly susceptible to diseases, and its yield potential declined. With a grant from Taiwan, INTA breeders began developing new varieties, but prices remained low and soybean production continued to fall to less than 10 percent of its peak in 1998/99.

Sesame. Sesame production declined because of a combination of factors. Unlike soybeans, sesame does not have a well-defined local market. Average grain quality is poor. National

per capita sesame consumption is low. U.S. and European markets prefer organic sesame, which is expensive to produce and tends to be low yielding. Improved sesame varieties are not widely promoted, resulting in weak seed demand. Most registered sesame seed is imported.

Peanuts. Peanut producers have access to attractive markets in Central America, Mexico, the United States, and Europe. Production areas are expanding and yields are improving. The peanut area grew at the expense of other oilseed crops. Peanut producers face a number of problems: a few varieties dominate the seed market; there is a dependence on registered seed imported from the United States; subsidies for U.S. peanut growers depress international prices; and low-quality "authorized" peanut seed grown from certified seed dominates commercial seed markets.

CHAPTER FOUR
KEY STAKEHOLDERS IN THE SEED SECTOR

The most important stakeholders in Nicaragua's seed sector include:

- Multinational seed companies and public crop research organizations;
- Public and private suppliers of basic and registered seed;
- Seed companies, *gremios*, universities, and INTA contracting seed production or buying seed from farmers;
- Distributors, rural retailers, and GON/donor programs linking seed companies with end users;
- Farmers purchasing seed in retail markets or from GON/donor programs; and
- Regulatory (DGS/MAG-FOR), advisory (National Seed Council [CONASEM]), and extension agencies (INTA) providing coordination, oversight, and quality control.

4.1 Government and Donor Stakeholders

National Assembly. The National Assembly defines the roles and responsibilities of public agencies responsible for regulating the seed industry. The 1998 National Seed Law (Ley de Producción y Comercialización de Semillas—Law 280) defines the regulatory environment of the seed industry and makes DGS responsible for implementing it.

MAG-FOR. The Ministry of Agriculture and Forestry is responsible for implementing regulatory policies governing certified seed production. It also fosters the development of the National Seed System by coordinating stakeholders and training seed producers. MAG-FOR is implementing policies to stimulate competition and investment in the seed sector, including:

- Accrediting private seed companies to test seed quality and certify seed;
- Implementing the Protection of Plant Variety Accessions Law (Law 318), which defines breeders' ownership rights over their varieties and protects the intellectual property rights of imported seed;
- Harmonizing seed trade standards and requirements in Central America, facilitating imports and increasing the size of potential markets for Nicaraguan seed;
- Strengthening CONASEM and encouraging participation by the private seed sector;

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- Developing a technical and legal framework to regulate testing and commercial release of agricultural biotech products; and
- Informing the public of the potential environmental benefits and risks of agricultural biotech products and their impact on production costs, crop yields, and product quality.

DGS/MAG-FOR. The primary role of MAG-FOR's Dirección General de Semillas is to regulate the seed certification system and promote the development of the national seed system by ensuring the active participation of the different seed sector stakeholders. DGS tests seed, conducts field inspections to determine seed categories, tags certified seed, and spot-checks retailers.

CONASEM (National Seed Council). Established by the 1998 Law 280, CONASEM provides a forum to discuss seed development policies. It convened in April 2001 but became truly functional in 2002. It requires ongoing support to ensure a forum where seed companies can actively participate in seed policy formation.

INTA/MAG-FOR. The National Institute of Agricultural Technology is an important public stakeholder in the national seed system. INTA's objectives include diversifying agricultural production, improving productivity, and raising the standard of living of farmers through the sustainable use of rural resources. INTA works with international research programs such as CIAT and CIMMYT to develop new varieties of grain and oilseed crops for Nicaragua. It conducts trials on farms and at regional research centers to assess the performance and adaptability of different varieties to Nicaraguan agronomic conditions. It also tests new varieties for private seed companies. The annual number of new variety releases by INTA, importers, and seed companies increased from 7 in 1998 to 18 in 2002. INTA has an impressive line of maize seed products, including conventional and high-protein hybrids and open-pollinated varieties particularly suited for high- and low-rainfall areas. INTA also released several new sorghum and bean varieties. Both INTA and ANAR introduced new rice varieties. Multinational seed companies introduced several new maize and sorghum hybrids.

Once a variety proves to be adapted to local farming conditions, INTA multiplies small quantities of genetically pure "basic" foundation seed into registered seed and sells it to seed companies that multiply it into certified seed. Using extension programs such as Asistencia Técnica Privada Modulo 2 (ATP2), INTA plays an important role in promoting improved varieties. INTA also sells registered seed to private seed companies, conducts on-farm trials to test new varieties, and provides technical assistance in transferring complementary agricultural technologies. The critical role of INTA's variety maintenance programs is particularly evident when it fails to maintain the genetic purity of parent seed stock. Farmers who purchase certified seed and recycle it for several years as farm-saved seed eventually notice increased variability in plant height, maturity, and other indicators of genetic degeneration. Farmers tend to attribute the variability to the variety, rather than to its genetic impurity, so improperly maintained varieties develop reputations for unreliable quality and yields, and eventually disappear from the market.

INTA also conducts an artisanal seed program targeting non-commercial segments of the national seed market. Encouraging farmers to multiply and save seed is, however, inconsistent with INTA's variety maintenance role. INTA would need to provide a continuous supply of parent seed to many small artisanal seed producers in order to maintain high seed quality. The cost and complexity of such a program would be unsustainable.

PTA/MAG-FOR. In 2002, MAG-FOR's new Agricultural Technology Project (PTA), financed by a loan from the World Bank, developed a new National Seed Plan and financed a large seed subsidy program called Libra por Libra. In its first phase (2001-2005), PTA plans to provide services to at least 60,000 small- and medium-scale farmers. Many of these services will involve information about, and access to, certified seed. PTA expects Libra por Libra to have a major impact on seed use during 2002-2004, increasing the use of certified maize seed from 19 to 28 percent of the production area. It estimates the use of certified bean seed will increase from 10 to 17 percent of the bean area. The use of certified rice seed is expected to grow even faster, increasing from 12 to 24 percent of the upland rice area (Table 24).

PTA's Agricultural Technology Assistance Fund[3] (FAITAN) provides funding for small-scale research, including seed research. PTA designed its Fondo de Asistencia Tecnica (FAT) to provide funding for technical assistance, including technical assistance for seed production. PTA budgeted funds for INTA to contract with private farmers for the production of registered seed, which INTA would subsequently sell to seed companies for multiplication into certified seed. PTA also supports INTA's plans to continue providing training, technical assistance, and credit to small farmers to produce and process non-certified, artisanal seed for themselves and their communities.

Table 24: National Seed Plan Targets

Crop	Year				TOTAL
	2002/03	2003/04	2004/05	2005/06	
Maize					
Area Planted with Certified Seed (thousand Mz)	80	95	117	117	409
Total Planted Area (thousand Mz)	420	420	420	420	1,680
% of Area Planted with Certified Seed	19%	23%	28%	28%	24%
Beans					
Area Planted with Certified Seed (thousand Mz)	26	30	42	45	143
Total Planted Area (thousand Mz)	270	270	270	270	1,080
% of Area Planted with Certified Seed	10%	11%	16%	17%	13%
Rice					
Area to Plant with Certified Seed	15	32	30	30	107
Total Planted Area (thousand Mz)	125	125	125	125	500
% of Area Planted with Certified Seed	12%	26%	24%	24%	21%

[3] Fondo de Apoyo a la Investigacion Tecnologica Agropecuaria de Nicaragua (FAITAN).

Crop	Year				TOTAL
	2002/03	2003/04	2004/05	2005/06	
Sorghum					
Area Planted with Certified Seed (thousand Mz)	20	20	20	20	80
Total Planted Area (thousand Mz)	70	70	70	70	280
% of Area Planted with Certified Seed	29%	29%	29%	29%	29%

Source: PTA/MAG-FOR

PNAPP/MAG-FOR. MAG-FOR's National Small Farmer Support Program (PNAPP), managed by the General Directorate of Territorial Delegations[4] (DGDT), played an important role in the seed sector during 1999-2001 by financing inputs (seed, fertilizer, and tools) for thousands of small farmers producing corn, bean, rice, and sorghum. In 2000, PNAPP distributed only certified seed. In 2001, PNAPP made loans for production inputs available at regional retailers, financing the production of 40,000 manzanas of corn, bean, rice, and sorghum by approximately 28,000 small farmers and rapidly expanding the network of regional seed retailers. Repayment rates were low, however, indicating that farmers viewed the program as a public subsidy rather than a renewable financial resource. Donor support for the program was weak, so MAG-FOR did not expand it on a national scale. DGDT is also responsible for implementing PTA's Libra por Libra Program, which will have broader and more sustained impact than PNAPP. DGDT single-mindedly pursued its mandate to use Libra por Libra as a market-development vehicle to demonstrate the benefits of improved varieties and hybrids, and extend distribution systems for certified seed to small farmers.

PROMESA/USAID. PROMESA (1998-2002) was a USAID project implemented by Development Alternatives, Inc. (DAI). It stimulated seed demand by introducing thousands of small farmers to improved varieties and hybrids, and increased supply by helping seed companies launch new products. It used a market-oriented approach to introduce new export crops for small farmers and resulted in increased private investment in the seed industry. It also provided technical analysis to MAG-FOR in assessing seed policies and implementing National Seed Plans. PROMESA activities included:

- New seed technologies, including biotechnology;
- On-farm variety demonstrations and field days for farmers to compare the performance of a wide selection of seed products;
- Seed training for GON and donor programs;
- Technical seminars, workshops, and conferences to create market linkages between seed sector stakeholders;
- Market information and technical assistance to private seed producers and INTA's registered seed program;

[4] Direccion General de Delegaciones Territoriales (DGDT).

- Business and marketing plans for seed companies;
- Advocacy for GON/donor programs to purchase and distribute seed through commercial channels, rather than subsidizing seed and developing independent channels that undermine seed companies and distort market competition; and
- Market research and technical support to regional seed associations to help their members establish networks of rural retailers to sell seed directly to farmers.

GON and Donor Rural Development Programs. GON and donor programs are major players in Nicaraguan seed markets. GON programs such as the Instituto de Desarrollo Rural (IDR) and the Fondo de Crédito Rural provide credit for production inputs. Donors include projects and cooperative agreements funded by USAID, the Canadian International Development Agency (CIDA), development agencies of the European Union, Japan, and Taiwan, and other donors. They provide technical assistance and credit to thousands of small- and medium-scale farmers, many of whom helped PROMESA conduct hundreds of on-farm variety trials and field days demonstrating the benefits of certified seed in terms of yields, per-unit production costs, and production risks.

GON- and donor-financed credit programs could assume the former role of the Rural Development Bank.[5] To improve repayment rates, the bank required borrowers to buy certified seed. Unfortunately, GON/donor credit programs rarely include this requirement or promote certified seed for risk mitigation and profitability. Some programs do not promote the use of certified seed or participate in the seed sector in sustainable ways. Some programs import seed directly, bypassing the commercial seed system and selling at subsidized prices and payment terms that undermine competitive markets. Some import varieties are inadequately tested under local conditions, increasing the risk of crop failures and undermining farmers' confidence in the quality of certified seed. Some discourage farmers from using certified seed by promoting artisanal seed production and processing methods. Designed to promote self-sufficiency, artisanal programs rarely use registered parent seed, choosing instead to cut costs by replanting genetically impure and potentially diseased farm-saved seed, usually resulting in low-quality seed and low yields. Even artisanal producers known as reliable suppliers of high-quality seed are unable to market seed outside their communities. Seed marketing systems are described in further detail below.

4.2 Seed Marketing Organizations

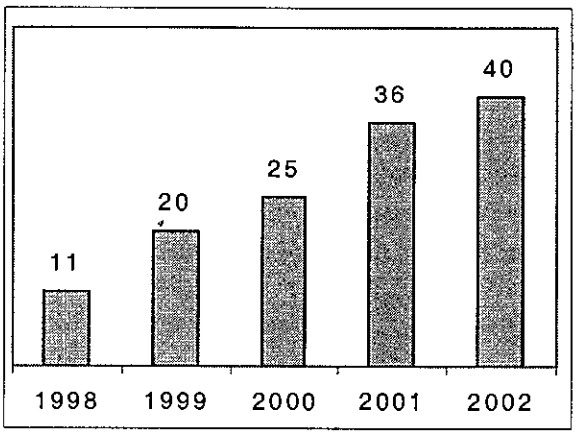
This section describes "for-profit" seed organizations that provide the basis of commercially sustainable seed systems. A variety of seed organizations—farmer groups, individual seed multipliers, and seed companies—market seed to farmers and GON/donor programs providing support to small farmers. The number of seed marketing organizations increased from 11 in 1998 to 40 in 2002 (Figure 2). Some seed marketing organizations are associated with farmer organizations (*gremios*). Others simply import and market seed. The size of the

[5] Banco Nacional de Desarollo Rural (BANADES).

seed market shared by these organizations is relatively small compared with the potential national demand for certified seed.

To understand the national seed system, it is useful to differentiate between different types of seed marketing organizations. There are seven categories of seed organizations—rural retailers, importer/distributors, importer/producers, *gremios*, cooperatives and universities; producer/marketers, and INTA seed producers—that provide the following, value-adding functions:

Figure 2: Seed Producer Organizations Marketing Seed



Variety Performance Testing. INTA is responsible for most of the variety testing and development in Nicaragua. Some private organizations (such as Aceitera Real and ANAR) also conduct applied seed research, principally variety screening and parent seed maintenance. Multinational seed companies (such as Monsanto) and a regional organization (Programa Colaborativo Centroamericano de Mejoramiento de Cultivos y Animales) also test new varieties.

Registered Seed. Most registered seed production is based on contracts between INTA and farmers. A small proportion of registered seed is imported.

Certified Seed. Individual farmers contracting with seed companies and seed producer associations produce certified seed. Some small-scale multipliers receive technical and financial support from INTA.

Quality Control and Certification. DGS/MAG-FOR supervises seed production operations in the field and processing plants, and tags bags of seed that meet certification standards.

Post-Harvest Operations. This process begins when seed companies purchase seed from farmers, includes DGS seed tags, and ends when seed companies sell it.

Marketing. Marketing activities include promotion, variety demonstrations, field days, regional seed fairs, and distribution operations conducted by suppliers of registered and certified seed.

The following section describes different types of seed marketing organizations and their scope of activity, organizational structure, legal status, and distribution systems.

4.2.1 Rural Retailers

Rural retailers include a variety of small retail outlets in rural communities, selling production inputs and other farm supplies. Rural retailers include general stores and other market intermediaries that sell a variety of consumer goods and production inputs to farmers. In some cases, even neighborhood *pulperias* qualify as rural retailers. They tend to be located near markets, bus stations, and other areas easily accessible to farmers. In remote markets such as the *puertas de montanas* in Nueva Guinea, farmers meet to sell products and purchase supplies, including seed, at rural retailers. They often repackage and sell seed in small packets. Most do not promote their seed products in the conventional sense of advertising and promotion. Their marketing strategies are based on personal contacts in the community, collegial *compadre* business relationships, and family ties. Few, if any, rural retailers are involved in introducing and promoting new varieties.

Rural retailers do not get technical training or financial support from the major seed importers, national seed companies, or public institutions. They have little access to credit from formal financial institutions, although they often get short-term credit from product suppliers and offer short-term credit to farmers.[6] Before PNAPP in 2001 and Libra por Libra in 2002, the volume of seed marketed through rural retailers was small. The market for certified seed shrank when the Rural Development Bank closed in the mid-1990s. Although credit remained scarce for many large farmers, GON- and donor-funded credit programs and financial institutions gradually developed to address the needs of small farmers, and the proportion of certified seed sold to small farmers increased.[7] Several major seed suppliers closed their regional offices, which had catered primarily to large farmers, and replaced them with rural retailers selling to small farmers. These new distribution systems offered several advantages. Rural retailer networks distribute seed directly to rural communities, instead of merely to regional capitals. The cost of maintaining rural retailer networks is lower than regional offices, and their potential effectiveness in marketing to small farmers is greater.

4.2.2 Importers/Distributors

Seed imports doubled during 1998-2002. In 2001, DGPSA/MAG-FOR issued 67 seed import permits, compared with 25 in 1998. There are two kinds of seed importers/distributors in Nicaragua. The first are private individuals, cooperatives, *gremios*, and GON/donor programs that occasionally import seed for their client beneficiaries. The other kind of imports and sells seed in competitive markets. Of these, the eight major commercial importers/ distributors in Nicaragua include:

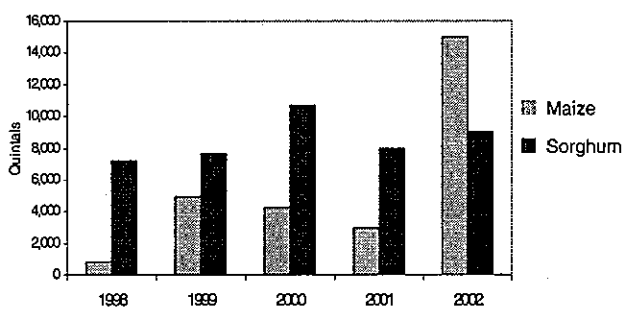
- **Comercial Importadora S.A.** sells DeKalb/Monsanto's hybrid maize and sorghum seed and imported vegetable seed.

[6] Importer/distributors typically sell seed on 30-day payment terms.
[7] MAG-FOR's PNAPP, for example, provided small farmers with access to credit.

- **Rappaccioli McGregor** sells DeKalb/Monsanto and Asgrow seed, as well as domestically produced, open-pollinated seed on consignment.
- **Servicio Agrícola Gurdian** sells DeKalb/Monsanto and Asgrow seed, as well as domestically produced open-pollinated seed on consignment for grain and oilseed crops.
- **Agroexito** sells imported vegetable seed.
- **Formuladora de Nicaragua** sells imported vegetable seed.
- **Agrocentro** sells Cristiani-Burkard maize and sorghum hybrids, as well as imported pasture and vegetable seed.
- **Tempanica** sells imported pasture seed.
- **Escalante Sánchez** sells imported pasture seed.

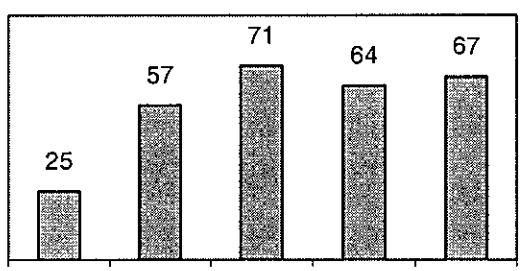
Importers/distributors sell through regional offices or networks of rural retail outlets, which sell directly to farmers and through intermediaries. In addition to distributing seed for international seed companies, most importers/distributors sell fertilizers, pesticides, and agricultural equipment. Seed sales typically represent only a small portion of total sales of importers/distributors.

Figure 3: Hybrid Seed Imports



MAG-FOR and PROMESA Estimates

Figure 4: Seed Import Permits



4.2.3 Importers/Producers

Like importers/distributors, importers/producers have well-defined management and distribution systems and administrative and technical staffs, and they sell other imported production inputs in addition to seed. They also produce seed domestically, usually using seed production contracts. Three companies in this category—Aceitera Real, COMASA, and Germinal—have considerable experience in seed production and marketing. Soybean and peanut seed suppliers such as Aceitera Real and COMASA import registered seed to sell directly to farmers and to multiply into certified seed. They also provide processing services.

Germinal provides seed processing services to other seed companies and farmers and produces its own open-pollinated maize and sorghum seed.

4.2.4 *Gremio* Farmer Associations

The newly established seed marketing organizations in the fourth category—*gremios*[8]—are involved in one or more aspects of variety development and introduction, seed imports, and seed production, processing, and marketing. This category includes three major farm *gremios* in Nicaragua: Asociación Nacional de Arroceros (ANAR), UNAG/Agronegocios S.A. (Agronegsa), and Unión de Productores Agropecuarios de Nicaragua (UPANIC). Each established commercial seed operations during the late 1990s, with mandates to sell seed to both members and non-members.

Like GON/donor programs, gremios provide a variety of products and services: training, technical assistance, credit, and production inputs. They sell primarily to farmers and institutional buyers. Some began to establish brand name recognition, positioning their seed products in national markets, penetrating foreign markets, and consolidating their internal organization and management systems. The size of UNAG, UPANIC, and ANAR offers obvious attractions. Their regional offices offer potential distribution networks that could reach up to 100,000 members. *Gremios* have not developed these internal distribution networks but have begun to establish networks of rural retailers. Sometimes the breadth and diversity of *gremio* activities create marketing problems. Some of the more conservative members of UNAG, for example, believe that small farmers should be self-reliant and independent of farm input suppliers by producing their own seed using artisanal seed methods. By promoting artisanal seed production, they hinder the adoption of certified seed.

ANAR's rice seed program currently involves variety testing and production of registered and certified seed. In 2001, ANAR established an agreement with INTA to conduct a collaborative program to develop and maintain new varieties. The commercial release of ANAR's first commercial seed crop—ANAR-97—in 2002 was a result of this collaboration. Demand for certified rice seed and new improved varieties is strong. ANAR's rice program lacks a long-term strategy, however. Anticipating reductions in rice import tariffs in 2005, ANAR wants to help rice farmers develop competitive advantages. It also wants to avoid competing with *gremio* members who produce certified rice seed. ANAR could focus on testing and introducing new varieties, and maintaining parent stocks of existing ones. It could serve as a seed marketing and distribution system by establishing local distribution outlets, including rural retailers. These issues are under discussion, however, and the future of the rice seed program is uncertain.

UNAG, founded in 1981, has local offices in approximately 90 municipalities throughout the country, and more than 70,000 members, most of whom produce basic grains. In 2000, UNAG established a trading company called Agronegsa to conduct some of the *gremio's* commercial operations. Agronegsa sells a variety of products, including red and black bean

[8] *Gremios* are farmer associations that lobby for their members.

seed, open-pollinated maize and sorghum seed, and imported vegetable seed. It also exports black beans to Costa Rica. Agronegsa uses various methods to buy seed from seed multipliers and foreign suppliers. Sometimes Agronegsa contracts farmers to produce seed. Increasingly, however, it relies on local seed producer organizations to contract with individual seed multipliers. In the future, Agronegsa will focus increasingly on grain and vegetable seed marketing, but it will continue to market certified seed of basic grain crops, supplied by national seed companies. Agronegsa has helped more than 500 former artisanal seed producers in Nueva Guinea, Boaco, Rivas, and Estelí graduate to certified seed production by providing farmers with a market for certified seed produced under contract. Agronegsa is organizing a national seed distribution using UNAG's local offices and projects.

UPANIC, founded in 1979, includes 30,000 farmers organized into crop-based associations: coffee, rice, sorghum, bananas, sugar cane, peanuts, soybeans, sesame, basic grains, and livestock. In 1998, UPANIC began producing certified seed to provide members with a reliable source of certified seed at reasonable prices and to generate income for other *gremio* operations. Its products include open-pollinated maize, sorghum, and bean seed. Initially, UPANIC offered credit to some seed producers under a grant from P.L. 480. When most of these loans were not repaid, the program was terminated. Subsequently, UPANIC used production contracts that guaranteed to purchase seed from multipliers. In 2002, UPANIC reduced its seed production operations pending additional donor funding. It is negotiating a grant to build a seed processing plant in Chinandega. Its future seed activities may be limited to processing seed for other organizations. Like UNAG, UPANIC could use its network of member organizations to organize a national seed distribution system.

4.2.5 Cooperatives and Universities

A fifth category of seed marketing organization includes agricultural universities and cooperatives. The Catholic School for Agriculture and Livestock (ECAGE) in Estelí produces certified seed of a variety of crops including open-pollinated maize and beans. It has active variety testing, certified seed production, and marketing programs. Four farm cooperatives established seed operations in the 1990s: Carazo Producers' Association (APROSEC); Boaco Agricultural Products Commercialization Service (ECOPABSA); Matagalpa Potato Producers Association (COOPPMAT) established in 1996 to provide imported and domestic potato seed to farmers in Matagalpa and Jinotega; and the Múltilies Cooperative Union (UCOOM) established in 1983. COOPPMAT helped 300 artisanal seed producers in Matagalpa, Jinotega, and Estelí graduate to certified seed production. Other cooperatives providing seed services include Multiple Service Cooperative of Santa Lucia (COSMUSAL) in Boaco, Cooperativa la Concordiana R.L. in Matagalpa, and Multiple Service Cooperative (COSERME) in Pueblo Nuevo, Estelí. Typically, cooperatives sell seed on credit to members and seed for cash to non-members including GON/donor programs.

4.2.6 Seed Producers/Marketers

Seed producers/marketers include individual farmers and organizations that produce certified seed; sometimes contracting other farmers to multiply seed. They include companies such as Federico Baltodano's Semillas Mejoradas S.A. (SEMSA) and Hector Rayo's Horteco, Vicente Alegre, Alcala Valenzuela, and others. Several of these organizations have established networks of rural retail outlets to sell seed directly to farmers. These producers and marketers are relatively large farmers who are either self-financed or obtain credit from commercial banks, producing large volumes of seed using modern cropping methods.

4.2.7 Regional Seed Associations

In the late 1990s, some cooperatives, universities, seed producers/marketers, and Agronegsa organized regional seed associations. These include the Southern Association of Seed Producers (APROSUR) in Carazo, the Western Association of Seed Producers (ASORESEM) in León, and the Northern Seed Producer Association (APROSEN) in Estelí. They provide seed marketing services, help seed producer organizations change from artisanal to certified seed production, and promote the use of improved varieties.

4.2.8 INTA Seed Producers

At least 16 seed producer groups, located throughout the country, receive technical support from INTA. They produce open-pollinated maize, sorghum, and bean seed in a wide range of categories, from artisanal to registered seed. There are two groups of INTA seed multipliers: large farmers producing basic and registered seed under contract, and small farmers receiving technical assistance from INTA's regional offices.

Seed producer groups are strategically important to INTA because they provide a distribution system for new varieties. Most of INTA's seed producer groups are small, typically 10 to 20 farmers. Most of the members of these groups are small farmers producing seed on one or two manzanas, although some produce seed on 30 manzanas or more. Seed producers are responsible for harvest, drying, and manual selection operations. Most of the seed is treated and sold in unmarked sacks. In some areas, members sell seed at the farmgate, while in other areas (e.g., Estelí) farmers process and bag seed in commercial processing plants. INTA provides financing and parent seed, as well as seed cleaning and packing services at its new seed processing plant in Managua. Sometimes INTA also provides assistance in marketing seed.

Many INTA seed producers began multiplying artisanal seed and selling it in their local communities. INTA provided training and parent seed, but it did not guarantee to purchase seed or help farmers sell it. Most seed producer groups had good production skills but weak financial and marketing capabilities. As these groups mature, they recognize the marketing advantages and potential profitability of certified seed they can sell throughout the country. Some organize into cooperatives and regional seed associations to market seed more

effectively. USAID's PROMESA provided business training seminars to several of these organizations, helped convert 1,000 farmers into certified seed producers, and promoted the use of seed production contracts between these farmers and seed companies. PTA's National Seed Plan calls for INTA to provide business training and marketing services to these groups. PTA plans to provide technical support to nine seed producer groups and their seed procurement and marketing operations.

4.2.9 Nicaraguan Exchange for Agriculture and Livestock

Another important player in the national seed market is the Nicaraguan Exchange for Agriculture and Livestock (BAGSA), an agricultural commodity exchange providing a transparent market for agricultural commodities. In the 1990s, BAGSA did not distinguish between certified and non-certified. Its laboratory was not equipped to test seed quality. By providing a market where grain was sold as seed, BAGSA flaunted the National Seed Law, which prohibits this practice, and fostered unfair competition that eroded seed prices and consumer confidence in the quality of certified seed. This practice reduced demand, crop yields, and agricultural output. In 2001, BAGSA decided to exclude non-certified seed from its marketing program.

4.3 Private Seed Companies

One reason for the low rates of adoption of certified seed during most of the 1990s was the failure of seed companies to take advantage of small farmers' increased access to credit and demand for certified seed. This section reviews the historical development of Nicaragua's seed industry, with particular emphasis on importers/distributors that import hybrid seed into Nicaragua.

4.3.1 The 1970s

During the 1970s, multinational seed companies, including DeKalb AgResearch, Pioneer International, and Empresa de Semillas Mejoradas de Centroamérica (SEMECA), established Nicaraguan subsidiaries to sell imported hybrid maize and sorghum seed. They also imported parent lines and began producing hybrid maize seed in Nicaragua. They exported approximately 80 percent of Nicaragua's hybrid seed production to other Central American countries. The Programa de Producción de Semillas de Granos Básicos (1986) provided the following information on seed production (Table 25) during this period.

Table 25: National Seed Production, 1972-1978

Crop	Volume of Seed Produced Annually (QQ)						
	1972	1973	1974	1975	1976	1977	1978
Maize	9,328	14,014	22,198	53,790	48,906	17,116	18,216
Sorghum	374	3,080	3,300	1,914	4,070	330	3,916

Crop	Volume of Seed Produced Annually (QQ)						
	1972	1973	1974	1975	1976	1977	1978
Beans	198	968	858	4,048	330	66	858
Total.	9,900	18,062	26,356	59,752	53,306	17,512	22,990

Source: PSGB, 1986

Seed importers included national seed traders, the Nicaraguan government, and multinational companies such as Pioneer de Centroamérica S.A., Rappaccioli McGregor S.A., Commercial International, Agrícola Humberto Chamorro, Servicio Agrícola Gurdian, Saballos Sacasa S.A., Agropecuaria Cuculiza Mántica S.A., Sucre Elias Frech, International Trading Corporation, Comercial de Occidente S.A., Pedro Aníbal Martínez, Carlos Guerra, Instituto Nacional de Comercio Exterior e Interior, and the Instituto Regulador del Abastecimiento. The primary seed import was hybrid sorghum seed (Table 26). The primary suppliers of seed imported into Nicaragua in 1974 and 1975 were the United States, Germany, Brazil, El Salvador, Honduras, and Costa Rica. In 1974, the United States provided 62 percent of seed (mainly hybrid sorghum, cotton, and vegetable seed), and El Salvador supplied 28 percent (mainly maize seed). Seed companies marketed imported seed through sales representatives, cooperatives, producer associations, regional wholesalers, and rural retailers. Seed imported by government institutions and distributed by INCEI and the National Development Bank bypassed the private sector.

Table 26: Volume of Seed Imports (selected crops), 1974-1975

Crop	1974 (QQ)	1975 (QQ)
Maize	6,142	519
Beans	N/A	150
Sorghum	13,639	14,972
Rice	810	1
Cotton	N/A	200
Vegetables	77	26
Other crops	6	12
Total	20,675	15,880

Source: PSGB, 1986

During the 1950s, 1960s, and 1970s, Nicaragua used more certified seed and other agricultural production inputs than other Central American country. Part of the success of certified seed was due to cotton production, which introduced many farmers to modern, high-input agriculture and provided access to credit. Nicaraguans recall with pride the country's former agricultural productivity and its reputation as "the breadbasket of Central America." In the 1970s, Nicaragua was known for its production and export of high-quality seed. GON agencies certified national seed production, but multinational seed companies controlled seed quality and export operations.

4.3.2 The 1980s

The restructuring of the Department of Agriculture in the 1980s and the formation of a seed department in the Dirección General de Técnica Agropecuaria initiated a new era of seed

development and promotion in Nicaragua. The GON introduced and promoted new varieties, including imported and domestic seed, to stimulate maize, bean, sorghum, and soybean production. During 1979-1985, the GON introduced nine improved bean varieties under the serial nomenclature "Revolucion." During 1979-1990, it introduced and promoted the NB (Nicaragua Blanco) maize varieties: NB-30, NB-100, NB-6, and NB-12 and the imported maize hybrids H-5 and B-833.

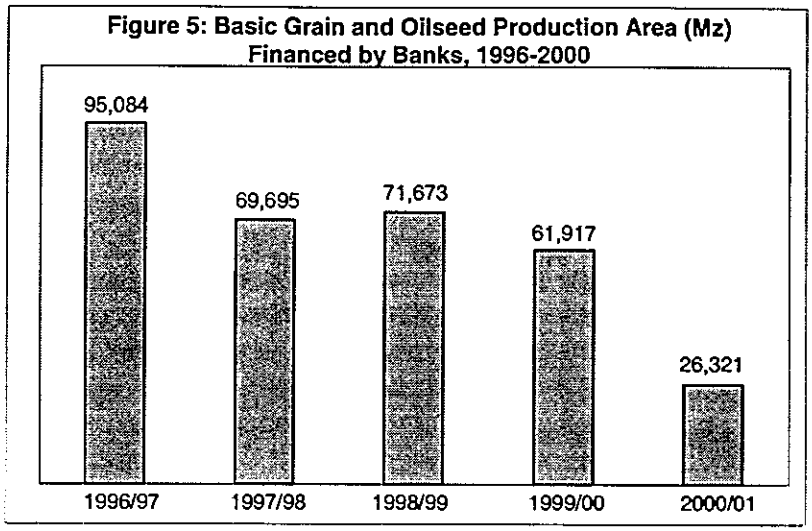
Because of political uncertainties associated with the new Sandinista government, foreign seed companies reduced their investments in Nicaragua in the late 1970s and early 1980s. They were replaced by a new parastatal organization called the National Seed Company, responsible for seed production and imports, and by PROAGRO, a parastatal organization responsible for distributing seeds and other production inputs to farms and cooperatives. The National Development Bank provided agricultural credit, particularly for maize and rice production, on attractive terms. The private sector's role in the national seed system declined, however, and inefficient GON distribution channels, combined with low loan recovery rates, eventually reduced farmer access to certified seed. Seed production and imports stagnated until, by the late 1980s, there was little high-quality certified seed available in national markets.

By the end of the 1980s, the centrally planned seed system had been unsuccessful in creating a sustainable demand for certified seed. Crop production grew increasingly inefficient. Many Nicaraguan farmers resorted to technologies they had used in the 1930s, and some economists said it would take at least 20 years for the country to recover. By 1988, GON programs, PVOs (CARE, COSUDE), NGOs (CIPRES, PRODERE, ADDAC, PRONORTE, PRODESSA), U.N. organizations (FAO, PNUD) and farmer organizations (UNAG, ATC) were promoting the production of artisanal seed. Because of unreliable seed quality, ineffective marketing, and inefficient distribution channels, as well as a contraction in the agricultural economy as a whole, the production and use of certified seed use continued to fall. Average national yields of basic grains and oilseed crops stagnated.

4.3.3 The 1990s to the Present

The 1990s brought radical changes in the national economy. The private sector remained weak, however, and a chaotic policy environment confounded business planning and discouraged investment. After a decade of central planning, the private sector was unable to take advantage of opportunities in the new market economy. Multinational seed companies were reluctant to reenter the national seed sector. Banks reduced their agricultural loan portfolios (Figure 5), and the use of certified seed remained low. Farmers planted only about 3 percent of maize production with imported hybrids, for example, and only about 5 percent with domestically produced certified seed of open-pollinated varieties (Figure 6).

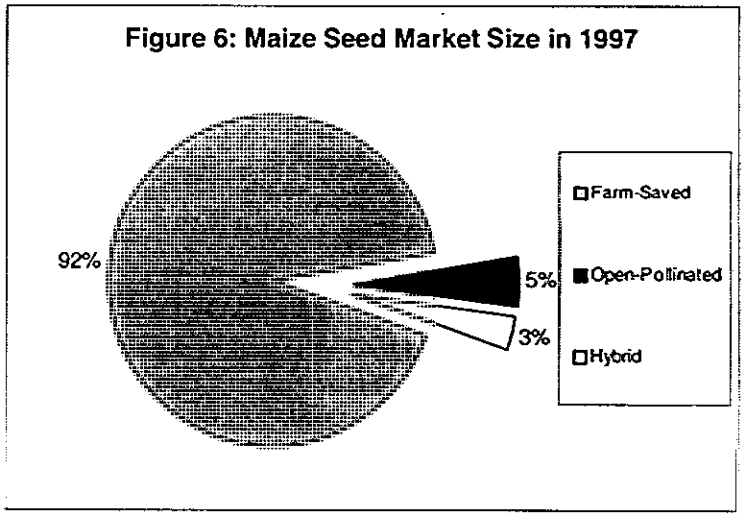
Today, the most important foreign seed suppliers in Nicaragua's maize seed markets are Central American seed companies. The leading supplier is Cristiani-Burkard, based in Guatemala, which had most of the hybrid maize seed market in Nicaragua during 2000-2002.



In 2000, PROMESA organized the first National Seed Fair to promote the use of certified seed and foster cooperation among foreign seed suppliers, domestic importers/distributors, and more than a dozen newly established national seed companies. Importers/distributors and national seed companies invested little in market research or promotion, but they were eager to receive training in these areas, as well as in general business management skills.

4.4 Individual Farmers

Individual farmers who buy certified seed are, ultimately, the pivotal stakeholders in the national seed sector. Seed companies distribute most of the certified seed used by small farmers through GON/donor programs, instead of through commercial channels. Until recently, field technicians in GON/donor programs made seed choices for their clients, rather than allowing farmers to choose. Another reason that farmers are not the primary seed decision makers is that many seed companies, particularly newly established ones, do not market directly to farmers. Seed companies have been reluctant to invest in extensive and expensive distribution systems to deliver seed to farmers in remote locations. The low cost of marketing to GON/donor programs make them attractive alternative targets in the short term, despite their unpredictability and instability over the long term.



CHAPTER FIVE
CONSTRAINTS TO SEED SECTOR DEVELOPMENT

5.1 Importance of Improved Seed

Certified seed of improved varieties can boost yields, raise production, improve food security, create jobs, increase incomes, and diversify agricultural production. Dramatic production increases result from the introduction of improved varieties and hybrids, and investment in certified seed generates higher returns than most other inputs. Crop breeding programs that generate new, high-yielding varieties adapted to local conditions, along with market-oriented seed systems in which public and private stakeholders use modern seed production and marketing practices, can make certified seed available to all farmers.

5.2 Increased Certified Seed Production and Imports

The volume of certified seed used for basic grain and oilseed crops in Nicaragua increased by more than 60 percent during 1996-2001, from 89,600 to 142,240 quintals, and is projected to grow to 187,400 quintals in 2002 (Table 27). The low use of complementary inputs and expansion of the cultivated area into frontier areas diluted the impact of increased certified seed use on a national level, however. Few farmers in frontier areas use certified seed or complementary production inputs. Thus, despite the increased volume of certified seed used, the percentage of the grain production area planted with certified seed grew little during this period. If certified seed use were to increase to 15-30 percent of the cultivated area, it would raise average national yields by 20-30 percent and reduce pressures for further expansion into ecologically fragile areas.

Table 27: Volume of Certified Seed Used and Area Planted for All Basic Grain and Oilseed Crops,* 1996-2001

	1996/97	1997/98	1998/99	1999/00	2000/01	Avg.
Volume of Certified Seed Planted (thousand QQ)	61	83	54	83	87	74
% of Cultivated Area Planted with Certified Seed	14%	20%	12%	17%	14%	15%

Source: PTA/MAG-FOR Report, 2002
* Maize, sorghum, rice, bean, soybeans, sesame, and peanuts.

Traditionally, farmers plant less than 10 percent of the maize, bean, and rice area with certified seed (Table 28). Increased use of certified seed during 1996-2002 resulted in national average maize yields rising by 14 percent. Bean yields increased 23 percent. Rice yields are expected to rise in 2003 because of the introduction of new varieties and increased use of certified seed. The use of certified sorghum seed also increased, but yields declined during this period because of unfavorable weather and expansion of sorghum production into marginally productive areas. Annex A Figures A-12 through A-16 show changes in the use of certified maize, bean, rice, sorghum, and peanut seed in Nicaragua during 1996-2001.

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Table 28: Certified Seed Use and Average Crop Yields, 1996-2001

	1996/1997 to 2000/2001			
	Avg. % of Area Planted with Certified Seed	Percentage Change in Area Planted with Certified Seed 1996-2001	Avg. Yield (QQ/Mz)	% Change in Avg. National Yields
Maize	9%	85%	18.5	14%
Beans	3%	318%	11	23%
Rice	12%	40%	26	-24%
Sorghum	78%	26%	27	-11%
Soybeans	89%	-37%	31	-8%
Sesame	52%	-31%	8	55%
Peanuts	60%	93%	44	27%

Source: PTA/MAG-FOR Report, 2002

5.3 Constraints to Seed Sector Development

National production of certified seed increased during 1996-2002 in response to growing demand. Supply responds to demand in the long term, but suppliers can respond more quickly if local seed systems are well developed, farmers' seed preferences are clearly understood, seed demand is predictable, parent seed is available, and seed policies favor investment. Many farmers understand the benefits of using certified seed, but unless well-adapted, moderately priced seed is available in local communities and promoted by credible rural retailers, it is difficult to convince farmers to use their scarce cash resources to purchase certified seed. Seed demand also depends on exogenous factors such as grain prices, interest rates, and natural disasters.

5.3.1 Registered Seed

High-quality parent seed for certified seed production is essential for the development of a competitive seed industry. Low-quality parent seed reduces yield potential and farmers' incentive to buy certified seed. In developed countries, universities and specialized seed companies provide parent seed to multipliers. Developing countries frequently rely on crop research and extension institutions like INTA.

If seed companies had purchased and multiplied all of INTA's registered seed, they could have produced enough certified seed to plant more than a third of the maize, beans, and rice production area (Table 29). Farmers planted only about 7 percent of this area with certified seed, indicating that the volume of INTA's registered seed did not constrain the use of certified seed. INTA faces one the problems facing seed companies—unpredictable demand for seed. INTA blames seed companies for unpredictable demand for registered seed just as seed companies blame GON/donor programs for unpredictable demand for certified seed. Lacking reliable projections of future seed demand, and without reliable sources of operating capital for seed procurement and processing, seed companies make low-risk production plans and do not take full advantage of INTA's ample supply of registered seed.

Table 29: Registered Seed Production and Percentage of National Production Area that Could Be Planted Using Certified Seed Produced from INTA's Registered Seed

Registered Seed Production					
	1997	1998	1999	2000	2001
Maize	370	102	741	643	346
Rice	1,782	548	3,030	2,662	2,330
Sorghum	48	66	48	49	64
Beans	474	514	1,006	1,417	2,179
% National Area that Could Be Planted Using Certified Seed Produced from INTA's Registered Seed					
Maize	24%	6%	44%	39%	16%
Rice	34%	11%	56%	48%	28%
Sorghum	100%	100%	100%	68%	112%
Beans	4%	4%	6%	9%	14%

Source: INTA

5.3.2 Certified Seed

The use of certified seed varies by crop and type of farmer. For example, farmers plant between 60 and 100 percent of the oilseed area with certified seed. Most oilseed producers are large farmers with sufficient assets for collateralized commercial loans. Some have irrigation systems to reduce production risks and ensure that loans are repaid. Large farmers have compelling technical reasons to buy certified seed. They use complementary production inputs such as fertilizers, crop protection chemicals, and machinery that take advantage of the yield potential of improved varieties and hybrids. Mechanized planting requires uniform, high-quality seed and reduces seeding rates and overall seed costs. These farmers sell a significant proportion of oilseed production overseas where high standards and price premiums encourage farmers to use high-quality seed.

Seed companies complain that GON/donors' demand for certified seed is unreliable. In the long term, however, reliable demand does not depend on GON/donor programs, but on seed companies marketing directly to farmers and developing loyal customers. Both INTA and seed companies need to market new varieties aggressively, offer price discounts for seed produced under contract, understand customer needs, and offer an expanding selection of seed products to increasingly discerning customers willing to pay more for high-quality seed. Another part of the solution is for the GON, including INTA, and donor programs to stop competing with private seed companies.

Seed companies complain that INTA has unfair advantages over private seed suppliers. The GON subsidizes INTA's research and technical assistance, and provides credit for parent seed and other inputs used in INTA seed programs. Although INTA has public funding for research and a mandate to provide seed to small farmers, seed companies must recover their research and marketing costs. INTA's new seed processing plant is another public investment that competes unfairly with private seed processors. Seed companies argue that INTA's sales

of certified seed or processing services tend to depress prices and that INTA should limit its role to registered seed, leaving certified seed markets to private seed companies.

Currently, 36 organizations, including farmer associations, cooperatives, and individual farmers, market certified seed in Nicaragua. Most are new to the seed industry, attracted by strong demand for certified seed by relief programs after Hurricane Mitch. Some government agencies and donor projects, particularly those funded by USAID, insisted that its agriculture programs use certified seed. Development projects, funded by PASA/DANIDA, Ayuda Obrera Suza (AOS), and INTA, created new seed companies, some of which graduated from artisanal to certified seed production and began exporting seed to other Central American countries. Small seed companies have demonstrated that they can produce high-quality seed, but their weak management skills limit market penetration and profitability. Some companies produce and sell large volumes of seed, but their profit margins tend to be small. They do not invest in marketing and promotion programs targeting farmers, preferring instead to focus their marketing efforts on GON/donor programs. They do not take full advantage of market information to forecast demand and plan seed production. Instead, they tend to base production decisions on production capabilities, without clearly defining target markets. Consequently, seed companies ignore some seed markets with attractive sales potential.

Seed distribution systems changed dramatically during 1998-2002. Previously, importers relied on their own regional offices to distribute seed and other inputs. After the National Agricultural Bank closed in the mid-1990s, many large farmers lost their access to production credit. Non-traditional donor-financed financial institutions became increasingly important sources of rural credit, particularly for small farmers. These changes had a profound impact on seed distribution channels. Importers/distributors reduced the number of their distribution outlets and began distributing through networks of small, rural retailers. Some 700 rural seed retailers, knowledgeable about local growing conditions and individual farmers, sell certified seed even in remote areas. PNAPP and Libra por Libra (see Section 6.4 of Chapter Six) increase seed sales through rural retailers, resulting in the establishment of hundreds of new ones. Unfortunately, some rural retailers continue to sell non-certified farm-saved seed. This low-quality seed competes with certified seed, which makes farmers skeptical of the quality of certified seed and reluctant to pay premium prices for it. To position certified seed as a high-quality, high-value product, seed companies collaborate with the DGS to spot-check rural seed retailers to ensure that seed is properly tagged and stored.

Nevertheless, seed distribution networks remain poorly developed and largely unregulated. The scarcity of registered seed retailers is not limited to remote rural areas. Even areas with good market access frequently lack registered outlets. The number of rural retail outlets registered at DGS increased in 2002, however, when DGS reduced annual registration fees for rural retailers from $200 to $15. For seed markets to grow to their full potential, distribution channels need to reach remote areas with high production potential. All of the major seed importers have retail outlets in the Jalapa valley, for example, where 30 percent of the maize area is planted with hybrids and a equal proportion is planted with certified seed of improved varieties. Few seed retailers exist in Nueva Guinea, however, where agronomic conditions are favorable and farmers grow more than 20,000 manzanas of maize. Consequently, farmers plant only about 1 percent of the cultivated area with certified seed.

New Varieties. To compete in regional and global markets, Nicaraguan farmers need a wide selection of domestically produced and imported certified seed. They also need a larger number of improved varieties of basic grains and oilseed crops. The number of varieties registered at MAG-FOR is an indicator of their availability to farmers, but since some registered varieties are not widely distributed in rural areas, another useful indicator is the number of imported or domestically produced varieties and hybrids of certified seed, which indicates their acceptance and use on a commercial scale. Table 30 summarizes the number of improved varieties and hybrids available during 1998-2001.

Table 30: Number of Improved Varieties of Basic Grain and Oilseed Crops Imported or Domestically Produced as Certified Seed

	1998/1999	1999/2000	2000/2001	2001/2002
Maize	9	9	7	12
Beans	5	6	5	8
Rice	6	5	5	11
Sorghum	14	15	4	15
Soybeans	1	1	1	1
Peanut	4	10	4	4
Sesame	7	5	5	5
Total	46	51	31	55

Source: MAG-FOR, PROMESA (see Annex A Table A-17)

Another indicator of farmers' seed choice is the number of newly registered varieties. New varieties may result from meaningless product differentiation that merely confuses farmers without increasing their seed choices in meaningful ways. Typically, however, the introduction of new varieties represents a broader selection of increasingly productive new varieties. The expanded selection of improved varieties during 1997-2002 reflects general conditions in Nicaraguan seed markets, with increased demand for certified seed and farmers searching for new varieties. MAG-FOR removed an important barrier to variety adoption by changing testing requirements. Previously, a new variety had to be "validated" in Nicaragua for at least two years before its commercial release. Today, variety performance data from other Central American countries are acceptable for registration, and only one crop season of in-country testing is required. Once varieties are registered and launched into commercial markets, however, seed companies want to protect their investment.

Despite the 2000 plant variety protection (PVP) law, the system has not been tested in the courts, and neither MAG-FOR nor INTA have defined policies concerning intellectual property rights over new varieties developed by public-sector plant breeders. Plant breeders at INTA and other seed organizations lack incentives to release new varieties that are superior to current commercial varieties. Weak coordination between INTA and MAG-FOR seed programs is one reason for poorly defined seed policies. For example, INTA refused to pay the MAG-FOR's DGS to register new varieties. To alleviate this bottleneck to new variety introductions, PROMESA paid the registration fees for 10 new varieties released between 1999 and 2002. This procedure was clearly unsustainable, however, and called for a revision of current registration policies.

The GON removed seed import taxes in 1998 to stimulate imports, but registration fees for new seed varieties continued. PROMESA advocated for the elimination of variety registration fees, resulting in a reduction of annual fees from $100 to $40 in 2001. The Union Aduanero Centroamericano (UAC) is negotiating a new fee structure that will standardize seed registration fees throughout Central America. The UAC agreement is expected to result in a proliferation of new varieties, seed company outlets, and seed producers.

The number of registered seed producers grew from about 100 in 1997 to more than 700 in 2002. Certified seed production can be highly profitable, even for small farmers, and many of Nicaragua's new seed producers are small farmers producing certified bean seed on only one or two manzanas. When they produce for seed companies that pay seed processing and storage costs and absorb marketing risks, seed becomes an attractive, high-value crop produced using low-tech production methods (Table 31).

Table 31: Farm-Level Seed Production Costs and Profits*

	Bean Seed	Open-Pollinated Maize Seed	Open-Pollinated Sorghum Seed
Avg. Seed Yield (QQ)	15	35	40
Farmgate Seed Price	$30	$18	$14
Total Income/Manzana	$450	$630	$560
Seed Production Cost/Manzana	$267	$415	$329
Gross Profit	69%	52%	70%
Gross Profit/Quintal	$12.20	$6.14	$5.78
Gross Profit/Manzana	$183	$215	$231

Source: PROMESA
*Medium-technology production using animal traction. Estimated seed production costs include production inputs, labor, and DGS supervision but ignore land rental or interest. The figures also assume that seed companies pay processing, tagging, and storage costs.

5.3.3 Increasing the Demand for Certified Seed

Nicaragua has the lowest level of certified seed use in Central America. In 2001, farmers planted less than 15 percent of the grain production area with certified seed. Nicaragua also has the lowest yields. The challenge for Nicaragua's seed industry is to develop marketing strategies that increase certified seed demand. The potential exists to increase the size of the seed market. Seed companies need to analyze farmers' needs and define strategies for developing existing markets and entering new ones. They need to promote certified seed as a way to reduce production risks and increase farm income by:

- Providing information to farmers about the advantages and availability of certified seed;
- Retraining extension agents who persist in telling farmers that certified seed is "too expensive";
- Extending distribution systems for certified seed to rural communities;

- Determining whether crop failures, frequently attributed to poor seed quality, are actually the result of other factors, including improper seed storage and planting procedures, non-certified seed and bad weather. By investigating such allegations, seed companies protect their reputations and have opportunities to talk to farmers about seed; and

- Demonstrating to banks and financial intermediaries that certified seed reduces production risks and improves repayment rates.

Seed companies can take advantage of donor programs to teach farmers the difference between seed and grain, and the overwhelming advantages of using certified seed instead of farm-saved seed. Donor support was critical in establishing a network of seed companies and technical assistance providers that planted hundreds of on-farm variety demonstrations each year. Donor projects used these demonstrations to hold more than 100 field days during 1999-2002. Policy makers can encourage private and donor-supported financial institutions to provide credit for seed with high yield potential and for complementary production inputs. In the long term, however, seed companies, rather than donors, need to expand seed distribution systems and demonstrate new varieties to farmers. The process of new variety adoption tends to be long and slow, so the seed companies that participated in field days during 1999-2002 may not have experienced increased seed sales immediately. Nevertheless, field days where farmers can talk with seed suppliers and other farmers are a time-honored way of selling seed and a standard practice in most well-developed seed systems.

Seed Demand Forecasting. Institutional seed markets are unpredictable. GON/donor programs frequently wait until the last minute before purchasing seed. These delays cause problems that ultimately reduce certified seed use. Unable to predict demand, and attempting to avoid expensive inventories, seed companies cut production. The resulting seed shortages force institutional buyers to purchase grain and provide it as seed. Farmers who plant grain instead of seed lose confidence in seed quality, including certified seed. Lacking confidence in seed quality and without a reliable supply of certified seed, some farmers revert to traditional farm-saved seed. Despite the unpredictability of institutional markets, however, marketing costs are low and potential profits are high. A single transaction with an institutional buyer can involve more seed, and greater profits, than hundreds of transactions with individual farmers.

Seed companies can reduce seed procurement delays by using long-term demand projections and promoting the use of production contracts. Seed production based on long-term sales projections reduces variability in the seed supply and enables occasional users to develop into loyal customers. Production contracts benefit both buyers and sellers by reducing marketing costs and seed prices. They foster marketing relationships based on trust and reinforce confidence in the high quality of certified seed.

Technical Information. One of the best ways to increase certified seed demand is to provide more and better technical information. Policy makers need to understand the role of certified seed in farm production. Seed companies need to understand the costs and profitability of production, processing, and marketing operations. Agricultural technicians need to understand the opportunity costs of planting farm-saved seed instead of certified seed.

Although critical to the adoption process, technical information is often insufficient to stimulate adoption. Many farmers need firsthand experience before adopting a new technology like an improved variety. They need to see how varieties perform under local conditions—preferably in their own fields—before investing in certified seed.

Market Size. Seed market size and growth rates are measurable in terms of value, volume, or proportion of cultivated area. The value of the current market for certified seed is $6 million. Annex A Table A-2 shows the volume of certified seed used and the area planted during 1996-2001. Because of continued expansion of the cultivated areas, the proportion of the area planted with certified seed remains low, despite significant increases in seed production and imports and in the area planted with certified seed (Annex A Table A-2). Certified seed is used extensively for grain sorghum and oilseed crops, however. Farmers plant most of the oilseed and feed-quality sorghum[7] area with certified seed as compared with a relatively small proportion of basic grains.

The supply of certified seed is enough to plant about 7 percent of the bean area, 10 percent of the maize area, and 18 percent of the rice area (Table 32). Domestic seed companies produce at least two-thirds of certified seed, except for industrial sorghum, of which about 70 percent of the seed is imported. Farmers plant more than 90 percent of the sesame, soybean, and peanut areas with domestically produced certified seed.

Table 32: Imported and National Production of Certified Seed, 2001/2002

Crop	Imported Certified Seed (percentage of total)	National Production of Certified Seed (percentage of total)	Area Planted with Certified Seed (percentage of national)	Percentage of National Area Planted with Certified Seed (imported and national)
Maize	32%	68%	8%	12%
Rice	10%	90%	7%	8%
Bean	3%	97%	4%	5%
Sorghum	72%	28%	28%	100%
Sesame	0%	100%	100%	36%
Soybean	0%	100%	100%	100%
Peanut	8%	92%	92%	100%

Source: MAG-FOR (see Annex A Tables A-2 and A-16)

The market potential for certified seed is attracting new seed importers and domestic producers. The potential size of the seed markets, measured in sales value, depends on how much seed is imported.[8] Annex A Table A-20 provides an estimate of the potential size of certified seed markets. If farmers planted certified seed produced in Nicaragua and sold at

[7] "Feed-quality sorghum" or "industrial sorghum" refers to grain sorghum used for animal feed. Most feed in Nicaragua is used for poultry. Most of the feed-quality sorghum, sometimes known as "industrial sorghum," is grown from imported hybrid seed, whereas most of the seed for "food-quality grain sorghum" is open-pollinated and domestically produced.

[8] Considering the limited availability of foundation seed from local sources, importing seed can be an attractive option. Another advantage of importing seed is the ease with which supplies can adjust to changes in farmer preferences.

current prices on the entire area of basic grain and oilseed production, it would cost $31 million annually. Planting the same area with imported seed would cost $49 million. Currently, imported seed represents about 25 percent of commercial seed sales.

PROMESA estimated the potential size of the market for certified seed to be approximately $12 million, double that of the $6 million market in 2002 (Annex A Table A-21). This estimate was based on the results of farm surveys and a study, described in Chapter Three, conducted by Maldidier and Marchetti (1996) using socioeconomic variables to divide farmers into eight categories listed below and described in greater detail in Annex A Tables A-22, A-23, and A-24:

- Rural wage earners;
- Campesinos/wage earners;
- Campesino farmers from the agricultural frontier;
- Campesinos using intensive production methods;
- Campesinos using extensive production methods;
- Small-scale farm entrepreneurs;
- Medium- and large-scale farm entrepreneurs; and
- Agrarian-reform beneficiaries.

PROMESA combined the results of Maldidier and Marchetti and farm surveys to estimate the number of farmers in each category and region who, without access to GON/donor programs or additional sources of credit, would purchase certified seed if it were available in their communities. Some 59,000 of Nicaragua's 249,000 farmers are potential seed buyers, representing a sustainable target market for certified seed. Table 33 summarizes their production areas and potential consumption of certified seed.

Table 33: Potential Target Market for Certified Seed in Area, Volume, and Value, 2001

	Total Area (thousand Mz)	Potential Target Area (thousand Mz)	Potential Seed Volume (QQ)	Potential Seed Value (thousand US$)
Maize	420	143	57	2,856
Bean	270	54	43	2,700
Rice	125	38	75	2,325
Sorghum	70	45	9	627
Sesame	15	15	1	105
Soybean	12	12	7	259
Peanut	35	35	70	3,920
Total	947	341	262	12,792

Source: Based on data from MAG-FOR, Nitlapan, and PROMESA; see Annex A Table A-20

Approximately 262,000 quintals of seed, with a potential retail value of $12.8 million, would plant 341,000 manzanas of basic grain and oilseed production. Approximately $5.7 million in maize, bean, and sesame seed, representing approximately 44 percent of the potential market, would be sold primarily to small farmers. About $4.17 million of soybean and peanut seed, representing 32 percent of the potential market would be sold to large farmers. An estimated $3 million of rice and sorghum seed, representing 23 percent of the potential market, would

be sold to both large and small farmers. The size of target markets and potential seed sales would increase if farmers had better access to credit and if transaction costs and interest rates were lower.

Access to Credit. Rural credit is scarce and expensive, and the high cost of credit restricts investment in agriculture. According to the World Bank's 1998 "Government of Nicaragua Living Standard Measurement Survey," less than 8 percent of Nicaraguan households have savings accounts, and only about 25 percent use formal sources of credit. Of the households that received loans in 1998, the median loan was only $136. Only 3 percent of the households in rural areas have savings accounts, and less than 20 percent have access to credit. More than 90 percent of rural households say they cannot afford to borrow at current interest rates. The World Bank cites the following constraints to credit in Nicaragua:

- Inadequate definition of property rights, particularly those of small farmers;
- High transaction costs of registering property and repossessing assets used as collateral;
- GON- and donor-backed financial institutions with loosely defined performance targets and objectives, offering unsustainable incentives subject to political pressures;
- Non-bank financial institutions, particularly cooperative and donor-backed financial institutions, that are inadequately supervised and do not operate on performance-based rewards;
- Laws that impede banks from capitalizing on the market potential of microcredit;
- Grain warehouses that do not provide enough farmers with receipts to use as collateral, resulting in most farmers selling their grain at harvest, rather than storing and selling it when prices increase; and
- Inadequate guidelines for rural credit institutions, resulting in poor selection of activities and borrowers to finance, public loans "crowding out" private loans, and unsustainable systems of financial intermediaries.

Since the demand for certified seed depends, in part, on farmers' access to production credit, high interest rates are important constraints to the adoption of certified seed. Most credit institutions, including microlenders, base their loan decisions on the availability of collateral and the borrower's credit history, rather than on expected returns to investment. Small farmers seeking credit for certified seed are unlikely to receive it. According to Rodriguez (1998), only about 15 percent of Nicaraguan farmers have access to credit, but the availability of credit varies by region. Around Managua and in the Pacific region, 20 percent of farmers had credit in 1998, compared with 15 percent in the Central region, and only 5 percent in the Atlantic region. Table 34 shows the percentage of basic grain and oilseed crop production financed by state and private banks from 1997 to 2001.

Table 34: Basic Grain and Oilseed Production Areas Financed by State and Private Banks, 1997-2001

	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	1997-2001 (average)	Avg. % of Cultivated Area Planted with Certified Seed 1997-2001
Maize	3.3%	0.2%	0.1%	0.1%	1%	9%
Sorghum	9.5%	11.9%	9.7%	12.0%	11%	69%
Rice	14.6%	10.0%	18.6%	8.1%	13%	10%
Beans	0.7%	0	0	0	<1%	2%
Soybeans	83.1%	71.7%	69.5%	57.8%	71%	96%
Sesame	5.3%	0.5%	0.1%	0.4%	1%	65%
Peanuts	82.7%	102.5%	49.8%	81.3%	79%	84%

Source: MAG-FOR

During 1997-2001, public institutions and commercial banks withdrew from financing small-scale agriculture. An estimated 71-79 percent of the soybean and peanut area, grown primarily by large farmers with collateral, continued to be financed by credit. With the exception of industrial sorghum, however, credit for grain production fell rapidly. Farmers used credit to produce only about 11-13 percent of sorghum and rice production. Credit for maize and bean production virtually disappeared.

The relationship between production credit and certified seed use is apparent. The availability of credit for soybean and peanut production resulted in strong demand for certified soybean and peanut seed. When financing for maize and bean production disappeared in the 1990s, the demand for certified seed also dropped. The use of certified seed of industrial sorghum remained high (69 percent) despite the relatively small proportion of the area financed (11 percent); many large sorghum producers continued to purchase certified seed, even without credit. Few sesame farmers used credit or certified seed. Table 35 summarizes the distribution of loans from commercial banks, donors, and cooperatives to rural areas in 1998, according to farm size.

Table 35: Distribution of Loans in Rural Areas According to Farm Size, 1998

Farm Size (Mz)	Commercial Bank Loans (%)	PVO/NGO Loans (%)	Cooperative Loans (%)
< 2	6.2	25.1	18.0
2-5	19.5	17.2	22.6
6-20	24.4	42.1	20.3
21-50	21.1	5.1	19.4
51-100	13.7	1.7	15.8
101-500	9.7	8.8	3.9
> 500	5.4	0	0

Source: Rodriguez (1998)

On average, loans for agricultural production are small. Most rural credit is in small loans made to small farmers. More than 70 percent of commercial bank loans and more than 80 percent of loans provided by donors and cooperatives went to farmers with less than 50 manzanas. Eighty-three percent of the loans provided by donors and cooperatives are for less

than $1,000 (Table 36). Even loans from commercial banks tend to be small; 65 percent are for less than $1,000. Donors and cooperatives rarely make loans for more than $5,000. Commercial banks are the primary source of financing for large farmers.

Table 36: Size of Loans According to Credit Source, 1998

Loan Size (US$)	Commercial Banks (%)	PVOs/ Donors (%)	Cooperatives (%)
< $200	25.3	18.2	67.0
$200-$1,000	40.1	65.6	22.4
$1,001-$5,000	11.2	16.2	6.4
$5,001-$10,000	4.4	0	4.2
> $10,000	19.0	0	0.0

Source: Rodriguez (1998)

Subsidized credit ended with the closure of the National Development Bank. Although agricultural credit remains scarce and expensive, credit for certified seed shows signs of improving. Unconventional donor-funded financial institutions are expanding. In-kind credit, such as INTA's "two-for-one" program,[9] provides seed to farmers in exchange for grain at harvest. GON programs, such as PNAPP and the Institute of Rural Development (IDR), use certified seed in their farmer assistance programs, expanding the demand for certified seed even in the absence of conventional credit. In the long term, however, farmers will need better access to commercial credit to finance seed and other production inputs.

Effect of Seed and Grain Prices on Demand for Certified Seed. The production of agricultural commodities usually responds to price changes. Table 37 shows the average farmgate prices of basic grains and oilseed crops during 1996-2000. Increased grain production during this period, despite declining grain prices, was a result of the expansion of low-input, "extensive" production methods. Surprisingly, grain prices did not increase after Hurricane Mitch in 1998, perhaps because food donations made up for crop losses.

Table 37: Average Price (US$/QQ) for Basic Grain and Oilseed Crops

	1996	1997	1998	1999	2000
Maize	10.8	9.9	8.6	7.2	9.5
Beans	42.8	41.0	38.9	32.9	28.2
Rice	11.6	11.2	10.7	9.6	8.7
Sorghum	8.3	7.0	7.5	6.4	6.9
Soybeans	11.1	10.6	11.1	10.6	10.3
Sesame	32.4	22.2	25.9	23.8	25.2
Peanuts	17.9	17.2	15.8	16.1	16.9

Source: MAG-FOR

[9] INTA's two-for-one system is a method of distributing and multiplying seed. It is also a way to recruit customers for INTA's technical assistance services. Consider, for example, an extension agent offering technical assistance for a modest fee in exchange for enrolling the farmer in the Productor Artisanal de Semilla (PAS) program. PAS farmers receive funding for seed and other inputs. The result is that seed and other in-kind credits are used to subsidize technical assistance.

Some commodities respond quickly to price changes, while others adjust over time. International markets tend to set the prices of most cash crops, and farmers are influenced by historic prices when deciding how much cash crops to plant. If the previous year's price was high, farmers tend to plant larger areas of cash crops. However, historic prices have less influence on planting decisions for food crops. Instead of reacting to historic prices, planting decisions depend on historic yields and local market demand.

Annex A Figures A-17 to A-24 compare the prices and planted area of grain and oilseed crops during 1996-2001. Sorghum, irrigated rice, soybeans, and sesame are cash crops and, as expected, there is a correlation between the planted area and the previous year's price. Fluctuations in the production area of food crops (maize and upland rice) resulted in predictable price changes. There was a significant increase in the production area of upland rice in 2000/2001, for example, resulting in prices declining to $10 per quintal. Beans are both food and cash crops for small farmers. Bean production reacted slowly, but predictably, to historic price changes. The bean production area grew slowly in response to price increases in 1997/1998 and did not respond to declining prices until 2000/2001.

Farmers' Seed Choice Decisions. Technology adoption by small farmers depends on their perceptions of potential benefits and risks. Experience in other countries indicates that the adoption of new agricultural technologies depends on the overall profitability of crop production. Profits depend on resource-based comparative advantages, effective use of production inputs, and access to markets for farm products. The prospect of increased farm profits creates incentives to invest in complementary technologies. The adoption of certified seed, in particular, depends on this "derived demand" based on farmgate prices and farmers' access to complementary production inputs, including credit.

Seed represents only a small portion of total production costs but a large portion of cash costs. Cash-poor farmers are reluctant to purchase seed, particularly when they have poor access to grain markets. Studies conducted by CIMMYT indicate that seed-to-grain price ratios are significant factors in the adoption of hybrid maize seed. The combination of low seed prices and high grain prices encourages farmers to buy hybrid seed. High seed-to-grain price ratios, on the other hand, cause farmers to use grain as seed, and reallocate resources to other inputs. A farmer may understand the potential benefits of certified seed and its importance to yields but realize that other factors—most of them uncontrollable—also affect yields. Substitutes for commercial fertilizer and pesticides exist, although they usually require significant changes in management practices. Substituting grain for seed, however, is simple and easy. Using farm-saved seed reduces the farmer's cash costs and, given the impact of other factors, the seed's impact on yields, profits, and production risks may not be immediately evident. He may even conclude that certified seed is less important than other inputs. If he lacks access to credit, he is even more likely to use farm-saved seed.

The lack of technical information constrains the adoption of certified seed. Faced with a selection of varieties, farmers consider rainfall, soil, pests, diseases, and farm technology to choose seed that fits their agronomic, financial, and management needs. Yet, many small farmers are insufficiently involved in seed choice decisions. Most of the certified seed that reaches small farmers goes through GON/donor programs. Anecdotal evidence indicates that

small farmers prefer certified seed, and surveys show that farmers associated with GON/donor programs are more likely to use certified seed. It is unclear, however, whether recent increases in certified seed demand by GON/donor programs are a cause or result of farmers' seed preferences. Some of these programs make seed choice decisions for farmers, and some of their field technicians are convinced that certified seed is inappropriate for small farmers. INTA plays an important role by providing unbiased information on variety performance to field technicians. Seed companies also play major role by helping farmers choose appropriate varieties and hybrids.

5.3.4 Institutional and Regulatory Policies

For the private sector to produce large volumes of high-quality seed, penetrate and develop markets, and improve distribution efficiency, it needs to be supported by a market-oriented policy framework and effective regulatory institutions that encourage plant breeding, seed production, and marketing. During 1998-2002, Nicaragua made important progress in creating and implementing a market-oriented seed regulatory system. Modern seed policies, consistent with regional harmonization initiatives, increased seed supply, demand, and stability in national seed markets. Nevertheless, policies and regulations constraining Nicaragua's seed industry development persist. The role of MAG-FOR in regulating biotech products is undefined, for example, and the current Seed Law and regulations provide excessively restrictive norms and cumbersome, anti-competitive procedures. The Seed Law centralizes seed testing, certification services, and regulatory functions in DGS which, because of resource, equipment, and infrastructure limitations, cannot respond quickly to changes in seed demand.

In 2002, CONASEM, created more than three years earlier by the 1998 Seed Law, became an effective, functional entity capable of contributing to the development of the national seed system. CONASEM can provide the supervision and oversight needed to ensure that seed policies have a positive, stabilizing effect on crop production. CONASEM's supervisory role, coordinated with the DGS's enforcement role, fosters market growth and stability.

Current regulatory framework. The 1998 Seed Law (Law 280) defines the regulatory environment in which the Nicaraguan seed industry operates, outlining the legal parameters for seed research, production, and marketing. The law provides a useful starting point for creating a regulatory environment that gives appropriate authority to public institutions and encourages private investment. However, the law and its implementation have serious flaws, some of which are summarized below:[10]

- Law 280 establishes the DGS as a "general directorate." The GON has not implemented this aspect of the law, however. Currently, the DGS functions as a department of the General Directorate for Animal and Plant Health (DGPSA). The DGS's budgetary

[10] Based on presentations made by Julio Munguía, national director of PROMESA, and Dr. Francisco Barquero, a consultant, in the seminar "Building a Sustainable Seed Business," organized by PROMESA in August 2001.

dependence on the DGPSA creates bureaucratic inefficiencies and undermines the DGS's authority and financial sustainability. A subsequent law (Law 290) formalizes the current arrangement.

- As noted previously, CONASEM is formally assuming its official functions and responsibilities more than three years after the Law 280 established the council. Unfortunately, most CONASEM members are from public institutions. Six represent public regulatory agencies, two represent universities, two represent producer associations (*gremios*), and one represents private seed companies.

- Law 280 provides exclusive authority over seed certification to the DGS, which does not have the resources to meet the growing demand for its services. The law also calls for incorporating public and private laboratories and research centers into MAG-FOR's Centro de Investigación y Análisis de Semillas, although neither the law nor its regulations establishes the procedures for doing so.

- Article 19 of Law 280 requires the DGS to turn over its income from seed certification to the Ministerio de Hacienda y Crédito Público which, in turn, sends it to MAG-FOR to finance various services and regulatory activities. Currently, less than half of this income returns to DGS to finance seed services.

- Article 6 of the regulations of Law 280 defines the *autorizada* seed category used when the volume of registered and certified is inadequate. The regulations do not mention the "apta" seed category; nevertheless, the DGS supervised and tagged apta seed until 2002.

- Article 16 of the regulations of Law 280 requires crop breeding and variety validation organizations to submit their results to the DGS for verification and evaluation. These submissions are unnecessary, unjustified, and inconsistent with the principles of intellectual property rights. They also ignore the competitive needs of seed companies selling proprietary varieties and hybrids.

- Article 20 of the regulations of Law 280 requires that seed and other planting materials that have lost their genetic or agronomic identity be removed from the seed registry. This requirement is ambiguous and requires clarification.

- Article 33 of the regulations of Law 280 requires DGS approval before crop researchers can deliver basic or registered seed to seed companies and multipliers, causing unnecessary bureaucratic delays that could be avoided by allowing research centers to deliver this seed directly to seed producers registered at the DGS.

- Article 38 of the regulations of Law 280 requires seed companies to register their containers and trademarks at the DGS. This procedure is redundant, since the Ministerio de Hacienda y Crédito Público's Trademark Law already requires this procedure.

- Article 43 of the regulations of Law 280 requires that color-coded tags on seed bags distinguish the different seed categories. The GON is unlikely to implement this regulation, however, given the ongoing regional seed trade harmonization initiative.

- Article 7 of Law 280 makes the DGS responsible for implementing the law and its regulations. DGS resources are inadequate for monitoring seed trade or investigating potential seed law violations, including failing to register trademarks and varieties, falsifying seed tags, and selling grain as a substitute for seed.

Law 280 is not widely known by seed sector stakeholders, who should understand the law and its implications. A survey of 20 seed producer organizations indicates that they are poorly informed about Law 280, its regulations, and the role of CONASEM.[11] Nevertheless, the Nicaraguan government has made substantial progress toward providing an environment conducive to seed sector growth and development, including:

- Passing strategic legislation such as the Ley de Protección para las Obtenciones Vegetales (Law 318 PVP);

- Joining the International Union for the Protection of New Plant Varieties (UPOV) in 2001;

- Negotiating at the Union Aduanero Centroamericano to harmonize seed trade regulations in Central America to increase seed trade within the region;

- Lowering registration costs;

- Defining procedures for accrediting private seed companies that provide seed industry services currently reserved for the DGS;

- Convening CONASEM; and

- Defining a national seed plan for 2002-2004.

Agricultural biotech product regulation. Stakeholders in Nicaragua's seed sector need to simultaneously encourage technology transfer and regulate the integration of new technologies, including agricultural biotech products. Biotech seed and planting materials can reduce production costs, raise yields, and improve the quality characteristics of basic grains and numerous specialty crops. In some cases, biotechnology can confer pest resistance, herbicide resistance, higher yield potential, and improved nutritional value to grain crops better than conventional breeding methods. Properly managed, biotechnology can play an important role in environmental protection by reducing the use of fertilizers, pesticides, and land devoted to crop production.

[11] Presented at the August 2001 PROMESA seminar "Building a Sustainable Seed Business."

Some of the agricultural biotech products currently used in foreign markets are so attractive that Nicaraguan farmers will inevitably import them, either legally, as was the case in Costa Rica and Honduras, or illegally, as in Brazil. The GON should subject biotech products to biosafety reviews that take into account Nicaragua's international trade agreements, including the Cartagena Protocols and its obligations as a member of the World Trade Organization. Nicaraguan policy makers have not defined standards and protocols to regulate the commercial release of a biotech product or to monitor its effects. Currently, they are unprepared to embrace the potential benefits of these products to the agricultural sector or to understand their potential risks to health and environmental protection. They need more information about the potential costs and benefits of these products. To modernize Nicaragua's approach to biotechnology and reap the potential benefits of biotech seeds, policy makers need to:

- Develop national risk assessment standards for agricultural biotech products, including science-based protocols for research, testing, and commercial release and use of biotech products;
- Create a national biosafety commission to review applications for the introduction and commercial release of agricultural biotech products and advise public decision makers;
- Conduct a public education program on agricultural biotechnology;
- Conduct an information campaign, focusing on the agriculture sector, on the potential benefits and risks of biotech products, emphasizing the experience of other developing countries; and
- Integrate appropriate biotech seed products into Nicaraguan agriculture.

CHAPTER SIX
ECONOMIC IMPACT OF CERTIFIED SEED

This chapter compares national grain production with consumption and trade, and summarizes the results of on-farm variety demonstrations comparing the performance of hybrids, certified seed of improved varieties, and farm-saved seed of common check varieties. It also compares the risks and profitability of using hybrids, certified seed of improved varieties, and farm-saved seed of common "check" varieties. INTA conducted some of the fieldwork cited below to assess the performance of its experimental varieties. These trials typically compared one or two new varieties with a common check variety. INTA used relatively large, 500 square meter plots in order to simulate commercial field conditions and generate valid information for economic analysis. In 1999-2002, PROMESA organized dozens of donors, seed companies, donor projects, and universities to establish hundreds of variety demonstration plots. Each 500 square meter plot included six to eight improved varieties, hybrids, and common check varieties. Farmers made all crop management decisions concerning tillage, fertilizers, and crop protection practices, which were identical for all varieties and hybrids in any given plot. The purpose of these demonstration plots was to increase farmers' awareness of the benefits of certified maize seed.

6.1 MAIZE

In 2001/02, for the first time in five years, Nicaragua was self-sufficient in maize production, producing 121 percent of national consumption. Favorable weather and increased use of certified seed were responsible for yield increases. Previously, production met only 80-90 percent of consumption (Table 38). Maize imports rose from 259,000 quintals in the mid-1990s to 1.9 million quintals in 2000/2001. Nicaragua sells excess maize in other Central American markets, although its competitive advantages may disappear in 2005 when preferential import tariffs are eliminated.

Table 38: Production, Consumption, and Trade of Maize, 1996-2001 (thousand QQ)

	1996/97	1997/98	1998/99	1999/00	2000/01
Consumption	7,899	7,418	5,838	6,793	6,522
Production	7,103	5,810	6,610	5,456	7,917
Production/Consumption	90%	78%	113%	80%	121%
Imports	259	376	561	1,963	1,864
Exports	57	248	48	39	2

Source: MAG-FOR

Table 39 summarizes the use of improved open-pollinated varieties and hybrids in Central America in 1997, including average national yields. Countries that use more improved varieties and hybrids tend to have higher yields.

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Table 39: Percentage of Area Planted with Improved Varieties and Hybrids and Average National Yields in Central America, 1997

	Percent of Area Planted with Improved Varieties	Percent of Area Planted in Hybrids	Average Yield (QQ/Mz)
Nicaragua	5.5%	1.3%	18
Guatemala	1.7%	15.4%	30
Honduras	7.2%	8.6%	24
Panama	0.7%	42.3%	21
Costa Rica	1.5%	41.0%	24
El Salvador	0.5%	47.6%	30

Source: CIMMYT Maize Impact Surveys, 1997

Table 40 summarizes the results of two years of PROMESA maize variety demonstrations in 48 locations and three types of growing conditions. Average yields under "favorable" conditions ranged from 56 to 104 quintals per manzana, compared with 50-55 quintals under "normal" conditions and 19-48 quintals in "unfavorable" conditions. The yields of certified seed of open-pollinated varieties and hybrids exceeded farm-saved seed by 18 and 46 percent, respectively.

Table 40: Average Yields of Certified and Farm-Saved Maize Seed in 48 Locations in Nicaragua, 2001

Growing Conditions	Hybrids (QQ/Mz)	Open-Pollinated Varieties (QQ/Mz)	Farm-Saved Seed (QQ/Mz)	Mean (QQ/Mz)
Favorable	73	58	43	67
Average	56	49	42	53
Unfavorable	41	33	36	39
Mean	57	46	39	53

Source: PROMESA, 2002

In some demonstration plots planted in low rainfall areas, farm-saved seed of *criollo* varieties outperformed open-pollinated varieties, indicating that the duration of the rainy season was insufficient for the mid- to long-season open-pollinated varieties and hybrids (the only types of certified maize seed currently available) and that farmers in these areas should plant short-season varieties and hybrids. The short-season *criollo* varieties produced in Nicaragua are only available as farm-saved seed. In other areas, where the duration of the rainy season and total rainfall are adequate but its distribution is unreliable, the "vigor" (heterosis) of hybrids helps plants take advantage of scarce soil moisture, making them relatively drought-tolerant. Under this type of drought condition, hybrids yielded more than certified open-pollinated seed or check varieties.

Table 41 compares the profitability of hybrids, improved varieties, and farm-saved seed. Farmers planting open-pollinated varieties, farm-saved F2 hybrid seed, or conventional farm-saved seed of check varieties sacrificed potential income ($143, $257, and $355 per manzana, respectively), compared with farmers who planted hybrid seed.

Table 41: Estimated Yield and Crop Value Data for Four Maize Seed Types, 1999-2001

	Hybrid	F2 Hybrid*	Open-Pollinated Variety	Farm-Saved Seed
Seed Cost per Manzana	$24	$2	$11	$2
Expected Yield (QQ/Mz)	85	49	65	35
Crop Income at US$7.20/QQ of grain	$607	$350	$464	$252

Source: PROMESA, 2002
*Grain from harvest of a hybrid seed crop, used as seed for a subsequent crop.

The profitability of hybrids and certified seed of improved varieties depends on management practices and the use of complementary production inputs such as fertilizer. In 2001/02, World Relief conducted large-scale trials that corroborated and refined PROMESA's conclusions. World Relief planted 800 manzanas of hybrid maize (HS-5G), an open-pollinated improved variety (NB-6), and farm-saved seed to compare their performance. The hybrid and improved variety were fertilized more than traditional varieties, which increased production costs while raising yields. The results (Table 42) clearly show the advantages, in terms of both yields and income, of using hybrids and certified seed of improved varieties. Yields of HS-5G and NB-6 were 240 and 140 percent greater, respectively, than farm-saved seed. Despite fertilizer costs, the hybrid and improved variety were more profitable, measured in terms of net income, than check varieties by $145 and $260 per manzana, respectively. World Relief did not design its field trials for statistical analysis; nevertheless, they clearly indicate the profitability of using certified maize seed of well-adapted hybrids and improved varieties, in combination with fertilizer.

Table 42: Yields and Income from Hybrid, Open-Pollinated Variety, and Farm-Saved Maize Seed in Northern Nicaragua, 2000/2001

	Maize Variety		
	Hybrid HS-5G	Open-Pollinated Variety NB-6	Check Varieties
Production Cost (US$)	$127	$116	$86
Yield (QQ/Mz)	85	60	25
Income	$425	$300	$125
Profit (net income)	$298	$184	$39

Source: World Relief Nicaragua, Final Report, 2000–2002

Table 43 compares the profitability of maize produced with farm-saved seed without fertilizer (low technology) with two levels of mechanization and fertilizer (medium and high technology). The importance of maize to household food consumption is reflected in a farmgate "shadow price" $2 per quintal higher for maize grown using low technology than maize from medium- and high-tech production. Both the medium- and high-tech models had significantly lower break-even prices ($5.61 and $6.06 per quintal, respectively), compared with the low-tech model ($7.14), indicating that high-yielding certified seed gives farmers more flexibility in coping with price fluctuations. Small farmers prefer the lower financial exposure of the medium-tech model, which costs $163 less per manzana than the high-tech model.

Table 43: Profitability of Maize Production Using Low, Medium, and High Levels of Technology

	Level of Technology		
	Low*	Medium**	High***
Production Cost (US$/Mz)	$100	$370	$533
Expected Yield (QQ/Mz)	14	66	88
Price (US$/QQ)	$9.20	$7.20	$7.20
Revenue (US$/Mz)	$129	$478	$637
Profit (US$/Mz)	$29	$108	$104
Break-even Yield (QQ/Mz)	10.9	51.1	73.6
Break-even Price (US$/QQ)	$7.14	$5.61	$6.06

Source: MAG-FOR and PROMESA survey data (see Annex Tables 26 and 27)
* Farm-saved seed, manual planting, zero fertilizer, minimal pesticide.
** Certified seed, animal traction, moderate fertilizer and pesticide.
*** Certified seed, tractor, fertilizer, and pesticide.

In summary, the profitability of maize production using certified seed, in combination with fertilizer and mechanization (draft animals or tractors) to raise labor efficiency, is significantly higher than low-input production using farm-saved seed of traditional varieties. In spite of the increased cost of seed, the adoption of hybrids and certified seed of improved varieties increases the likelihood of generating profits when yields and prices fluctuate.

6.2 BEANS

Nicaraguans prefer small red beans, an inexpensive and popular source of protein. Nicaragua has the highest level of bean consumption in Central America (Table 44).

Table 44: Per Capita Consumption (kg) of Beans in Central America, 1998

	Beans
Nicaragua	21.3
Guatemala	7.0
El Salvador	7.9
Honduras	13.7
Costa Rica	9.2
Panama	1.7

Source: PROFRIJOL, 1999

Nevertheless, Nicaragua has been self-sufficient in bean production since 1996, exporting significant volumes of red beans to Costa Rica and El Salvador. Farmers are adopting certified seed of high-yield, improved varieties to produce export-quality beans. Small hillside farms with adequate rainfall during the Apante season produce most of the certified bean seed.

Table 45: Production, Consumption, and Trade of Beans, 1996-2001 (thousand QQ)

	1996/97	1997/98	1998/99	1999/00	2000/01
Consumption	1,506	1,466	1,364	2,039	2,067
Production	1,647	1,574	3,280	2,962	2,942
Production/Consumption	109%	107%	240%	145%	142%
Imported	44	30	124	159	61
Exported	213	186	52	288	158

Source: MAG-FOR

Despite the importance of beans to the national diet and exports, the use of certified bean seed in Nicaragua remains one of the lowest in Central America (Table 46). The commercial release of new high-yield, disease-resistant red and black bean varieties for Central American markets is increasing the demand for certified seed.

Table 46: Area and Yield of Beans Planted with Certified and Criollo Varieties, 1996

	% of Area Planted in Improved Varieties	Yield (QQ/Mz) Certified	Yield (QQ/Mz) Criollo	Yield Difference (QQ/Mz)
Nicaragua	30%	13.1	10.1	3.1
Guatemala	40%	17.0	12.6	4.4
El Salvador	25%	16.4	12.0	4.4
Honduras	46%	13.7	11.6	2.1
Costa Rica	85%	8.7	7.1	1.6
Panama	40%	22.4	13.7	8.7
Weighted Avg.	37%	13.8	10.7	3.1

Source: PROFRIJOL, 1997

The high incidence of *mosaico dorado* and other diseases reduces yields of traditional varieties, so INTA released several improved varieties developed by crossing disease-resistant lines with popular high-yield varieties with good consumer acceptance. Table 47 summarizes the results of on-farm variety trials of one new red bean variety (INTA-Estelí) grown under "favorable" and "unfavorable" conditions. Farmers used traditional, low-input management practices in these trials. Except for differences in seed, the management practices were identical for both the improved and traditional varieties. On average, INTA-Estelí yielded 18 percent more than traditional varieties, and its superiority increased under "favorable" agronomic conditions. The improved variety also generated 13 percent higher net profit.

Table 47: Yield and Income Data for Validation Trials of INTA-Estelí versus Traditional Bean Varieties in 27 Locations in Segovia, 2000

	Traditional Red Bean Variety	Improved Variety INTA-Estelí
Seed Cost (US$/Mz)	$22	$42
Yield (favorable locations) (QQ/Mz)	17.4	21.5
Yield (unfavorable locations) (QQ/Mz)	7.3	9.8
Average Yield (QQ/Mz)	11.4	13.9
Average Net Profit (US$/Mz)	$210	$242
Average Marginal Rate of Return	—	164%

Source: INTA, Annual Technical Report, 2001

Many consumers in Mexico, the Caribbean, and other Central American countries prefer black beans, providing a low cost, low risk opportunity for small farmers to diversify production exports. During 2000-2002, PROMESA and INTA tested black bean varieties in dozens of field trials. The table below summarizes the performance of DOR-500, one of the most promising improved black bean varieties.

Table 48: Demonstration Trial Results: Black Bean Variety DOR-500 and Traditional Varieties in 15 Localities in Pacific Sur, 2000

	Traditional Black Bean Varieties	INTA-DOR 500
Seed Cost (US$/Mz)	$19	$35
Yield in Favorable Conditions (QQ/Mz)	12.3	16.6
Yield in Unfavorable Conditions (QQ/Mz)	5.9	9.6
Average Yield (QQ/Mz)	9.1	13.2
Net Profit (US$/Mz)	$148	$206

Source: INTA, Annual Technical Report, 2001

DOR-500 yields were 31 percent higher, on average, than traditional varieties, and net profits were 28 percent higher. DOR-500 was particularly effective under unfavorable conditions where yields fell as a result of drought and low soil fertility. Its resistance to mosaic virus makes it popular with farmers in hot, low-lying areas where the disease is endemic.

6.3 RICE

During 1996-2000, national rice production was 50-60 percent lower than consumption. In 2001, rice importers and the National Association of Rice Growers negotiated an agreement with the GON (MAG-FOR and MIFIC) such that for each quintal that importers purchase from Nicaraguan producers, they can import an equal volume of rice without paying import tariffs. Rice markets responded immediately. The demand for high-quality, domestically produced rice increased dramatically. The demand for certified rice seed, used to produce rice with the same quality as imports, grew faster than production. National rice production, along with the demand for certified rice seed, will remain strong as long as the subsidy program continues.

Table 49: Production, Consumption, and Trade of Rice, 1996-2001 (thousand QQ)

	1996/97	1997/98	1998/99	1999/00	2000/01
Consumption	6,248	6,453	7,606	5,556	5,938
Production	3,149	3,669	3,803	2,995	3,627
Production/Consumption	50%	57%	50%	54%	61%
Imported	1,459	1,453	1,162	1,531	1,014
Exported	45,218	68	3	3	4

Source: MAG-FOR

Variety validation trials conducted by INTA clearly show the yield and income advantages of certified rice seed. Table 50 provides the 1999/2000 trial results of a new variety—INTA-Dorada—tested against traditional seed sources in six locations in Jalapa and Quilali. INTA conducted these trials under controlled field conditions. Crop management was uniform for all treatments. The farm-saved seed used as checks was from degenerated improved varieties.

Table 50: Yield and Income Data for Two INTA Rice Varieties versus Traditional Seed, 1999

	Farm-Saved Seed	INTA-Dorada
Seed Cost (US$/Mz)	$36	$55
Yield in Favorable Conditions (QQ/Mz)	91.3	95.4
Yield in Unfavorable Conditions (QQ/Mz)	56.2	70.4
Average Yield	82.7	76.6

Source: INTA, Annual Technical Report, 1999

INTA-Dorada was clearly superior to the farm-saved seed, with 9 percent higher yields and $99 higher net profit per manzana. It generated $4.58 in profits for each $1 invested in certified seed. Its yield superiority was even more evident under unfavorable conditions. In 1999/2000, INTA conducted extensive validation trials of its most promising early maturing rice variety, INTA 2000. These were on-farm trials located in 32 drought-prone areas. Traditional seed was genetically degenerated seed of old improved varieties. Table 51 summarizes the results of these trials.

Table 51: Yield and Income Based on Validation Trials of INTA-2000 and Farm-Saved Seed, 1999/2000

	Farm-Saved Seed	INTA 2000
Seed Cost (US$/Mz)	$26	$44
Yield in Favorable Conditions (QQ/Mz)	66	78
Yield in Unfavorable Conditions (QQ/Mz)	34	45
Average Yield	52	64
Net Profit (US$/Mz)	$486	$582

Source: INTA, Annual Technical Report, 1999

INTA 2000 yielded 23 percent more than farm-saved seed and 20 percent higher profits. Its superior performance was even more striking in unfavorable, drought-prone locations, where

it outperformed farm-saved seed by 32 percent. Every dollar invested in certified seed of INTA-2000 generated $5.33 in profits. Farmers like INTA-2000 because of its tolerance to disease and its early maturity.

6.4 SORGHUM

National sorghum production exceeded consumption in 1996/1997 and again in 2000/2001, but fell short in the intervening years. Despite the extensive use of hybrid seed on 40-80 percent of the "industrial" sorghum area, production costs exceed those of the foreign competitors. In 2001, the National Sorghum Growers' Association (ANPROSOR) negotiated an agreement with Nicaraguan poultry growers, MIFIC, and MAG-FOR. The agreement calls for the GON to guarantee a minimum price that allows grain sorghum producers to be profitable and allows poultry producers to pay world market grain prices. Hybrid and certified seed is indispensable for achieving high yields and meeting the quality standards of imported grain.

Table 52: Production, Consumption and Trade of Sorghum, 1996-2001 (thousand QQ)

	1996/97	1997/98	1998/99	1999/00	2000/01
Consumption	1,284	2,816	1,776	2,452	1,160
Production	2,655	1,913	1,131	1,742	1,744
Production/Consumption	207%	68%	64%	71%	150%
Imported	209	8	7	5	7
Exported	26,509	148	3	0	0

Source: MAG-FOR

During 1998-2000, INTA tested two sorghum varieties: INTA LP-99 and INTA LP-2001. The results show the profitability of using improved and traditional rice varieties. INTA used high-quality seed of both varieties. INTA conducted field trials in 42 locations in Estelí, Madriz, Managua, Carazo, Masaya, and Granada. The control variety was IRAT-204, a popular variety in these areas. Table 53 summarizes the results. Improved variety LP-99 had 11 percent higher yields and was 9 percent more profitable than the traditional variety. Certified LP-99 seed cost $6 per manzana more than IRAT-204 but resulted in $20 per manzana higher profits. Farmers like the new variety for its early maturity, short stature, and strong stems, as well as its high yield potential.

Table 53: Results of Validation Trials for Sorghum Variety INTA LP-99 in 42 Localities, 1998-2000

	Improved Variety INTA LP-99	Traditional Variety IRAT-204
Seed Cost (US$/Mz)	$8	$2
Average Yield (QQ/Mz)	26	23
Net Profit (US$/Mz)	$229	$209

Source: INTA, Annual Technical Report, 2000

In another validation trial conducted during the same period, INTA tested certified seed of improved variety INTA LP-2001 against farm-saved seed of traditional varieties in 31 locations in Chinandega, Managua, Masaya, Carazo, Granada, and Matagalpa. Approximately 22 percent of the traditional varieties were either Tortillero Precoz or Pinolero-1. Table 54 summarizes the results.

Table 54: Results of Validation Trials for Sorghum Variety INTA LP-2001 in 31 Localities, 1998-2000

	Improved Variety INTA LP-2001	Traditional Variety INTA LP-99
Seed Cost (US$/Mz)	$8	$2
Average Yield (QQ/Mz)	40	34
Net Profit (US$/Mz)	$359	$309

Source: INTA, Annual Technical Report, 2000

Certified seed of INTA LP-2001 was superior to farm-saved seed of traditional variety INTA LP-99. On average, INTA LP-2001 generated 15 percent higher yields and 14 percent higher profits than INTA LP-99 did. Farmers prefer the improved variety for its yield potential, grain quality, short stature, and livestock fodder quality.

6.5 Potential Impact of Certified Seed on the Agricultural Economy

Grain and oilseed producers can improve their competitive advantage in regional markets by planting hybrid and certified seed, using complementary production inputs, and adopting modern management practices. Regardless of competitive advantage, however, grain production will remain an important element of the agricultural economy because of its role in on-farm consumption and national food security and because of its potential to integrate small-scale subsistence farmers into the commercial economy. Modern maize production can help tens of thousands of small farmers make the transition from subsistence agriculture to diversified, export-oriented production of high-value crops. Increased export crop production and related manufacturing and processing creates jobs and income. Agribusiness growth also benefits other industries and contributes to overall economic development. The high risks of agricultural production in Nicaragua and the absence of risk-management tools such as crop insurance and access to production credit, however, make farmers extremely conservative in their investment decisions. Farmers may be reluctant to buy seed even when they understand that using hybrid and certified seed results in increased yields and income.

MAG-FOR's Agricultural Technology Project estimated the potential impact of certified seed on Nicaragua's agricultural economy. PTA assessed the anticipated impact of its Libra por Libra certified seed program during 2002-04, which is expected to result in increased grain production and crop diversification. If farmers plant certified seed from the Libra por Libra Program on the same area as in previous years, the program will result in increased grain production. Average maize yields are expected to increase from 25 to 41 quintals of maize per manzana, from 10 to 14 quintals of beans, 43 to 73 quintals of rice, and 30 to 41 quintals of grain sorghum (Table 55). MAG-FOR expects the program to double the volume

of grain produced by farmers who take advantage of the seed price subsidies of the Libra por Libra Program.

Table 55: Yield Estimates Used to Calculate the Potential Impact of the Libra por Libra Program

	Average Grain Yields (QQ/Mz)	
	Non-certified Seed	Certified Seed
Maize	25	41
Beans	10	14
Sorghum (white)	30	41
Rice	43	73

Source: Agricultural Technology Project (PTA/MAG-FOR)

If Libra por Libra is implemented as planned, 100,000 farmers will increase grain production by 4.8 million quintals, a 59 percent increase in national production (Table 56). Increased maize production would represent most (58 percent) of the increase, compared with 6 percent for beans, 11 percent for sorghum, and 25 percent for rice.

Table 56: Projected Impact of the Libra por Libra Program on Grain Production

	Area (Mz)	Grain Production (QQ)		Increased Production (QQ)	Percent Increased Production
		Non-certified	Certified		
Maize	65,604	1,668,140	1,038,615	2,706,755	62%
Beans	22,500	217,500	106,000	323,500	49%
Sorghum (white)	17,500	516,250	201,250	717,500	39%
Rice	15,000	637,500	450,000	1,087,500	71%
Total	120,604	3,039,390	1,795,865	4,835,255	59%

Source: Agricultural Technology Project, 2002

If Libra por Libra results in a pure production effect, farm income will increase from $108 to more than $250 per year. A 50-pound bag of maize seed that plants 1.5 manzanas will increase income by $170 per manzana; a 75-pound bag of bean seed to plant one manzana will increase income by $108 per manzana; a 40-pound bag of sorghum seed for two manzanas and will increase income by $82 per manzana; and two 100-pound bags of rice seed to plant two manzanas and will increase income by $257 per manzana (Table 57). Farmers who receive seed for more than one crop, or for more than one planting season, will benefit from even greater increases in annual income.

Table 57: Number of Seed Recipients and Anticipated Increase in Average Farm Income from the Libra por Libra Program (US$)

	Non-certified Seed	Certified Seed	Increased Income	Number of Producers
Maize (1.5 Mz)	$272	$442	$170	56,386
Beans (1 Mz)	$221	$329	$108	22,500
Sorghum (2 Mz)	$421	$586	$164	8,750
Rice (1 Mz)	$364	$621	$257	15,000
Total				102,636

Source: Agricultural Technology Project, 2002

If farmers use certified seed from Libra por Libra to maintain the same volume of grain production as in previous years, the program's impact will be on the area diverted from grain production to other, higher-value crops. Increased yields and incomes from Libra por Libra could divert more than 43,000 manzanas from grain production to other crops. Most (58 percent) of the area potentially diverted would be from maize production, compared with 17 percent for beans, 11 percent for sorghum, and 14 percent for rice. If diversification is successful, it can result in much higher farm income than if they simply use seed to increase grain production.

Table 58: Potential Production Diversification Impact of the Agricultural Technology Project in Basic Grains

	Avg. Annual National Grain Production (QQ)	Area Planted with Certified Seed (Mz)	Area Potentially Diverted to Other Crops (Mz)	Percentage of Grain Area Potentially Diverted
Maize	1,668,140	40,431	25,173	58%
Beans	217,500	15,128	7,372	17%
Sorghum (white)	516,250	12,591	4,909	11%
Rice	637,500	8,793	6,207	14%
Total	3,039,390	76,943	43,661	

Source: Agricultural Technology Project, 2002

There are important opportunities for Nicaragua's small farmers to diversify into livestock, forestry, agro-forestry, horticulture, aquaculture, and high-value niche export markets. Certified seed can make important contributions to transitions from grain, oilseed, and tuber crop production to more labor-intensive, high-value crops such as melons and vegetables. Nicaragua has a poor record of accomplishment in non-traditional, export-oriented production and marketing. For decades, GON and donor programs have introduced small farmers to alternative crops, but sustained successes are rare. There may be no quick fixes or shortcuts to the transformation of Nicaragua's agricultural system. Instead, farmers may have to make marginal changes and prolonged transition stages, one of which may involve modern grain production. As farmers incorporate certified seed into their grain production practices, they can devote more resources to developing high-value products.

6.6 Potential Environmental Impact

A recurring theme in this report is the low yields of basic grains and oilseed crops, and the opportunity to raise them by using more certified seed. Certified seed is not a panacea or guarantee of productivity, but under typical conditions it raises yields significantly, and its effects increase dramatically when used in combination with complementary production inputs. Technologies that increase agricultural productivity provide incentives to invest in farm infrastructure and conserve the natural resources used in production. Intensive farming methods based on the use of certified seed and complementary inputs can mitigate the effects of extensive agricultural practices on the agricultural frontier.

During the 1990s, Nicaraguan farmers used low-input, extensive management methods, particularly for grain production. According to surveys conducted by Nitlapan, a research and consulting organization associated with the Universidad Centroamericano, more than 80 percent of Nicaraguan farmers use extensive methods. Production increases in the 1990s were made at a high cost to the environment. Extensive production caused erosion, accelerated the advance of the agricultural frontier, and reduced agricultural sustainability, particularly in hillside agriculture. Farm-saved seed of traditional varieties will continue to be important in subsistence farms located in marginal production areas. Substituting traditional varieties with certified seed is not appropriate for all farming systems. It is increasingly evident, however, that sustaining agricultural growth, diversifying the sources of farm income, and protecting the natural environment will require widespread use of certified seed.

Subsistence farmers practicing slash-and-burn methods in mountainous areas are denuding the hillsides, leaching soil nutrients, and causing erosion, mudslides, and floods. The cycle of land clearing and nutrient depletion results in abandoned fields and migration to urban centers or increasingly marginal and environmentally fragile areas. These environmentally unsustainable production practices trap farmers at the subsistence level.

Improved varieties increase farm income and allow farmers to devote fewer resources to food crop production. When improved varieties are used with environmentally sound methods of hillside production (cover crops, live barriers, contour plowing, and minimum tillage) they help farmers reduce production risks, increase income, diversify production, adopt sustainable agricultural practices, break out of the poverty cycle, and, in the process, slow the advance of the agricultural frontier. The long-term solutions to the rural poverty cycle and environmental degradation is to stop farming in the hillsides or to switch to production of high-value crops. Unfortunately, however, high-value crops require long-term investment and technical support production and marketing. Few farmers can make the leap directly from subsistence to high-value crop production. The transition from subsistence to high-yielding grain production is a more realistic alternative.

CHAPTER SEVEN
STIMULATING COMPETITION IN NICARAGUA'S SEED SECTOR

This chapter discusses competitiveness in Nicaragua's seed sector, including marketing strategies, public policies, and private investment. It also recommends activities to improve the efficiency of Nicaragua's seed sector. The interventions described below can address institutional, supply, demand, and policy constraints.

7.1 Competitive Marketing Channels

GON and donor programs are major players in national seed markets, purchasing an estimated 30 percent of the commercial seed in Nicaragua.[15] If properly designed to be market-driven and oriented toward the use of certified seed, these programs can strengthen and extend seed marketing channels to remote rural areas. Some donor programs create market distortions by importing seed directly, however, bypassing commercial channels and creating non-competitive and unsustainable new channels. Programs selling seed at subsidized prices create unregulated secondary markets and undercut commercial suppliers. Programs promoting artisanal seed production and processing to increase self-sufficiency undermine the reputation of certified seed and result in farmers using low-quality seed that increases production risks.

To avoid dependence on unsustainable GON and donor programs, seed companies are developing marketing strategies and distribution systems to sell seed directly to farmers. Seed companies operating in increasingly competitive national markets are cultivating competitive advantages by cutting costs, forming strategic alliances, and investing in equipment and training. They are planting variety demonstrations, distributing technical information, holding field days and seed fairs, and advertising certified seed. Companies that can seed directly to small farmers and generate profits will introduce new varieties quickly and efficiently. To be profitable, however, they need:

- Varieties adapted to Nicaraguan growing conditions;
- Competitive market conditions;
- Effective regulatory agencies;
- Transparent markets;
- Market information; and
- Efficient seed distribution systems.

[15] Source: CIMMYT.

Nicaraguan seed companies are beginning to compete in foreign markets. Low profit margins on most open-pollinated seed are insufficient to attract competition from multinationals. Unfortunately, low margins are also insufficient to justify elaborate promotion programs and extensive distribution systems. This is where donor programs can help. World Relief, for example, established distribution channels to the *puertos de montaña* that supply seed to farmers in remote areas of Nueva Guinea. Donor-funded seed programs are motivating seed companies to package seed in 10- and 25-pound bags and conduct field days for the small farmer market. These innovations help seed companies refine their competitive advantages and compete in foreign markets.

7.2 Seed Policies to Foster Competitiveness

Before the mid-1990s, national seed policies protected domestic seed producers from foreign competitors, and protected farmers from the alleged predatory practices of seed companies. MAG-FOR's 1996 National Seed Plan clearly abandoned protectionist policies. Ongoing negotiations to harmonize customs requirements in Central America clearly indicate MAG-FOR's ongoing commitment to foster competition and help national seed companies develop competitive advantages. The current policy environment is designed to encourage seed companies to develop the competitive tools they need in other Central American markets. MAG-FOR is dismantling tariff and non-tariff barriers that provided competitive advantages to inefficient national seed companies. Regional seed trade agreements are resulting in foreign seed companies introducing new varieties and expanding their Nicaraguan operations.

MAG-FOR's Agricultural Technology Project adopted an aggressive, market-oriented seed strategy to increase the use of certified seed. In 2001, MAG-FOR's Delegaciones Territoriales decided to buy only certified seed. MAG-FOR's DGS ensures seed quality and promotes the use of certified seed. It applies its certification standards with a rigor appropriate for the current stage of Nicaragua's seed sector development. The DGS helps seed companies train multipliers in quality control methods. Recognizing that market growth may exceed its seed certification capacity and that private companies could certify seed more efficiently, the DGS developed a system for accrediting private laboratories and seed companies to provide these services previously reserved for the DGS.

MAG-FOR is increasingly aware of its role in facilitating, rather than regulating, private seed sector development and encourages seed companies to participate in policy debates in CONASEM. It reduced registration costs for new varieties and streamlined the requirements for variety validation trials. To continue facilitating private-sector–led development of Nicaragua's seed sector, MAG-FOR is:

- Providing technical assistance and training in policy analysis and advocacy to CONASEM;
- Implementing existing seed policies, particularly the new plant variety protection law;

- Assisting CONASEM in drafting new legislation and regulations and opposing legislation that threatens seed sector development, including the biodiversity law, the genetic resources access law, the biosafety law, and lawsuits attacking the plant variety protection law;

- Seeking approval to implement an accreditation system for private seed laboratories and seed companies;

- Reducing DGS dependence on MAG-FOR financing and increasing its responsiveness to changes in seed markets;

- Training CONASEM members in strategic and financial planning;

- Modernizing DGS's regional offices;

- Expanding DGS services (accreditation of seed labs and companies, seed tag spot-checks, and training on seed varieties and seed pathology) to meet the growing demand for certified seed; and

- Establishing an appropriate policy framework based on scientific criteria, to govern agricultural biotech products.

Nicaragua needs a regulatory framework for agricultural biotech products that ensures environmental safety. Policies governing testing and commercial releases of agricultural biotech products must balance the public's right to information and need for protection from potentially harmful substances, with the potential advantages of biotechnology of lower production costs, higher yields, and improved productivity and nutrition. Specific activities needed to develop the regulatory framework include:

- Developing standards and procedures for testing and releasing agricultural biotech products;

- Training public regulatory agencies to use environmental impact studies;

- Equipping universities to test and monitor biotech products;

- Creating and strengthening linkages between local and foreign universities to test and monitor the effects of agricultural biotech products; and

- Continuing outreach programs to the agricultural community and the public through technical information on biotechnology.

INTA will continue to plan an important role in testing new varieties and assessing their adaptability to Nicaragua's agricultural conditions. Most of the open-pollinated maize and sorghum varieties currently used in Nicaragua were developed by INTA, in collaboration with international crop research centers. In the late 1990s, INTA shifted its emphasis away

from artisanal seed and two-for-one credit programs. Its new policy emphasizes registered seed production and calls for an end to certified seed production that competes with private seed companies. When, because either the market is too small or seed users are too poor, the demand for new varieties is insufficient to attract commercial producers, INTA serves an important function by producing seed for markets that the private sector ignores.

Multinationals tend to dominate hybrid seed markets, suggesting that INTA should focus on open-pollinated varieties. It remains to be seen whether Nicaraguan seed companies can produce and market INTA's hybrid maize seed at prices that compete with multinational suppliers.[16] INTA's maize and sorghum programs may be able to produce seed of hybrid parent lines that will allow Nicaraguan seed producers to compete with multinational seed companies with superior economies of scale in research, production, marketing, and financing. INTA can strengthen its seed operations, increase production, and ensure that high-quality, early generation seed is available to Nicaraguan seed companies at the right time and place and at appropriate prices by:

- Adopting a market-driven pricing strategy;
- Upgrading seed processing and storage infrastructure, and providing financing to ensure that registered seed, the critical first link in the national seed system, can satisfy a growing market;
- Developing a system for forecasting certified seed demand to use as the basis for planning parent seed production;
- Not dumping registered seed inventories in certified seed markets, which should be reserved for private seed companies;
- Clearly defining seed production and pricing policies and transparent procedures for selling registered seed;
- Planning basic and registered seed production based on projected demand, rather than on historic sales;
- Producing seed based on production contracts;
- Incorporating new intellectual property rights protection for new varieties (Law 318, February 2001) into plant breeder incentives to release new varieties, and reinvesting profits from protected varieties in variety development programs; and
- Establishing policies that limit INTA seed activities to the production of basic and registered seed.

[16] INTA worked closely with CIMMYT to develop these maize hybrids. The substantial cost of their combined efforts was publicly financed and does not have to be recovered from the sales of hybrid parent lines. The implicit subsidy from publicly financed research and development may give INTA a cost advantage over multinational seed companies.

7.3 Stimulating Competitiveness through Investment

Nicaragua has resource-based comparative advantages in seed production based on its central location in Central America, diverse agronomic conditions, irrigation potential, low labor costs, seed production experience, and proximity to North American seed research and production areas. Before Nicaraguan seed companies can exploit these advantages in export markets, however, they need to sharpen their competitive strategies in national markets. Competitive national seed markets are characterized by:

- A wide range of seed products;
- Aggressive marketing and promotion programs; and
- Distribution systems for seed and complementary inputs that reach farmers directly, rather than through GON/donor programs.

Nicaraguan seed companies have made significant progress during 1998-2002 in developing competitive advantages. The national seed industry in general and newly established seed companies in particular, are consolidating and forming strategic alliances to cut costs and increase efficiency. If consolidation results in marketing seed directly to farmers instead of through GON and donor programs, Nicaraguan seed companies will be sustainable and competitive in foreign markets. Widespread use of certified seed will require additional investment, however, including:

- Private investment to produce and market certified seed and other production inputs;
- Public investment to improve farmers' access to agricultural markets for production inputs and farm products;
- Credit programs for agricultural production and post-harvest operations;
- Training in the benefits and use of complementary production inputs;
- Incorporation of regional seed organizations into CONASEM;
- Infrastructure needed for value-added agribusiness development; and
- GON and donor programs to attract private investors.

Foreign investment would improve research and marketing, boost sales, expand national seed markets, and give domestic seed producers better tools to compete in regional markets. Historically, multinational seed companies were reluctant to invest in Nicaragua because of its small size, political and economic instability, high information and other transaction costs, and obstacles to international trade. MAG-FOR is addressing these problems and several multinational seed companies, including Monsanto, Cargill, Cristiani-Burkard, and PROSELA, are demonstrating renewed interest in investing in Nicaragua. Given stable

economic and political conditions, clear and enforceable contract laws, and continued growth in Central American seed markets, Nicaragua should be able to attract foreign investment in the seed industry.

Competition between domestic seed producers and importers is increasing. Both seed producers and importers are expanding their seed product lines with high quality, competitively priced seed products, including new public and proprietary varieties and hybrids. They are holding field days where they demonstrate new varieties and participating in regional and national seed fairs where they establish production and distribution agreements. They are developing marketing and sales programs targeting small farmers. Increased competition from foreign seed companies is good for farmers and, ultimately, for the national seed industry. It attracts new products, stimulates marketing programs, and expands distribution systems. Producing, importing, and exporting seed are complementary activities for seed companies and for the national seed system as a whole.

7.4 Stimulating Seed Demand

In the long term, GON and donor programs should use private seed distribution systems. They should buy from private seed companies rather than engage directly in seed importation, production, and distribution. Seed companies, for their part, should use variety demonstrations, field days, videos, radio spots, and technical bulletins to promote improved varieties to small farmers. They need to develop new domestic and international marketing relationships. Activities that promote new marketing relationships are summarized below:

- Targeting seed companies, seed producers, and importers/ distributors at one level through field days, seminars, and demonstration plots;
- Training seed companies in marketing strategies;
- Providing market information from the DGS's newly updated GERMEN management information system;
- Training field technicians and extension agents, many of whom work for GON/donor projects and influence farmers' seed purchase decisions, in the value of certified seed;
- Establishing and training regional seed committees to prepare local seed promotion campaigns, including seminars on the benefits of certified seed;
- Improving small farmers' access to credit for production inputs;
- Demonstrating to banks that certified seed reduces production risks and improves loan repayments;
- Showing banks the low risk inherent to loans for post-harvest seed operations, which are significantly less than loans for agricultural field operations; and

- Convincing banks to insist on using certified seed in their programs.

7.5 Increasing the Seed Supply

Seed companies need to improve production and distribution efficiency. Activities that promote increased efficiency are summarized below:

- Helping seed companies, farm associations, and rural retailers establish efficient seed distribution systems;
- Establishing seed production contracts between INTA, farmers producing registered seed, seed companies and producers of certified seed;
- Reducing or altogether eliminating variety registration costs, thereby facilitating germplasm exchanges within Central America;
- Extending seed distribution systems throughout the country to provide access to certified seed to farmers in all areas; and
- Surveying rural retailers to determine their needs for technical information, training, and credit.

7.6 Adoption of Improved Varieties by Small Farmers

Donors are shifting from "doer" to "facilitator" roles to increase the sustainability of Nicaragua's commercial seed system. Increasingly, they work through private seed companies to reach small farmers. To encourage the development of a sustainable, commercial seed system, donors must stop competing with private seed companies, promoting artisanal seed production, and encouraging farmers to save their own seed. They need to stop importing and subsidizing seed prices and interest rates. Instead, they should buy seed from importers and domestic seed companies, and promote the use of improved varieties and hybrids. They need to update their technical assistance programs by introducing new seed technologies and providing marketing assistance to farmers producing high-value seed products. Donors can stimulate seed markets and facilitate their own transactions by buying seed produced under contract. They need to train field technicians to help farmers choose what varieties to plant rather than making the decision for them.

Farmers need to decide what type of seed to plant and exercise their choices in private markets rather than through GON and donor programs. They need to determine the optimal combination of commercial, certified seed purchased from local seed retailers and farm-saved seed. Farmers need to buy seed, rather than rely on free or subsidized seed from donor and government programs, and insist on a wide choice of imported and domestic certified seed of improved varieties.

7.7 Competition between National and Foreign Seed Companies

Seed import and production decisions increasingly depend on competitive advantages. The volume of seed produced under contract is growing. Importers and domestic seed companies are extending their distribution systems to reach farmers, even in remote areas. Access to new seed technologies, including agricultural biotech products, is improving. A new plant variety law protecting the rights of plant breeders is stimulating the commercial release of new varieties. Few incidents of piracy or mislabeling have occurred. Distributors are increasingly active in conducting market research, getting to know farmers, and understanding the market forces that determine demand for imported and domestic seed.

Seed companies, including importers, are marketing a growing portion of their seed directly to farmers, through local dealers. Some dealers continue to receive support from donors, but farmers, rather than the GON and donor organizations, increasingly make seed decisions. Regional seed producer associations operate in Leon, Carazo, and Estelí, providing information, marketing, and lobbying services. Associations are still involved in selling to donors and government programs, but they sell a growing proportion of seed through rural retailers.

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ANNEX A

TABLES AND FIGURES

Table A-1: Yields for Selected Crops in Central America (QQ/Mz)

Crop/Country	Year				
	1996	1997	1998	1999	2000
Maize					
Costa Rica	40	29	25	30	27
El Salvador	35	26	29	39	35
Guatemala	28	23	26	28	28
Honduras	25	24	16	19	22
Nicaragua	18	18	19	18	20
Beans					
Costa Rica	10	5	5	7	8
El Salvador	13	13	9	14	13
Guatemala	10	9	10	11	11
Honduras	10	14	14	7	11
Nicaragua	10	8	12	10	10
Rice					
Costa Rica	63	55	69	65	61
El Salvador	80	68	108	81	89
Guatemala	28	29	35	40	40
Honduras	42	48	40	36	36
Nicaragua	53	54	50	53	55
Sorghum					
El Salvador	23	25	31	20	25
Guatemala	18	18	18	18	18
Honduras	18	20	17	13	15
Nicaragua	35	25	19	28	33
Sesame Seed					
Costa Rica	9	9	9	9	9
El Salvador	12	10	12	10	11
Guatemala	11	10	10	11	11
Honduras	20	20	19	18	18
Nicaragua	8	4	5	6	10
Soybeans					
El Salvador	36	38	37	37	37
Guatemala	43	43	42	44	43
Honduras	31	31	33	33	31
Nicaragua	35	33	23	34	35

Source: Food and Agriculture Organization Statistics

Table A-2: Areas[1] Cultivated with and without Certified Seeds

Crop	Item	YEAR[2]					%Δ
		1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	
Maize	Total Area (1,000 Mz)	398.5	333.0	360.9	355.7	441.8	11
	Seed Available (1,000 QQ)	8.1	7.3	24.8	10.5	21.3	163
	Area Cultivated with Certified Seed[4]	20.3	18.4	62.0	26.2	53.4	163
	% of Area Cultivated w/Cert. Seed	5.1	5.5	17.2	7.4	12.1	137
Sorghum	Total Area (1,000 Mz)	77.0	76.7	58.9	63.1	62.7	-19
	Seed Available (1,000 QQ)	12.5	8.6	8.3	13.8	13.2	5
	Area Cultivated with Certified Seed[4]	62.6	43.1	41.5	63.1	65.8	5
	% of Area Cultivated w/Cert. Seed	81.4	56.2	70.3	100.0	100.0	23
Rice[3] (oro)	Total Area (1,000 Mz)	96.6	107.0	119.9	88.2	129.6	21
	Seed Available (1,000 QQ)	33.0	2.8	3.1	12.4	20.2	612
	Area Cultivated with Certified Seed[4]	16.5	1.4	1.6	6.2	10.1	612
	% of Area Cultivated w/Cert. Seed	17.1	1.3	1.3	7.0	7.8	487
Beans	Total Area (1,000 Mz)	171.3	192.9	270.5	296.9	290.9	70
	Seed Available (1,000 QQ)	3.5	0.5	2.9	11.3	10.9	215
	Area Cultivated with Certified Seed[4]	4.3	0.6	3.7	14.1	13.6	215
	% of Area Cultivated w/Cert. Seed	2.5	0.3	1.3	4.8	4.7	85
Soybean	Total Area (1,000 Mz)	14.1	19.5	25.9	12.9	6.1	-57
	Seed Available (1,000 QQ)	18.3	32.0	13.0	16.5	6.4	-65
	Area Cultivated with Certified Seed[4]	14.1	19.5	21.7	12.9	6.1	-57
	% of Area Cultivated w/Cert. Seed	100.0	100.0	83.9	100.0	100.0	0
Sesame	Total Area (1,000 Mz)	37.4	17.2	11.2	11.5	16.7	-55
	Seed Available (1,000 QQ)	1.5	0.7	0.7	0.4	0.9	-41
	Area Cultivated with Certified Seed[4]	21.4	9.4	9.4	9.7	6.0	-72
	% of Area Cultivated w/Cert. Seed	57.3	54.8	83.8	84.4	35.9	-37
Peanuts	Total Area (1,000 Mz)	15.6	21.1	20.7	32.9	30.5	95
	Seed Available (1,000 QQ)	11.9	24.5	35.0	60.2	87.1	630
	Area Cultivated with Certified Seed[4]	6.0	12.2	17.5	30.1	30.5	411
	% of Area Cultivated w/Cert. Seed	38.3	58.1	84.6	91.5	100.0	161

Source: MAG-FOR
[1] Harvested areas.
[2] Information closed at March 27, 2001.
[3] Omitting 1996.
[4] Area cultivated with certified seed is estimated by dividing seed available by the rate of seed per manzana.

Table A-3: Percentage of Certified Seed Used in Maize and Yields (QQ/Mz) 1997

Country	% of Area Planted with Certified Seed	Yields
Costa Rica	43	29
El Salvador	48	26
Guatemala	17	23
Honduras	16	24
Nicaragua	7	18

Source: CIMMYT maize impact survey, 1997

Table A-4: Technological Level Used and Agricultural Productivity

Country	Labor Productivity[1]		Growth Rate (%)	Fertilizer Consumption[2]		Agricultural Machinery[3]	
	1979-1981	1995-1997	1979-1997	1979-1981	1995-1997	1979-1981	1995-1997
Argentina	12,195	13,833	13.4	46	254	73	112
Australia	20,880	29,044	39.1	269	376	75	65
Brazil	2,047	3,931	92.0	915	898	139	142
Chile	2,612	5,211	1,999.5	321	1,131	86	119
Colombia	1,926	2,890	50.1	812	2,853	77	118
Costa Rica	3,159	4,627	46.5	2,650	3,636	210	246
Mexico	1,482	1,690	14.0	570	538	54	71
New Zealand	-	-	-	1,965	4,247	367	488
Nicaragua	1,334	1,407	5.5	392	147	19	11

Source: Based on World Bank Report

[1] Labor productivity measures the value added per agricultural worker. Measurement units are not defined, but the differences in labor productivity between countries is nevertheless apparent.

[2] Fertilizer consumption measures fertilizer consumption per hectare.

[3] Agricultural machinery measures the tractor use per worker per arable hectare.

Table A-5: Summary of the Regionalization of Nicaragua (agro-ecological variables)

Macro-Regional Variables	Sub-Region	Relief and Soil Characteristics	Climate	Natural Vegetation	Soil Use in %[1]	Main Production Systems	Yield (QQ/Mz)
I New Agricultural Frontier (NAF)	NAF of the last 10-25 years	Mostly alluvial plains but also some mountainous areas in the north (Isabelia) and the south (Chontaleña). Deforestation resulting in fragile soil subject to lixiviation and acidification.	A humid tropical climate (2,000 to 4,000 mm of annual rainfall), with an excess of water that can cause problems; possibility for an Apante bean cycle and a Postrera maize cycle, and good for planting rice.	Humid tropical forest (pine and mangrove).	a) 20-40 b) 40-60 d) < 10	An extensive livestock raising system and basic grain production.	Maize: 16-25 Bean: 10-20 Row rice: 30-40
	Pioneer fronts						
	Indigenous communities				a) 60-80 b) 20-40 d) < 2	Multi-crop production (maize, beans, rice, bananas, and tubers). Cattle and hog raising.	
II Old Agricultural Frontier (OAF)	Northern coffee-producing OAF	Eastern mountain ranges (> 400 meters above sea level) and some valleys.	A semi-humid climate (1,400 to 2,000 mm of annual rainfall) with the same crop cycles as Macro-region 1 but with less excess water problems.	Sub-tropical forest.	a) < 10 b) 60-80 d) < 10	Multi-crop production (coffee, basic grains, bananas, and plantains) Cattle raising.	Maize: 18-25 Bean: 6-12 Row coffee: 5-10
	Southern cattle-raising OAF	Slopes of the Chontaleña mountain range (< 400 meters above sea level) and parts of the adjacent plains.			a) < 10 b) 60-80 c) < 10	Dairy production.	Maize: 8-16 Bean: 4-8
III Large Coffee and Livestock Owners Region	Large livestock and coffee farms	Higher elevations of the Isabelia and Dariense mountain ranges and some valleys.	A semi-humid climate (1,100 to 1,650 mm of annual rainfall), with cooler temperatures and two agricultural cycles.	Sub-tropical forest highlands.	a) + d) < 10 b) 40-60 c) 20-30	Coffee and dairy farms (and cool-climate vegetables).	Coffee: 20-30 (un-processed berries)
	Large cattle ranches	Plateaus and hilly areas of the Chontaleña mountain ranges with low soil fertility.	A variable climate: some arid areas and others with 1,300 to 1,500 mm of annual rainfall.	Forest with caducous foliage.	a) < 10 b) 60-80 d) < 10	Extensive beef and dairy farm production.	
IV Dry Region	Northern campesino region	Variable: plains and hills of the Pacific area; plateaus with plains and fluvial valleys. Variable soil: either fertile yet shallow soil or soil with low fertility of limited agricultural use.	A dry and semi-arid climate (less than 1,200 mm of annual rainfall), a long summer (180 days), sometimes only one crop cycle per year, livestock feeding problems during the summer	Forest with small bushes and a tropical treeless plain.	a) 10-20 b) 60-70 c) --- d) 10-20	Extensive cattle raising; industrial sorghum production; monoculture production of cotton, sugar cane, and sorghum; basic grain production and cattle raising; extensive horticulture based on rainfall and irrigation.	Maize: 15-20 Bean: 8-12
	Large cattle ranches						Maize: 10-20 Bean: 4-12

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Macro-Regional Variables	Sub-Region	Relief and Soil Characteristics	Climate	Natural Vegetation	Soil Use in %[1]	Main Production Systems	Yield (QQ/Mz)
V Pacific Plateaus	Pacific entrepreneurs	Volcanic plains and flatlands. Deep fertile soil, subject to erosion and sometimes with high clay content.	Favorable climate (1,100 to 1,650 mm of annual rainfall) that allows two crop cycles (Primera and Postrera) although it depends on the effect of the dry canicula period in August.	Tropical treeless plains.	a) 0- 10 b) 20-30 c) 10-20 d) 50-60	Mechanized monoculture production of cotton, sugarcane, and sorghum; Coffee production in the plateau of Carazo and Sierras.	Maize: 20-40 Bean: 5-10 Rice: 30-40 Sesame: 8-10
	Campesino groups	Idem but sometimes more unfavorable (hills and hillsides).				Multi-crop production and agricultural using animal traction.	
VI Peri-urban Smallholders Region	Inserted in the Pacific plateaus (V)	The northwest slope of the Carazo plateau. Fertile soil but not as deep as in the Pacific plateaus.	Similar to the climate of Pacific plateaus.	Same as in the Pacific plateaus.	a) --- b) --- c) 30-40 d) 60-70	Intensive production of fruit, basic grain, tubers, horticulture, and flowers.	Maize: 20-40 Bean: 8-15 Rice: 20-40

Source: Maldidier and Marchetti. 1996. El Campesino-Finquero y el Potencial Económico del Campesinado Nicaragüense. NITLAPAN.
[1] a: forests; b: pasture; c: perennial crops; d: annual crops.

Table A-6: Summary of the Regionalization of Nicaragua (socioeconomic variables)

Macro-Regional Variables	Sub-Region	History Patterns	Land Holding[1]	Social Status	Market Access	Inhab./ Km^2	Urbani-zation Level	Nonagricultural Activities
I New Agricultural Frontier (NAF)	NAF of the last 10-25 years	Recent agricultural settlement in an area where, since the turn of the century, the economy has been based on mines, lumber, rubber, and banana exploitation.	50-200 Mz	Campesinos in a process of social differentiation.	Little market access; poor transportation and communication infrastructure with few, poorly maintained roads and a communication system based on rivers and horses.	8-10	Low	Mines and lumber exploitation.
	Pioneer fronts		100-200 Mz	Poor campesinos with little social differentiation.		6-8		Idem plus hunting.
	Indigenous communities	Old Sumo and Miskito communities.	Communal land			2-4		River fishery and hunting.
II Old Agricultural Frontier (OAF)	Northern coffee-producing OAF	Campesino settlement in the higher elevations dating from the 1940s and 1950s and an IAN-PRICA-led settlement during the 1960s.	5-50 Mz	A socially differentiated campesino class and a small number of large landowners.	Variable: some areas have good market access while others do not.	15-20	Low	_____
	Southern cattle-raising OAF		20-50 Mz			10-15		
III Large Coffee and Livestock Owners Region	Large livestock and coffee estates	Large estates formed during the 1800s with an expansion into national land during the last 50 years.	Medium and large estates from 100 to more than 500 Mz	Large landowners with pockets of poor campesinos.	Good road system.	40-60	Low	_____
						8-15		

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Macro-Regional Variables	Sub-Region	History Patterns	Land Holding[1]	Social Status	Market Access	Inhab./ Km$^{2)}$	Urbani-zation Level	Nonagricultural Activities
IV Dry Region	Northern campesino region	An area of pre-Columbian settlement with large estates dating from the colonial period into which the agricultural frontier expanded in the 1800s.	5 to 15 Mz and farms of more than 200 Mz	Large cattle ranches and groups of medium-scale campesinos.	Variable: some areas are accessible by vehicle while others are only accessible by foot or by horse.	15-20	Low	Handicraft activity and trade with Honduras.
	Large cattle ranches	Large cattle ranches have expanded into the area since the 1900s.	200–500 Mz	Large cattle ranches and groups of poor campesinos.		5-10	Low to medium	Handicraft activity; fishery and beach tourism in the Pacific coast.
V Pacific Plateaus	Pacific entrepreneurs	An area of pre-Columbian settlement with large estates dating from the colonial period, and strong cotton and sugar cane expansion beginning in the 1940s and k50s.	Medium holdings between 50 and 200 Mz	Middle and high class as well as a large number of working class	The best infrastructure of the country, with access to cities and ports, and strong agro-industrial development.	20-30	High	An agro-industrial sector and an informal urban sector.
	Campesino groups		Small holdings between 5 and 15 Mz	Differentiated group of campesinos.		60-100		
VI Peri-urban Smallholders Region	Inserted in the Pacific plateaus (V)	An area of pre-Columbian settlement, in which the development of large coffee estates (late 1800s) and cotton estates (1950s), together with increased population, limited campesino access to land as holdings became increasingly fragmented.	Very small holdings between ¼ and 5 Mz	Smallholder campesinos, relatively homogeneous.	Very good access to main urban centers of the country.	200-400	High	Handicraft business and an informal urban sector.

Source: Maldidier and Marchetti. 1996. El Campesino Finquero y el Potencial Económico del Campesinado Nicaragüense. NITLAPAN.
[1] Range of holdings that belongs to most of the farm areas of the region.

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Table A-7: Basic Grains and Oilseed Crops: Area,[1] Production, and Yields[2]

Crop	Item	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-02
Maize	Area (1,000 Mz)	399	333	361	356	442	420
	Production (1,000 QQ)	7,103	5,810	6,610	5,456	7,917	8,400
	Yield (QQ/Mz)	18	17	18	18	18	20
Sorghum	Area (1,000 Mz)	77	77	59	63	63	70
	Production (1,000 QQ)	2,655	1,913	1,131	1,742	1,744	2,250
	Yield (QQ/Mz)	34	25	19	28	28	32
Rice (oro)	Area (1,000 Mz)	1997	107	120	88	130	125
	Production (1,000 QQ)	3,149	3,669	3,803	2,995	3,627	4,425
	Yield (QQ/Mz)	33	34	32	34	28	35
Beans	Area (1,000 Mz)	171	193	270	297	291	270
	Production (1,000 QQ)	1,647	1,574	3,280	2,962	2,942	2,700
	Yield (QQ/Mz)	10	8	12	10	10	10
Soybean	Area (1,000 Mz)	14	20	26	13	6	12
	Production (1,000 QQ)	479	638	595	433	174	408
	Yield (QQ/Mz)	34	33	23	34	29	34
Sesame	Area (1,000 Mz)	37	17	11	12	17	15
	Production (1,000 QQ)	223	148	69	90	115	120
	Yield (QQ/Mz)	6	9	6	8	7	8
Peanuts	Area (1,000 Mz)	16	21	21	33	30	35
	Production (1,000 QQ)	676	828	672	1,500	1,414	1,575
	Yield (QQ/Mz)	43	39	32	46	46	45
Cotton	Area (1,000 Mz)	5	2	-	-	1	5
	Production (1,000 QQ)	54	20	-	-	7	61
	Yield (QQ/Mz)	10	8	-	-	12	12

Source: MAG-FOR
[1] Harvested areas.
[2] The first five years show information closed as of March 27, 2001; the sixth year is estimated.

Table A-8: Agricultural Production: Growth Rate and Output by Region (1993-1998)

Crop	Pacific		Managua		Central		Atlantic	
	Growth Rate (%)	National Share (%)	Growth Rate (%)	National Share (%)	Growth Rate (%)	National Share (%)	Growth Rate (%)	National Share (%)
Maize	-16.0	7.1	0.1	1.1	-1.6	65.7	43.6	26.2
Beans	-20.2	4.2	-16.3	0.6	11.4	72.0	16.5	23.2
Rice	-12.4	17.2	0.0	0.0	0.2	33.0	25.4	49.7
Sorghum	-16.5	51.0	-11.9	17.5	-1.7	0.3	0.0	0.0
Soybean	24.5	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Sesame	-25.7	86.0	58.6	14.0	-100.0	0.0	0.0	0.0
Peanuts	13.3	100.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Based on World Bank Report, with MAG-FOR and Banco Central de Nicaragua data

Table A-9: Maize Production by Season

Year	Item	Primera	%	Postrera	%	Apante	%	Total
1996/1997	Planted Area (Mz)	279,613	57	93,048	19	118,906	24	491,567
	Harvested Area (Mz)	220,196		90,579		87,737		398,512
	Percentage Harvested	79		1997		74		81
	Output (QQ)	4,157,524		1,900,743		1,045,078		7,103,345
	Yields (QQ/Mz)	19		21		12		18
1997/1998	Planted Area (Mz)	310,237	58	101,896	19	120,170	23	532,303
	Harvested Area (Mz)	245,646		67,973		19,357		332,976
	Percentage Harvested	79		67		16		63
	Output (QQ)	4,850,327		771,820		187,349		5,809,496
	Yields (QQ/Mz)	20		11		10		17
1998/1999	Planted Area (Mz)	274,700	61	48,000	11	128,352	28	451,052
	Harvested Area (Mz)	216,559		30,700		113,629		360,888
	Percentage Harvested	79		64		89		80
	Output (QQ)	4,521,277		399,700		1,689,344		6,610,321
	Yields (QQ/Mz)	21		13		15		18
1999/2000	Planted Area (Mz)	308,060	58	102,825	19	121,448	23	532,333
	Harvested Area (Mz)	187,851		70,147		107,444		365,442
	Percentage Harvested	61		68		88		69
	Output (QQ)	4,012,488		1,267,051		1,161,537		6,441,076
	Yields (QQ/Mz)	21		18		11		18

Source: MAG-FOR

Table A-10: Bean Production by Season

Year	Item	Primera	%	Postrera	%	Apante	%	Total
1996/1997	Planted Area (Mz)	60,007	21	92,295	32	133,930	47	286,232
	Harvested Area (Mz)	51,300		55,089		64,952		171,341
	Percentage Harvested	85		60		48		60
	Output (QQ)	479,597		530,835		636,758		1,647,190
	Yields (QQ/Mz)	9		10		10		10
1997/1998	Planted Area (Mz)	65,666	20	109,440	33	159,888	48	334,994
	Harvested Area (Mz)	49,822		100,881		42,204		192,907
	Percentage Harvested	76		92		26		58
	Output (QQ)	444,617		850,903		278,080		1,573,600
	Yields (QQ/Mz)	9		8		7		8
1998/1999	Planted Area (Mz)	72,296	20	105,300	30	176,382	50	353,978
	Harvested Area (Mz)	64,074		43,400		163,017		270,491
	Percentage Harvested	89		41		92		76
	Output (QQ)	767,914		280,100		2,231,658		3,279,672
	Yields (QQ/Mz)	12		6		14		12
1999/2000	Planted Area (Mz)	71,126	21	100,574	29	174,362	50	346,062
	Harvested Area (Mz)	56,971		95,477		143,157		295,605
	Percentage Harvested	80		95		82		85
	Output (QQ)	583,332		956,981		1,412,576		2,952,889
	Yields (QQ/Mz)	10		10		10		10

Source: MAG-FOR

Table A-11: Rice Production (without irrigation) by Season

Year	Item	Primera	%	Postrera	%	Apante	%	Total
1996/1997	Planted Area (Mz)	72,477	96	2,666	4		0	75,143
	Harvested Area (Mz)	61,009		2,623				63,632
	Percentage Harvested	84		1998				85
	Output (QQ)	1,637,036		67,568				1,704,604
	Yields (QQ/Mz)	27		26				27
1997/1998	Planted Area (Mz)	73,822	94	4,529	6		0	78,351
	Harvested Area (Mz)	63,218		3,695				66,913
	Percentage Harvested	86		82				85
	Output (QQ)	1,728,571		102,920				1,831,491
	Yields (QQ/Mz)	27		28				27
1998/1999	Planted Area (Mz)	90,724	95	4,700	5		0	95,424
	Harvested Area (Mz)	77,684		3,000				80,684
	Percentage Harvested	86		64				85
	Output (QQ)	2,199,475		71,700				2,271,175
	Yields (QQ/Mz)	28		24				28
1999/2000	Planted Area (Mz)	100,769	93	7,179	7		0	107,948
	Harvested Area (Mz)	40,499		7,144				47,643
	Percentage Harvested	40		100				44
	Output (QQ)	1,163,654		245,694				1,409,348
	Yields (QQ/Mz)	29		34				30

Source: MAG-FOR

Table A-12: Total Sorghum (industrial, non-industrial, and criollo) Production by Season, 1996-2000

Year	Item	Primera	Postrera	Apante	Total
1996/1997	Planted Area (Mz)	30,612 (36)	54,670 (64)	0	85,282
	Harvested Area (Mz)	29,979	47,084	0	77,063
	Percentage Harvested	1998	86	0	90
	Output (QQ)	966,660	1,687,852	0	2,654,512
	Yields (QQ/Mz)	32	36	0	34
1997/1998	Planted Area (Mz)	34,230 (38)	57,028 (62)	0	91,258
	Harvested Area (Mz)	22,958	53,832	0	76,790
	Percentage Harvested	67	94	0	84
	Output (QQ)	557,788	1,355,127	0	1,912,915
	Yields (QQ/Mz)	24	25	0	25
1998/1999	Planted Area (Mz)	21,070 (27)	56,500 (73)	0	77,570
	Harvested Area (Mz)	15,316	43,600	0	58,916
	Percentage Harvested	73	77	0	76
	Output (QQ)	393,026	737,800	0	1,130,826
	Yields (QQ/Mz)	26	17	0	19
1999/2000	Planted Area (Mz)	20,167 (32)	42,316 (68)	0	62,483
	Harvested Area (Mz)	19,435	41,660	0	61,095
	Percentage Harvested	96	1,998	0	1,998
	Output (QQ)	353,432	1,205,325	0	1,558,757
	Yields (QQ/Mz)	18	29	0	26
1996-2000	% Planted (of yearly total)	95	5	0	100
	Ave. % Harvested	74	91	0	83
	Ave. Yield	28	28	0	28

Source: MAG-FOR

Table A-13: Industrial Sorghum Production by Season

Year	Item	Primera	%	Postrera	%	Apante	%	Total
1996/1997	Planted Area (Mz)	8,725	17	42,158	83		0	50,883
	Harvested Area (Mz)	8,725		34,753				43,478
	Percentage Harvested	100		82				85
	Output (QQ)	502,055		1,389,117				1,891,172
	Yields (QQ/Mz)	58		40				43
1997/1998	Planted Area (Mz)	6,168	19	26,526	81		0	32,694
	Harvested Area (Mz)	4,591		24,309				28,900
	Percentage Harvested	74		92				88
	Output (QQ)	207,859		872,141				1,080,000
	Yields (QQ/Mz)	45		36				37
1998/1999	Planted Area (Mz)	4,622	10	41,900	90		0	46,522
	Harvested Area (Mz)	4,084		32,500				36,584
	Percentage Harvested	88		78				79
	Output (QQ)	195,150		565,000				760,150
	Yields (QQ/Mz)	48		17				21
1999/2000	Planted Area (Mz)	2,561	10	23,864	90		0	26,425
	Harvested Area (Mz)	2,348		23,249				25,597
	Percentage Harvested	92		1997				1997
	Output (QQ)	127,801		835,062				962,863
	Yields (QQ/Mz)	54		36				38

Source: MAG-FOR

Table A-14: Non-Industrial Sorghum Production by Season

Year	Item	Primera	%	Postrera	%	Apante	%	Total
1996/1997	Planted Area (Mz)	2,947	37	5,058	63		0	8,005
	Harvested Area (Mz)	2,912		5,058				7,970
	Percentage Harvested	1999		100				100
	Output (QQ)	57,904		109,018				166,922
	Yields (QQ/Mz)	20		22				21
1997/1998	Planted Area (Mz)	608	2	23,921	1998		0	24,529
	Harvested Area (Mz)	607		23,293				23,900
	Percentage Harvested	100		1997				1997
	Output (QQ)	11,887		318,763				330,650
	Yields (QQ/Mz)	20		14				14
1998/1999	Planted Area (Mz)	647	7	8,812	93		0	9,459
	Harvested Area (Mz)	141		6,986				7,127
	Percentage Harvested	22		79				75
	Output (QQ)	3,193		120,552				123,745
	Yields (QQ/Mz)	23		17				17
1999/2000	Planted Area (Mz)	319	3	10,877	1997		0	11,196
	Harvested Area (Mz)	254		10,836				11,090
	Percentage Harvested	80		100				1999
	Output (QQ)	5,091		216,993				222,084
	Yields (QQ/Mz)	20		20				20

Source: MAG-FOR

Table A-15: Criollo Sorghum Production by Season

Year	Item	Primera	%	Postrera	%	Apante	%	Total
1996/1997	Planted Area (Mz)	18,940	72	7,454	28		0	26,394
	Harvested Area (Mz)	18,342		7,273				25,615
	Percentage Harvested	1997		1998				1997
	Output (QQ)	406,701		189,717				596,418
	Yields (QQ/Mz)	22		26				23
1997/1998	Planted Area (Mz)	27,454	81	6,581	19		0	34,035
	Harvested Area (Mz)	17,760		6,230				23,990
	Percentage Harvested	65		95				70
	Output (QQ)	338,042		164,223				502,265
	Yields (QQ/Mz)	19		26				21
1998/1999	Planted Area (Mz)	15,801	73	5,788	27		0	21,589
	Harvested Area (Mz)	11,091		4,114				15,205
	Percentage Harvested	70		71				70
	Output (QQ)	194,683		52,248				246,931
	Yields (QQ/Mz)	18		13				16
1999/2000	Planted Area (Mz)	17,287	70	7,575	30		0	24,862
	Harvested Area (Mz)	16,833		7,575				24,408
	Percentage Harvested	1997		100				1998
	Output (QQ)	353,432		153,270				506,702
	Yields (QQ/Mz)	21		20				21

Source: MAG-FOR

Table A-16: Certified Seed Supply: National and Imported (QQ)

Crop	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001
National Seed Supply					
Maize	6,610	6,520	19,910	6,240	18,350
Rice	33,000	1,500	3,130	12,340	18,810
Bean	2,950	390	2,860	7,960	10,590
Sorghum	939	1,399	660	3,129	5,210
Sesame	1,499	119	0	379	880
Soybean	16,599	30,630	13,039	16,539	6,370
Peanut	11,780	20,770	31,980	55,760	82,110
Imported Seed Supply					
Maize	1,510	820	4,900	4,220	2,990
Rice	0	1,340	0	70	1,400
Bean	500	100	60	3,340	270
Sorghum	11,590	7,220	7,630	10,670	7,940
Sesame	0	540	680	0	0
Soybean	1,720	1,410	0	0	0
Peanut	160	3,700	3,030	4,450	5,000
Total Supply: National and Imported					
Maize		7,430	11,420	24,130	9,230
Rice		34,340	1,500	3,200	13,740
Bean		3,050	450	6,200	8,230
Sorghum		8,159	9,029	11,330	11,069
Sesame		2,039	799	0	379
Soybean		18,009	30,630	13,039	16,539
Peanut		15,480	23,800	36,430	60,760
Certified Seed Coverage, Mz of National Area					
Maize (.30 QQ/Mz)		24,767	38,067	80,433	30,767
Rice (1.5 QQ/Mz)		22,893	1,000	2,133	9,160
Bean (.75 QQ/Mz)		4,067	600	8,267	10,973
Sorghum (.20 QQ/Mz)		40,795	45,145	56,650	55,345
Sesame (.05 QQ/Mz)		40,780	15,980	0	7,580
Soybean (.6 QQ/Mz)		30,015	51,050	21,732	27,565
Peanut (2 QQ/Mz)		7,740	11,900	18,215	30,380
Certified Seed Coverage, % of National Area					
Maize		4.65	8.44	15.11	5.95
Rice		29.24	1.05	1.1998	9.2000
Bean		1.21	0.17	2.39	3.07
Sorghum		44.70	58.20	90.66	82.64
Sesame		236.69	142.20	-	
Soybean		n/a	n/a	n/a	n/a
Peanut		n/a	n/a	n/a	n/a
National Yield Average, QQ/Mz					
Maize		17	18	18	18
Rice		34	32	34	28
Bean		8	12	10	10
Sorghum		25	19	28	28

Crop	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001
Sesame		9	6	9	7
Soybean		33	23	34	29
Peanut		39	32	46	46

Source: National Seed Directorate, MAG-FOR

Table A-17: Seed Varieties Used in Nicaragua

Crop	No.	1998/1999	1999/2000	2000/2001
Maize	1	DICTA-GUAYUPE	C-343	H-53
	2	H-CH	C-385	H-59
	3	HR-93	CENTA	HS-5G
	4	HS-5G	H-53	HS-7
	5	LOS DIAMANTES	H-59	HS-9
	6	NB-30	HS-5G	NB-6
	7	NB-6	NB-6	NB-S
	8	NB-90-43	NB-9043	
	9	NB-S	NB-S	
Beans	1	DOR-364	COMPAÑÍA	DOR-364
	2	DOR-582	DOR-364	DOR-582
	3	DOR-590	DOR-582	Estelí-150
	4	ESTELI-150	ESTELI-150	INTA-CANELA
	5	TIO CANELA	INTA-MASATEPE	DOR-500
	6		TIO CANELA	
Rice	1	INTA-N1	ALTAMIRA-9	ALTAMIRA-9
	2	ALTAMIRA-11	ANAR-1997	ANAR-1997
	3	ALTAMIRA-9	INTA-N1	INTA-N1
	4	O-Llanos-4	O-Llanos-4	O-Llanos-4
	5	ORIZICA LL-4	T-SEN-10	T-SEN-10
	6	TAICHUNG 10		
Sorghum	1	C8-8886	89-66	82 G-55
	2	AMBAR-7175	AP-660	887 V1
	3	CB-887-VI	CB-899	887 V2
	4	CB-H-2966	F-899	PINOLERO-1
	5	CB-H-8946	FORRAJE-895	
	6	ESMERALDA	FORRAJE-896	
	7	F-895	H-877-V1	
	8	F-898	H-877-V2	
	9	H-887-V2	H-887-V1	
	10	HZ-966	H-887-V2	
	11	PINOLERO-1	H-8968	
	12	PINOLERO-2	MERCURIO	
	13	PIONEER-8346	PINOLERO-1	
	14	SUDAX SX-17	ST-686	
	15		SX-17	
Soybeans	1	CEA-CH-86	CEA-CH-86	CEA-CH-86
Peanuts	1	G. RUNNER	AT-120	AT-120
	2	FLORUNNER	FLORIDA MDR-1998	F-MDR-1998
	3	G. GREEN	FLORUNNER	G. GREEN
	4	RUNNER SUN OLEIC	F-MDR-1998	G. RUNNER
	5		G. GREEN	
	6		G. RUNNER	
	7		GEORGIA GREEN	
	8		GK-7	

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Crop	No.	1998/1999	1999/2000	2000/2001
	9		R. SUN OLEIC	
	10		VALENCIA	
Sesame	1	NICARAO	CHINA ROJA	CHINA ROJA
	2	CHINA ROJA	ICTA-R-198	ICTA R-198
	3	ICTA-R-198	INAMAR	INAMAR
	4	INAMAR	NICARAO	NICARAO
	5	IR-198	PRECOZ RAMA	PRECOZ RAMA
	6	NICARAO		
	7	PRECOZ RAMA		

Source: MAG-FOR and PROMESA records

Table A-18: Basic Grain and Oilseed Crops: Percentage of Area Planted with Certified Seed, 2001/2002[1]

Crop	Area[2]	Seed[3] Needed	Seed Available	Area with Certified Seed	% Area Planted with Certified Seed	Deficit QQ	Deficit %
Maize	420	168.2	25.72	64	15	142	85
Rice	125	250.2	18.81	9	8	231	92
Sorghum	70	14.2	7.78	39	56	6	44
Beans	270	216.2	10.59	13	5	205	95
Soybeans	12	7.2	6.37	11	88	1	12
Peanuts	35	70.2	82.11	41	100	-12	0
Sesame	15	1.05	0.89	13	85	0	15
Total	947	726.25	152.27	190			

Source: MAG-FOR and Dirección Nacional de Semillas
[1] Closed as of March 27, 2001.
[2] Projected area in 1,000 Mz.
[3] Seed in 1,000 QQ.

Table A-19: Volume and Value of the Seed Market Basic Grains and Oilseed Crops[1]

Crop	Area[2]	Rate QQ/Mz	Seed[3] Needed	National Price (US$)	National Value (US$)	Imported Price (US$)	Imported Value (US$)
Maize	420	0.40	168.2000	35	5,880	85	14,280
Rice	125	2.2000	250.2000	30	7,500	40	10,000
Sorghum	70	0.20	14.2000	40	560	100	1,400
Beans	270	0.80	216.2000	60	12,960	85	18,360
Soybeans	12	0.60	7.20	35	252	45	324
Peanuts	35	2.2000	70.2000	50	3,500	70	4,900
Sesame	15	0.07	1.05	100	105	100	105
TOTAL	947				30,757		49,369

Source: MAG-FOR, Dirección Nacional de Semillas, and projections estimated
[1] Closed as of March 27, 2001.
[2] Projected area in 1,000 Mz.
[3] Seed in 1,000 QQ.
[4] Prices estimated from different sources.

Table A-20: Actual and Potential Seed Market— Basic Grain and Oilseed Crops

Crop	Area[1]	Total Seed Market[2]	% Market Covered	Actual Supply[3]	Value of 75% Nat[4].	Value of 25% Imp[5].	Supply Deficit[6]	Potential Market[7] (%)	Potential Market[8] (Vol.)	National Value[9]	Imported Value[10]
Maize	420	168	15	26	675	547	142	34	57	1,399	1,457
Rice	125	250	8	19	423	188	231	30	75	2,025	300
Sorghum	70	14	56	8	233	195	6	64	9	179	448
Beans	270	216	5	11	477	225	205	20	43	2,333	367
Soybean	12	7	88	6	167	72	1	100	7	227	32
Peanuts	35	70	100	70	2,625	1,225	0	100	70	2,450	1,470
Sesame	15	1	85	1	67	22	0	100	1	74	32
TOTAL	947	726		140	4,667	2,473	586		263	8,687	4,106
Estimated Value Of National & Imported Seed					$7,140		Potential Sales Of National And Imported Seed			$12,792	

Source: MAG-FOR, Dirección Nacional de Semillas, and projections made based on Nitlapan farming system classification

1 Estimated area as of March 27, 2001 (in 1,000 Mz).

2 Estimated by multiplying area by rate per manzana (in 1,000 QQ).

3 Seed available (in 1,000 QQ).

4 In average 75% of the actual seed supply is national. Value is estimated by multiplying national seed supply by national price (in 1,000 dollars).

5 In average 25% of the actual seed supply is imported. Value is estimated by multiplying imported seed supply by imported price (in 1,000 dollars).

6 Seed needed to cover 100% of the total seed market (in 1,000 QQ).

7 Estimated based on Nitlapan classification of farming systems.

8 Estimated by multiplying the total seed market by the percentage targeted (potential).

9 Estimating the following national supply: maize 70%, rice 90%, sorghum 50%, beans 90%, soybean 90%, peanuts 70%, and sesame 70% (in 1,000 dollars).

10 Estimating the following imported supply: maize 30%, rice 10%, sorghum 50%, beans 10%, soybean 10%, peanuts 30%, and sesame 30% (in 1,000 dollars).

Table A-21: Target Seed Markets

Target Markets		Target by Region[1]						
Number of Farmers[2,3]	**Total National**	**I**	**II**	**III**	**IV**	**V**	**VI**	**Total Target**
Farming System A	55	0.0	1.1	2.2	0.0	2.2	0.0	5.5
Farming System B	55	0.0	2.2	2.2	2.2	2.2	2.2	11.0
Farming System C	15	0.9	3.6	0.0	0.0	0.0	0.0	4.5
Farming System D	25	0.0	1.3	0.0	5.0	3.8	2.5	12.5
Farming System E	20	0.0	2.0	0.0	4.0	4.0	0.0	10.0
Farming System F	15	0.0	2.3	0.0	0.0	5.3	0.0	7.5
Farming System G	4	0.0	0.0	0.4	0.4	1.2	0.0	2.0
Farming System H	60	0.0	1.2	1.8	1.8	1.2	0.0	6.0
Total	249	0.9	13.6	6.6	13.4	19.8	4.7	59.0
Number of Manzanas[4]	**Total National**	**I**	**II**	**III**	**IV**	**V**	**VI**	**Total Target**
Maize	420	14.3	42.8	14.3	42.8	28.6	0.0	143
Beans	270	0.0	16.2	16.2	16.2	0.0	5.4	54
Rice	125	0.0	7.5	0.0	15.0	15.0	0.0	38
Sorghum	70	0.0	0.0	0.0	13.4	31.4	0.0	45
Sesame	15	0.0	0.0	0.0	0.0	15.0	0.0	15
Soybeans	12	0.0	0.0	0.0	0.0	12.0	0.0	12
Peanuts	35	0.0	0.0	0.0	0.0	35.0	0.0	35
Total	947	14	67	30	87	137	5	341
Volume of Certified Seed[5]	**Total National**	**I**	**II**	**III**	**IV**	**V**	**VI**	**Total Target**
Maize	168	5.7	17.1	5.7	17.1	11.4	0.0	57
Beans	216	0.0	13.0	13.0	13.0	0.0	4.3	43
Rice	250	0.0	15.0	0.0	30.0	30.0	0.0	75
Sorghum	14	0.0	0.0	0.0	2.7	6.3	0.0	9
Sesame	1	0.0	0.0	0.0	0.0	1.0	0.0	1
Soybeans	7	0.0	0.0	0.0	0.0	7.0	0.0	7
Peanuts	70	0.0	0.0	0.0	0.0	70.0	0.0	70
Total	726	5.712	45.096	18.672	62.784	125.7	4.32	262
Value of Certified Seed[6]	**Total National**	**I**	**II**	**III**	**IV**	**V**	**VI**	**Total Target**
Maize	$8,400	285.6	856.8	285.6	856.8	571.2	0.0	$2,856
Beans	$13,500	0.0	810.0	810.0	810.0	0.0	270.0	$2,700
Rice	$7,750	0.0	465.0	0.0	930.0	930.0	0.0	$2,325
Sorghum	$980	0.0	0.0	0.0	188.1	438.9	0.0	$627
Sesame	$105	0.0	0.0	0.0	0.0	105.0	0.0	$105
Soybeans	$259	0.0	0.0	0.0	0.0	259.0	0.0	$259
Peanuts	$3,920	0.0	0.0	0.0	0.0	3920.0	0.0	$3,920
Total	$34,914	286	2,132	1,096	2,785	6,224	270	$12,792

Source: MAG-FOR, NITLAPAN's farming system classification, and PROMESA estimates.

[1] Regions
I Atlantic and New Agricultural Frontier
II Old Agricultural Frontier
III Large Coffee and Livestock Estates
IV Dry Region
V Pacific Plateaus
VI Suburban Small Farms

[2] Farming Systems
A. Rural Wage Earners
B. Semi-Campesinos/Wage Earners
C. Campesino Farmers from the Agricultural Frontier
D. Farmers Using Intensive Methods of Farming
E. Farmers Using Extensive Methods of Farming
F. Farmers
G. Medium- and High-Scale Farm Entrepreneurs
H. Agrarian Reform Beneficiaries

[3] Number of farmers in thousands

[4] Number of Mz in thousands

[5] Volume in thousands of QQ

[6] Estimating the following national supply: maize 70%, rice 90%, sorghum 50%, beans 90%, soybean 90%, peanuts 70%, and sesame 70% (in 1,000 dollars)

Table A-22: Social Sectors and Type of Agricultural Farmers (1989)

Social Sector	Production Units	No.	Producer Type	Main Location
1. Rural Wage Earners	50,000 to 60,000	1	Agricultural workers	Whole country but mostly in Macro-region 5 and larger coffee farms
		2	Tenant farmers	Whole country plus the larger cattle ranches
2. Semi-Campesinos/Wage Earners	50,000 to 60,000	3	Semi-workers	Whole country, specifically Macro-regions 2, 3, 4, and 5
		4	Peri-urban smallholders	Southwest of Managua; Macro-region 6
		5	Poor campesinos with land	Old Agricultural Frontier; Macro-region 2
3. Campesinos from the Agricultural Frontier	10,000 to 15,000	6	Poor campesinos from the mountains	New Agricultural Frontier
		7	Stock-breeder campesinos from the mountains	Macro-region 1
4. Campesinos Using Intensive Methods of Farming	20,000 to 25,000	8	Multi-crop producers from the Pacific region	Flatlands of the Pacific area; Macro-region 5
		9	Bean or horticultural producers	Dry and semi-dry areas; Macro-region 4
		10	Small coffee producers	Highlands of the Old Agricultural Frontier; Macro-region 2
5. Campesinos Using Extensive Methods of Farming	20,000	11	Multi-crop and stock-breeder producers	Flatlands of the Pacific area; Macro-region 5
		12	Stock-breeder campesinos	Dry and arid areas; Macro-region 4
		13	Livestock campesinos	Old Agricultural Frontier
6. Farmers	10,000 to 15,000	14	Ranchers from the Pacific region	Flatlands of the Pacific area; Macro-region 5
		15	Coffee ranchers	Highlands of the Old Agricultural Frontier; Macro-region 2
		16	Stock-breeder ranchers	Lowlands of the Old Agricultural Frontier; Macro-region 2
7. Medium- and High-Scale Farm Entrepreneurs	3,000 to 4,000	17	Intensive entrepreneurs	Pacific area; Macro-region 5; coffee sectors in Macro-region 3
		18	Extensive entrepreneurs	Macro-regions 3 and 4 and to a lesser degree 2 and 5
8. Agrarian Reform Beneficiaries	60,000	19	Poorest beneficiaries	Whole country but more in the internal regions
		20	Agrarian reform campesinos	Whole country
		21	Entrepreneur associations	Whole country but more in the Pacific area

Source: Maldidier and Marchetti. 1996. El Campesino-Finquero y el Potencial Económico del Campesinado Nicaragüense. NITLAPAN.

Table A-23: Available Resources by Type of Farmer

Social Sector	No.	Producer Type	Available Resources			
			Land	Labor	Building and Equipment	Livestock
1. Salaried Campesinos	1	Agricultural workers	No land at all except for a small yard.	Family head plus the wife and children.	Hand equipment only.	Chickens and hogs; sometimes 1 or 2 cows.
	2	Tenant farmers	Half a manzana of land.			
2. Semi-Campesinos	3	Semi-workers	Limited access as sharecroppers, land renters, or borrowers, with 2 to 5 Mz.	Family labor plus some occasional small amount of hired labor.	Hand equipment; no oxen, mules, trailers, or peel removers.	Chickens and hogs plus 1 or 2 cows.
	4	Peri-urban smallholders				
	5	Poor campesinos with land	Ownership of 5 to 30 Mz, with 3 to 10 Mz for agricultural use.			Chickens and hogs plus a small livestock herd.
3. Campesino Farmers from the Agricultural Frontier	6	Poor campesinos from the mountains	Ownership of 50 to 200 Mz of forest.	Family labor plus some payday workers.	Hand equipment plus horses or mules.	Small livestock herd made up of 2 to 5 cows.
	7	Stock-breeder campesinos from the mountains	100 to 400 Mz of forest.	Family labor plus some payday workers, sharecroppers, or tenants.	Infrastructure such as fences for livestock raising.	Livestock herd made up of 20 to 50 animals, with 10 to 20 cows.
4. Campesinos Using Intensive Methods of Farming	8	Multi-crop producers	Little access to land; ownership of 4 to 10 Mz, with 2 to 5 Mz for agricultural use.	Only family labor plus some temporal hired labor.	Equipment for animal traction such as sprayings, grain removers, and containers.	Livestock herd made up of 5 to 10 animals, with 2 to 4 cows.
	9	Bean or horticultural producers				
	10	Small coffee producers	Idem, with 5 to 15 Mz for agricultural use.		Hand-operated peeler, mules, and sometimes oxen.	Livestock herd made up of 5 to 6 cows.
5. Campesinos Using Extensive Methods of Farming	11	Multi-crop and stock-breeder producers	Ownership of 10 to 20 Mz, with 4 to 10 Mz for agricultural use.	The same as in Item 4, but it could be some hired labor or some tenants.	The same as in Item 8 but with agricultural machinery and livestock infrastructure.	Livestock herd made up of 10 to 20 animals, with 4 to 8 cows.
	12	Stock-breeder campesinos from the dry regions	Ownership of 20 to 100 Mz, with 10 to 30 Mz for agricultural use.		Livestock infrastructure such as fences, milk containers; cheese maker and small buildings.	Livestock herd made up of 15 to 30 animals, usually between 10 and 15.
	13	Stock-breeder campesinos	Ownership of 40 to 200 Mz, with 20 to 50 Mz for agricultural use.			Livestock herd made up of 50 to 100 animals, with 10 to 30 cows.
6. Farmers	14	Ranchers from the Pacific region	Ownership of 20 to 50 Mz.	Family labor with many temporal workers and 1 or 2 permanent workers or tenants.	Agricultural tractor and equipment, vehicle, storage, containers, and buildings.	Variable.
	15	Coffee ranchers	Ownership of 50 to 200 Mz in only one farm.		Wet pre-industry building, and mules.	Livestock herd made up of 30 to 50 animals.
	16	Stock-breeder ranchers	Ownership of 100 to 400 Mz in one or two farms.		Horses and mules, cutting equipment, cheese maker, loading/ unloading livestock place, and vehicle.	Livestock herd made up of 70 to 200 animals, with 20 to 50 cows.

Social Sector	No.	Producer Type	Available Resources			
			Land	Labor	Building and Equipment	Livestock
7. Medium- and High-Scale Farm Entrepreneurs	17	Intensive entrepreneurs	Ownership of 200 to 1,000 Mz.	Permanent and temporal hired workers; very often some tenants.	Agricultural machinery, transportation, and agro-industry.	Variable.
	18	Extensive entrepreneurs	Ownership of more than 500 Mz in two or three farms.		Livestock infrastructure and transportation.	Livestock herd made up of 400 to 1000 animals.
8. Agrarian Reform Beneficiaries	19	Poorest beneficiaries	Ownership of 2 to 3 Mz per family.	Members are generally men and to a greater or lesser degree their relatives.	Hand equipment only.	Same as in Item 3.
	20	Agrarian reform campesinos	Variable: the same as those in Items 8, 9, or 10.		A good equipment level: oxen, tractor, etc.	Small livestock herd.
	21	Entrepreneur associations	High percentage of land share per member.	Members and income-earning workers.	High equipment level: tractor, trucks, irrigation, etc.	Variable.

Source: Maldidier and Marchetti. 1996. El Campesino-Finquero y el Potencial Económico del Campesinado Nicaragüense. NITLAPAN.

Table A-24: Production Systems by Type of Farmer

Social Sector	No.	Producer Type	Production Strategy	Type of Agricultural Production System (main crops and techniques)
1. Salaried Campesinos	1	Agricultural workers	Agricultural production complementing for family income and taking advantage of the disposable labor.	Basic grain production system; manual planting with a stake after cutting field vegetation and then firing it; securing food for family consumption; rarely use oxen.
	2	Tenant farmers		Idem, but there is a graze cultivation with larger areas and sometimes some livestock.
2. Semi-Campesinos	3	Semi-workers	A short-run logic of surviving, without too much risk and securing, at the most, the food for the family.	Basic grain production system after cutting field vegetation and then firing it, plus chicken and hog raising; no perennial crops and scant livestock.
	4	Suburban smallholders		Extensive multi-crop production of basic grains, tubers, bananas, plantains, citric, etc. for family consumption and sale.
	5	Poor campesinos with land		Basic grain production in low-producing lands after cutting field vegetation and then firing it; herbicide applications; hog raising; livestock for family consumption, and coffee production in high lands.
3. Campesino Farmers from the Agricultural Frontier	6	Poor campesinos from the mountains	Securing food for family consumption and maximizing job earnings with extensive systems of production.	Extensive basic grain production after cutting the field vegetation and then firing it; bananas, plantains, sugarcane, hog raising, and livestock raising.
	7	Stock-breeder campesinos from the mountains		Extensive system of livestock raising for milk production, and agricultural production, after cutting the field vegetation and then firing it, for on-farm consumption.
4. Campesinos Using Intensive Methods of Farming	8	Multi-crop producers	Maximization of yields per planted area with market integration and maximum use of family labor.	Multi-crop production such as basic grains, sesame, tubers, etc.; use of animal traction, chemical inputs, a market-oriented production in association with a little livestock.
	9	Bean or horticultural producers		Basic grain and horticulture production, animal traction, commercialization of agricultural inputs, and a little livestock.
	10	Small coffee producers		Basic grain production after cutting field vegetation and then firing it and sometimes plowing, coffee and cocoa plantations, and a livestock for on-farm consumption.
5. Campesinos Using Extensive Methods of Farming	11	Multi-crop and stock-breeder producers	Securing the maximum earnings of family labor based on extensive farm exploitation and farm expansion strategy.	The same as in Item 8 but with livestock raising, milk production, and more extensive agriculture.
	12	Stock-breeder campesinos from the dry regions		Livestock raising and milk production; agricultural production for family consumption (maize, beans, etc.).
	13	Stock-breeder campesinos		Livestock raising and milk production, and basic grain production for on-farm consumption.
6. Farmers	14	Ranchers from the Pacific region	Seeking the best earnings and the highest rate of profit.	Agricultural machinery used to produce rice, cotton, and sugarcane; industrial production of feed for livestock.
	15	Coffee ranchers		Coffee production, livestock raising, and milk production; agricultural production for on-farm consumption.
	16	Stock-breeder ranchers		Livestock raising and milk production; agricultural production for on-farm consumption.
7. Medium- and High-Scale Farm Entrepreneurs	17	Intensive entrepreneurs	Profit maximization; low risk; seeking subsidies through credit and exchange rate.	Monoculture production system for cotton, coffee, rice with agricultural machinery use and chemical inputs.
	18	Extensive entrepreneurs		Extensive or semi-extensive livestock raising and milk production.

Social Sector	No.	Producer Type	Production Strategy	Type of Agricultural Production System (main crops and techniques)
8. Agrarian Reform Beneficiaries	19	Poorest beneficiaries	Same as Sector 2 and sometimes as Sector 4.	Basic grain production with stake or oxen plow, a hardly perennial crop production, no livestock, a high use of chemical inputs.
	20	Agrarian reform campesinos	Same as Sector 4.	Multi-crop production system, and livestock raising similar to Item 8 but with a higher use of capital and imported inputs.
	21	Entrepreneur associations	Until 1988, seeking rents and subsidies.	Productive specialization for coffee and cotton; livestock raising; capital intensive and imported input use.

Source: Maldidier and Marchetti. 1996. El Campesino-Finquero y el Potencial Económico del Campesinado Nicaragüense. NITLAPAN.

Table A-25: Yields (QQ/Mz) of Maize Hybrids and Varieties in PROMESA Demo Plots in Multiple Locations, Primera/Postrera 2001

Locations	Cultivars													
	NB-S	NB-6	NB-9043	NB Nutrinta	H-INTA 991	HQ-INTA 993	HS-3G	HS-5G	HS-9	H-59	C-343	C-385	Check Variety	Avg.
La Limonera, Jalapa			96	104		114	108	91	103	111	105			104
Las Piedras, Quilalí	68		86		86	87	96			95		97		88
Puntalitos, Jalapa			69		79	77	98	65	89	83	81			80
La Piedra, Jícaro			72		78	71		71		77		64		72
Los Manchones, Quilalí			66		86	77	90	70		60			36	69
Palo Herrado,		52	50		72	78	79		70	57	95			69
Los Potreros 1, Jícaro			63		71	71		81		74		83	35	68
El Salto, Jinotega		62	59		49		73		68	68	82			66
Apalí Nuevo, San Fdo.			62		70	78		62		76		71	39	65
Arenales, Quilalí	52	64	67	48	73		82		77	80		78	29	65
Río Grande, P. Nvo.					67	73	53	65		65				65
El Jiquelite, Quilalí	48				57	64	66		64	66		75	62	63
Valle Viejo No. 1		60	52			63	70	53	70	65				62
Panalí 3, Quilalí			53		70	60		68		69		81	32	62
Orosí, San Fernando		53		59	60			36	75				84	61
Abangasca Sur	61	53	56			67	66	60	72	71			32	60
Nueva Guinea			39	37	69		86	30	74	79				59
Wibuse, San Dionisio	48		56		64	66	57	54		64	63			59
San Juanillo, Darío	51	54		38	58		69		50	71		68		57
Ciudad Antigua, Urb.	57		59		59					56	54			57
Las Ollas, Jinotega		48	41		56		78		62	52	71		37	56
Malpaisillo	49	51				67	64	51	55	57	67		35	55
Cerro Blanco, Quilalí	44		74		28	44	69		70	62		68	34	55
Aguas Calientes	32		45		67	59	63	43	61	51				53
San Pedro Susucayán, J.	50		36		39	85	58	32	53	41			69	51
Pancasán	42	51				59	45	55	60	57	49		29	50
Goyena		48			71	40		50		45	48	33		48
Masatepe	39	46		41	48		58	44		53		49		47
Apalí Viejo, Jícaro			35		33	71				48			47	47
Los Potreros 2, Jícaro			64		25	66		35		38		50	36	45
Las Joyas	42	40				51	51	39		49	38			44
Sal. Sta. Rita, Quilalí	39	41	41				47	43	41				44	42
La Ceiba/La Arenera			46	28		62	50	43	38	46	41		26	42
Panalí 2, Quilalí					38	36	46	46	38	42			48	42
El Bosque, Quilalí					39	42	42	43	46	44			34	41
El Enchape			39	31		32	49	51	50	49			30	41
Río Arriba	41		30		46	39	37	37	47	43				40
Ensayo	33	40				44	47	29	47	39	42		33	39
San Nicolás, San Fdo.			19		40	44		51		23		59		39
Panalí 1, Quilalí	33	36					42	43	38	37			39	38
La Marañosa, Wiwilí		24	43		39		39		44	40	45		31	38
Tisma					33	36		41	42					38
San Diego, Jícaro			28		41	26		39		28		33	49	35
Guinea Vieja			36	28		21	53	45	45	20			30	35
Chilcas 2	24	26			36		38			41	42			35
Pencal, P. Nvo.	31	16			41	27			31			22		28
El Corozal, Wiwilí		21	23		16		31		36	16	42		17	25
El Homo, P. Nvo.	5	16			27	23			17			26		19
Average	42	43	52	46	54	58	62	50	56	56	60	60	39	53
Maximum	68	64	96	104	86	114	108	91	103	111	105	97	84	104
Minimum	5	16	19	28	16	21	31	29	17	16	38	22	17	19
Mode	48	53	59	28	39	71	53	43	70	57	42	68	36	62

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Table A-26: Production Cost of One Manzana of Maize (2000/2001) Using Farm-Saved Seed and Minimum Technology

Item	Total Cost						
	Rate	Unit	Unit Cost	(US$)	(C$)	(%)	Cash Cost
A. Land Rent	1	MZ	15.4	15.4	209.9	15.4	0.0
B. Labor				52.8	720.2	52.9	0.0
C. Seed (farm-saved seed)	20	Lbs	0.1	2.3	31.5	2.3	0.0
D. Pesticides	1	Lt	9.5	9.5	129.2	9.5	9.5
E. Field Cost				80.0	1,090.7	80.0	9.5
F. Financial Cost				1.9	26.1	1.9	1.9
G. Field and Financial Costs				81.9	1,116.8	82.0	11.4
H. Administration and Marketing Cost				18.0	245.5	18.0	18.0
I. Total Costs				1999.9	1,362.3	100.0	29.4
% of Cash Costs							29.4
J. Revenue	14	QQ	9.2	129.2	1,762.6	129.3	
K. Net Profit	400.2						
L. Breakeven Analysis							
Breakeven Yield (QQ/Mz)	10.8						
Breakeven Price/QQ	7.1						

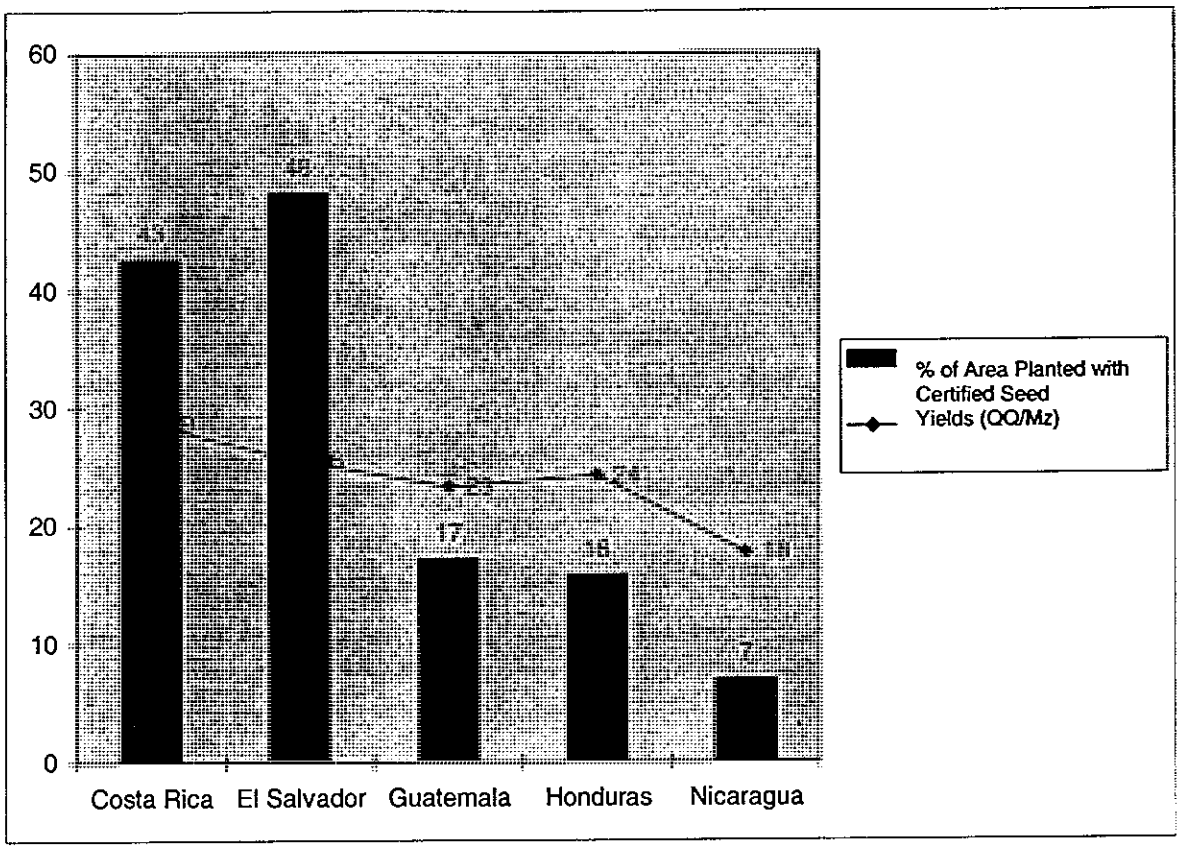
Source: UNAG estimates and PROMESA adjustments. Exchange rate: C$13.64 = US$1

Table A-27: Production Cost of One Manzana of Maize[1]

Item	Semi-Tech with Oxen				Tech with Machinery			
	All Costs	%	Cash Cost[2]	%	All Costs	%	Cash Cost[2]	%
Land Rent	22.7	6.1	0.0	0.0	22.7	4.3	0.0	0.0
Land Preparation (oxen)	31.4	8.5	16.0	6.3				
Land Preparation (machinery)					184.8	34.7	184.8	36.2
Labor	81.9	22.2	41.0	16.2	19.5	3.7	19.5	3.8
Seed[3]	34.0	9.2	34.0	13.4	34.0	6.4	34.0	6.7
Agro-Chemical Inputs	103.1	27.9	103.1	40.7	124.7	23.4	124.7	24.4
Services	58.5	15.8	30.0	11.8	88.7	16.6	88.7	17.4
Infrastructure Maintenance	1.4	0.4	1.4	0.5	1.4	0.3	1.4	0.3
Administration	16.6	4.5	8.0	3.2	28.1	5.3	28.1	5.5
Financial Cost	20.0	5.4	20.0	7.9	29.1	5.5	29.1	5.7
Total Cost	369.6	100.0	253.5	100.0	532.8	100.0	510.2	100.0
Expected Yields (QQ)	66.0		66.0		88.0		88.0	
Price US$/QQ	7.2		7.2		7.2		7.2	
Revenue	477.7		477.7		637.0		637.0	
Breakeven (yields)	51.1		35.0		73.6		70.5	
Breakeven (price)	5.6		3.8		6.1		5.8	
Net Profit	108.1		224.2		104.1		126.8	

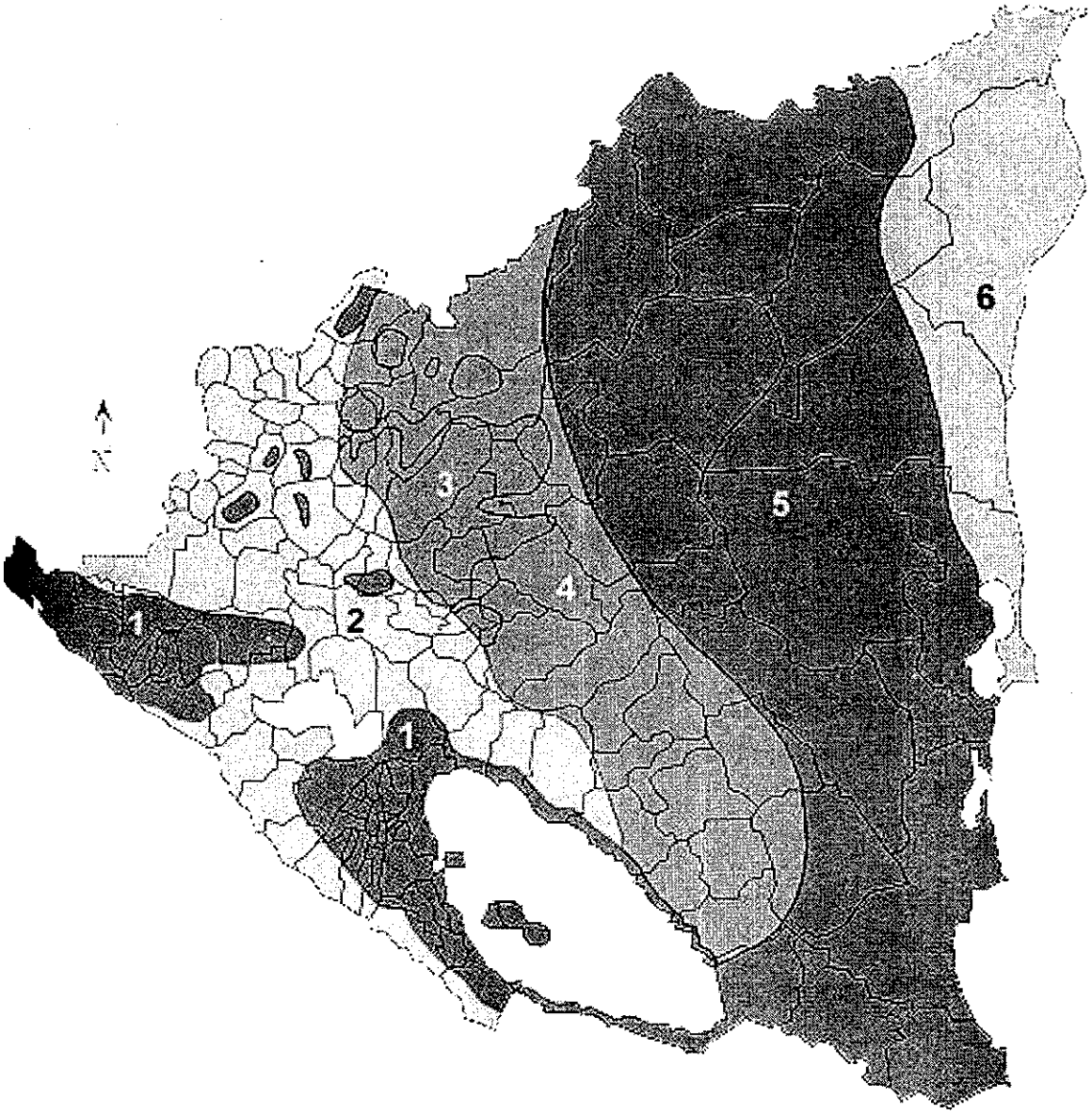
Source: MAG-FOR, 1988, and PROMESA estimates
[1] In U.S. dollars: US$1 = C$10.5.
[2] Considering total and partial non-cash costs.
[3] Estimating cost of hybrid seed.

Figure A-1: Maize Yields (QQ/Mz) and Percentage of Area Planted with Certified Seeds in 1997



Source: CIMMYT, 1997

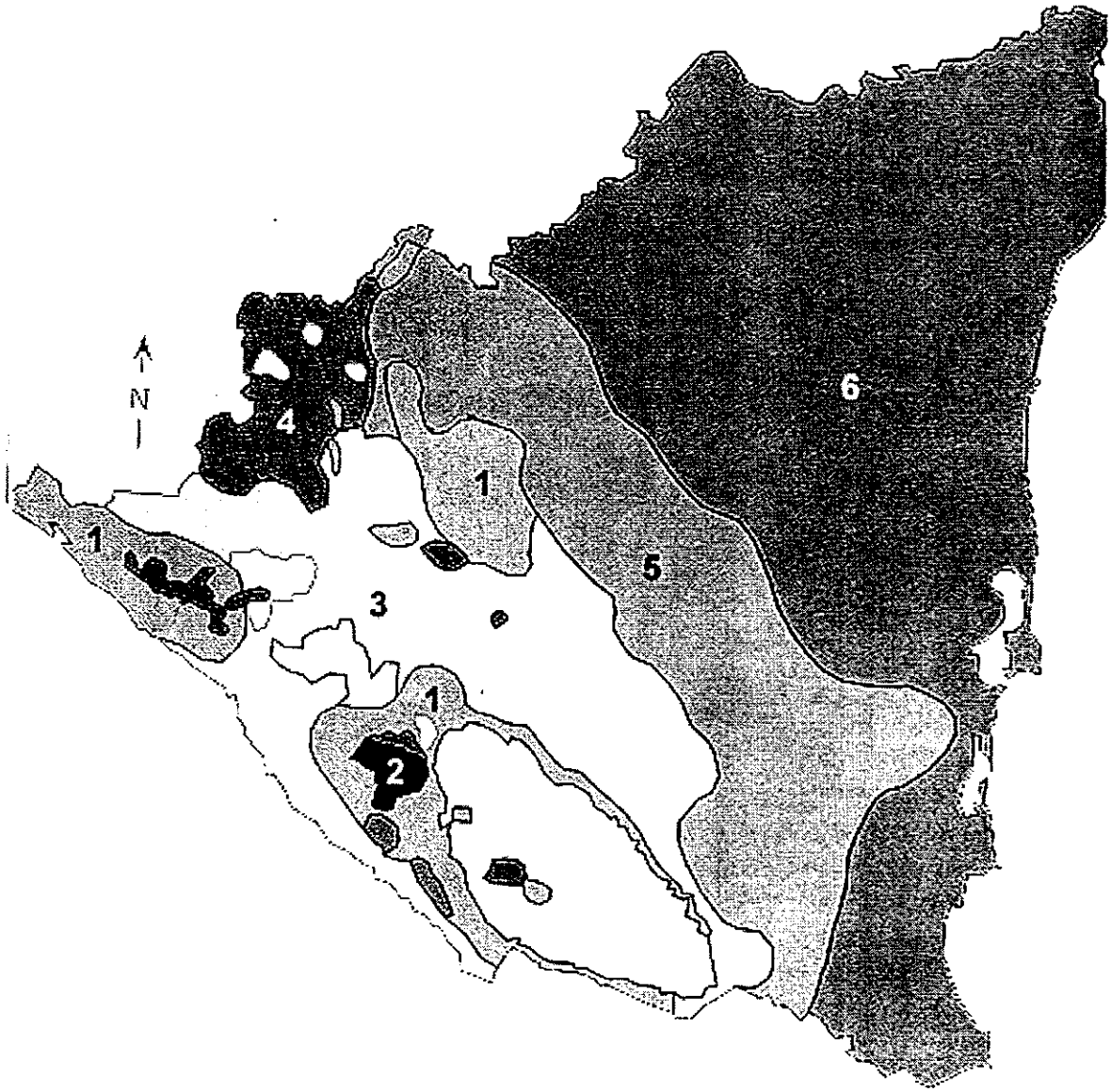
Figure A-2: Agro-Ecological Regions of Nicaragua, According to Maldidier and Marchetti (1996)



Regions:

1. Pacific Plateaus
2. Dry Tropic
3. Central-North Mountains
4. Central Valleys and Mountains
5. Humid Tropic
6. Timber and Mangroves of the Atlantic

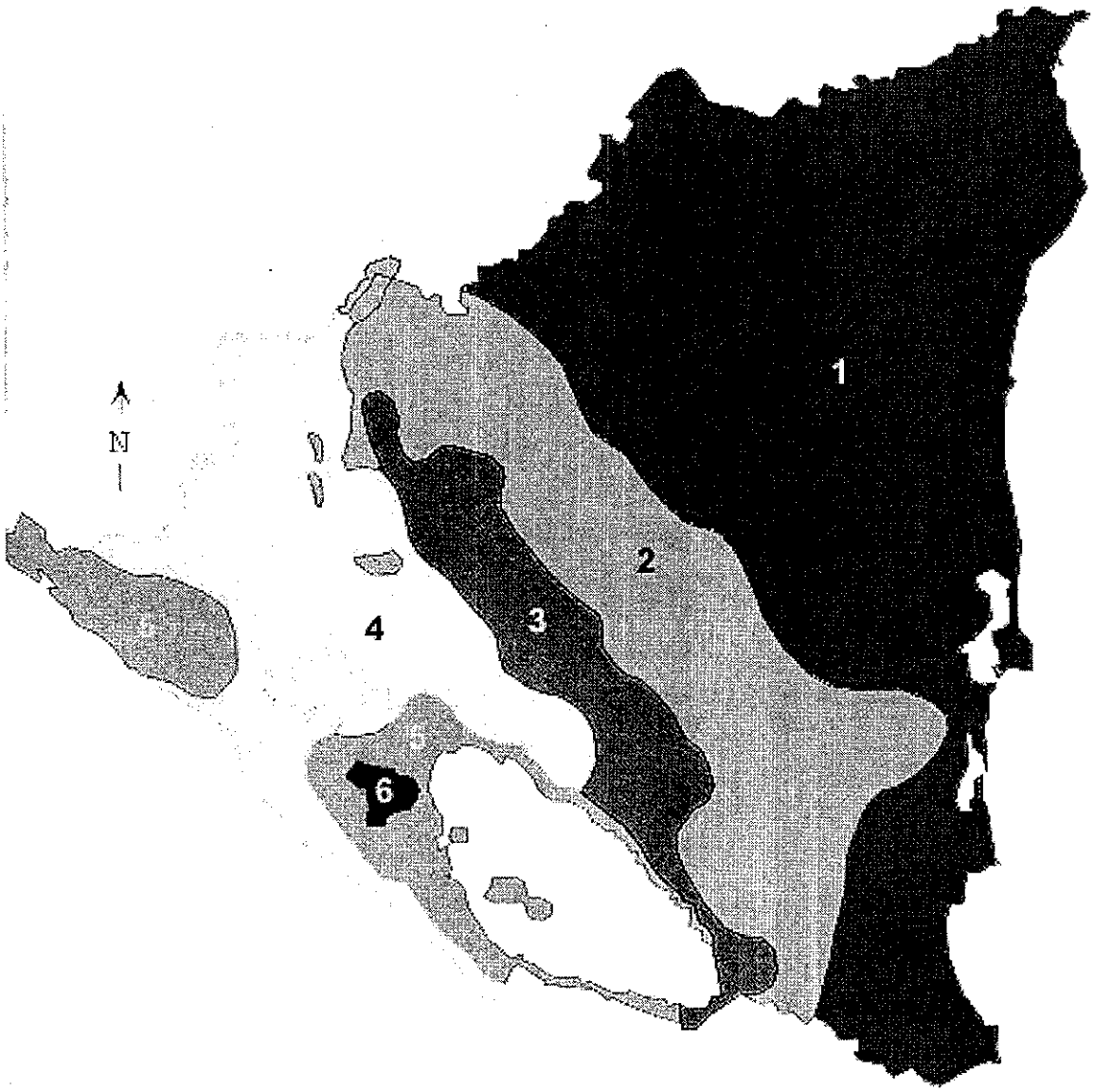
Figure A-3: Socioeconomic Regions of Nicaragua, According to Maldidier and Marchetti (1996)



Regions:

1. Intensive Large-Scale Producers
2. Suburban Small Farmsteads Region
3. Extensive Livestock Producers
4. Old Peasant Zones
5. Old Agricultural Frontier
6. New Agricultural Frontier

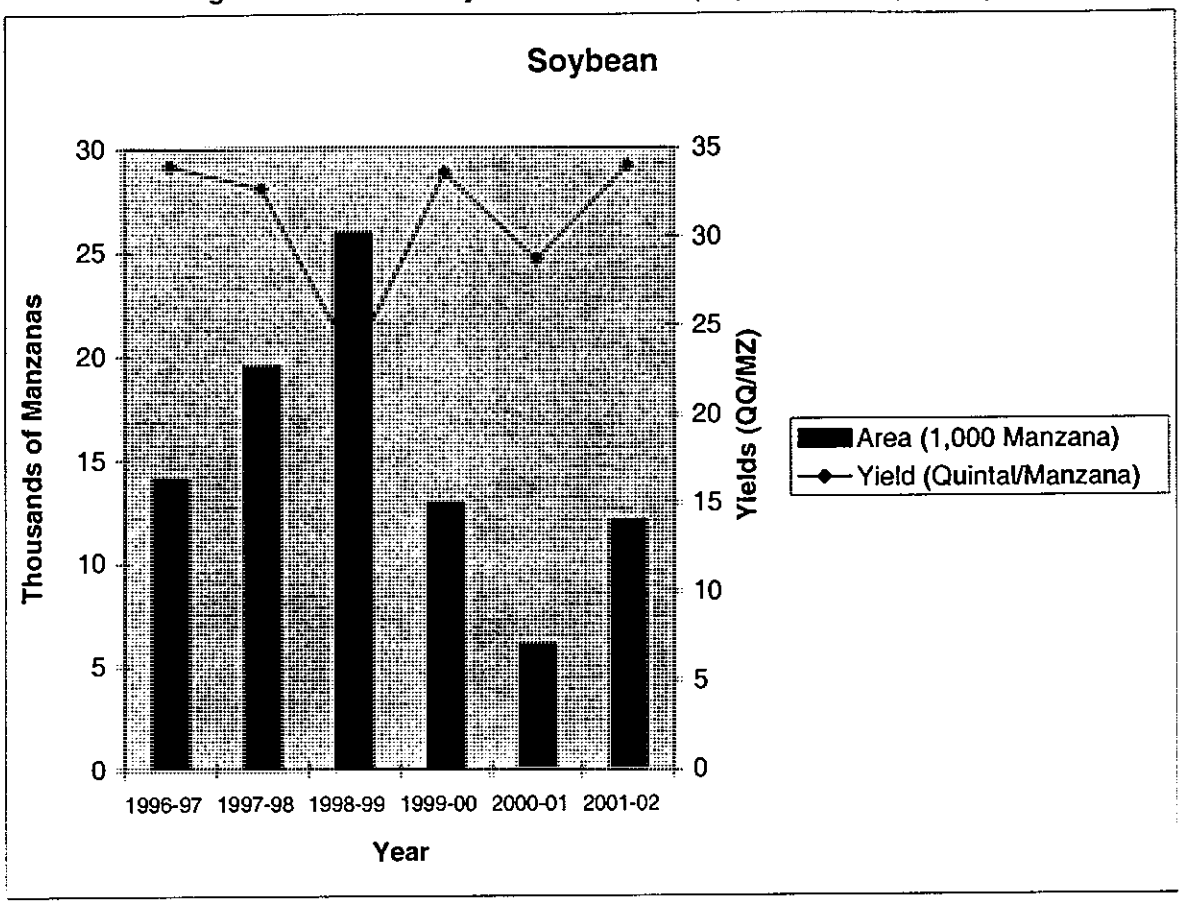
Figure A-4: Agricultural Regions of Nicaragua, According to Maldidier and Marchetti (1996)



Regions:

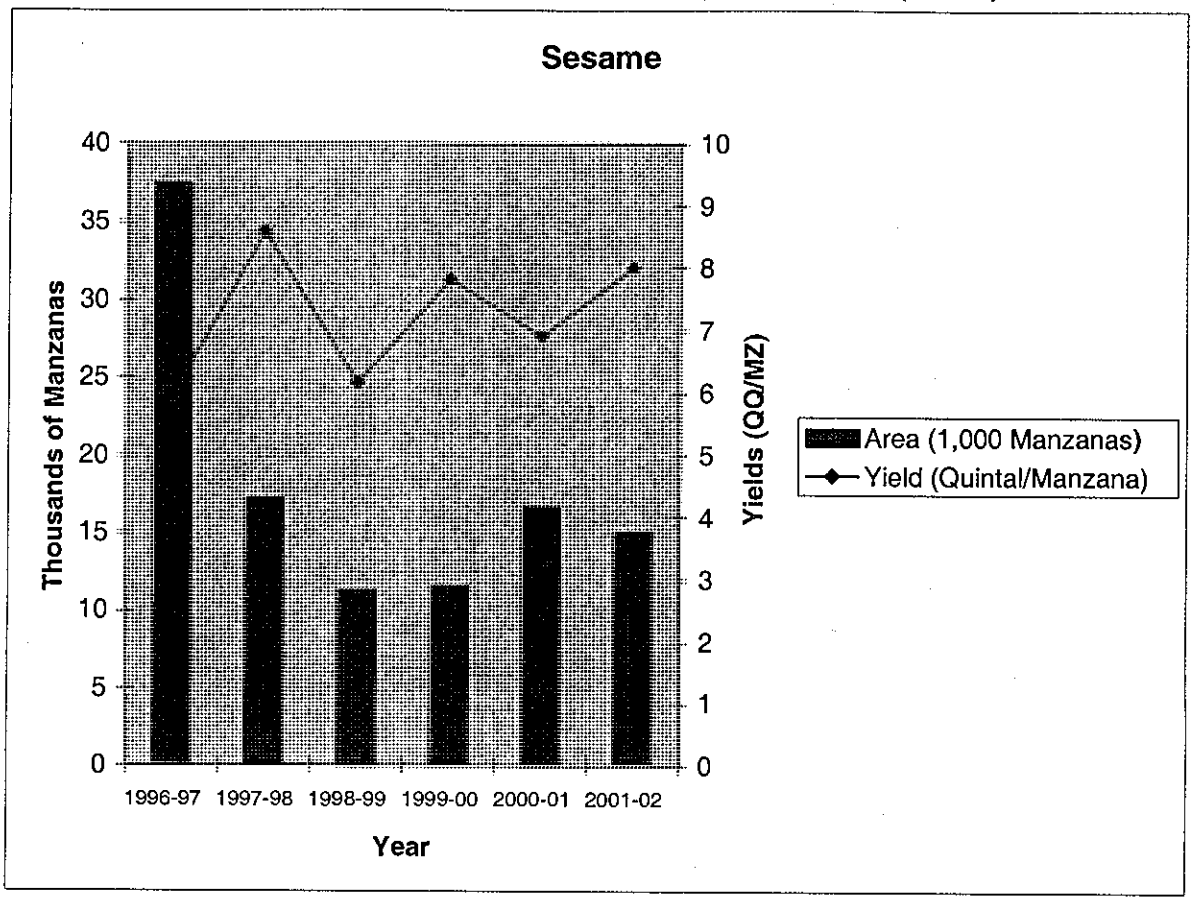
1. Atlantic and New Agricultural Frontier
2. Old Agricultural Frontier
3. Large Coffee and Livestock Estates
4. Dry Region
5. Pacific Plateaus
6. Suburban Small Farms

Figure A-5: Area of Soybean Production (Mz) and Yields (QQ/Mz)



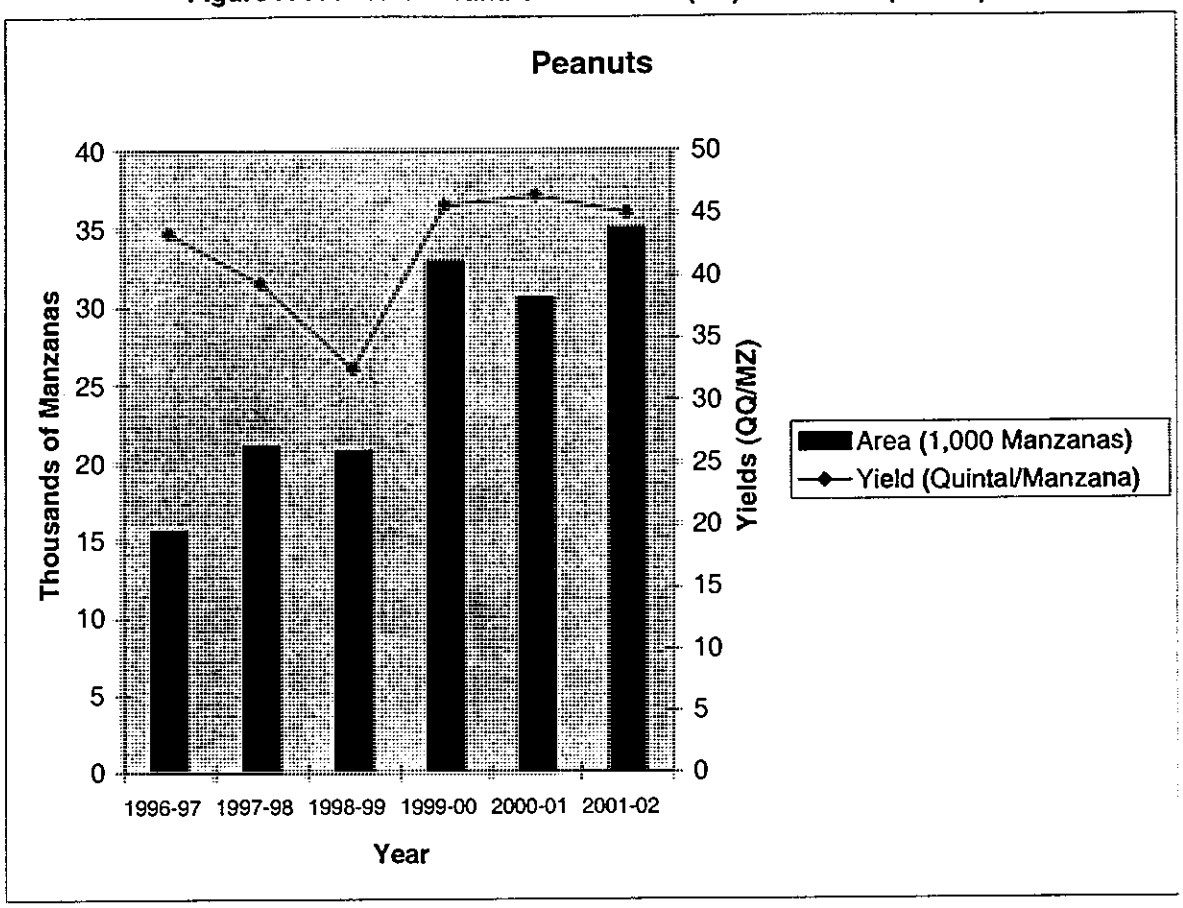
Source: MAG-FOR statistics

Figure A-6: Area of Sesame Production (Mz) and Yields (QQ/Mz)



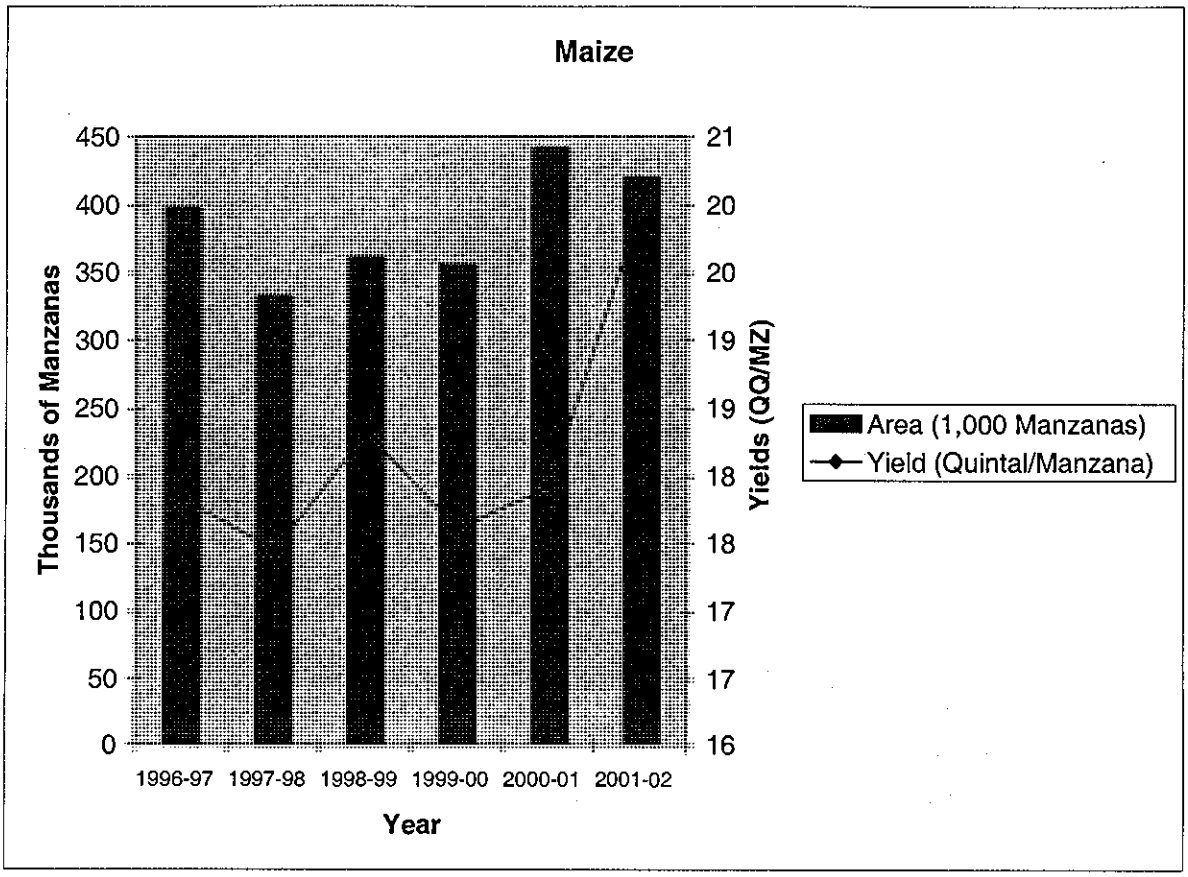
Source: MAG-FOR statistics

Figure A-7: Area of Peanuts Production (Mz) and Yields (QQ/Mz)



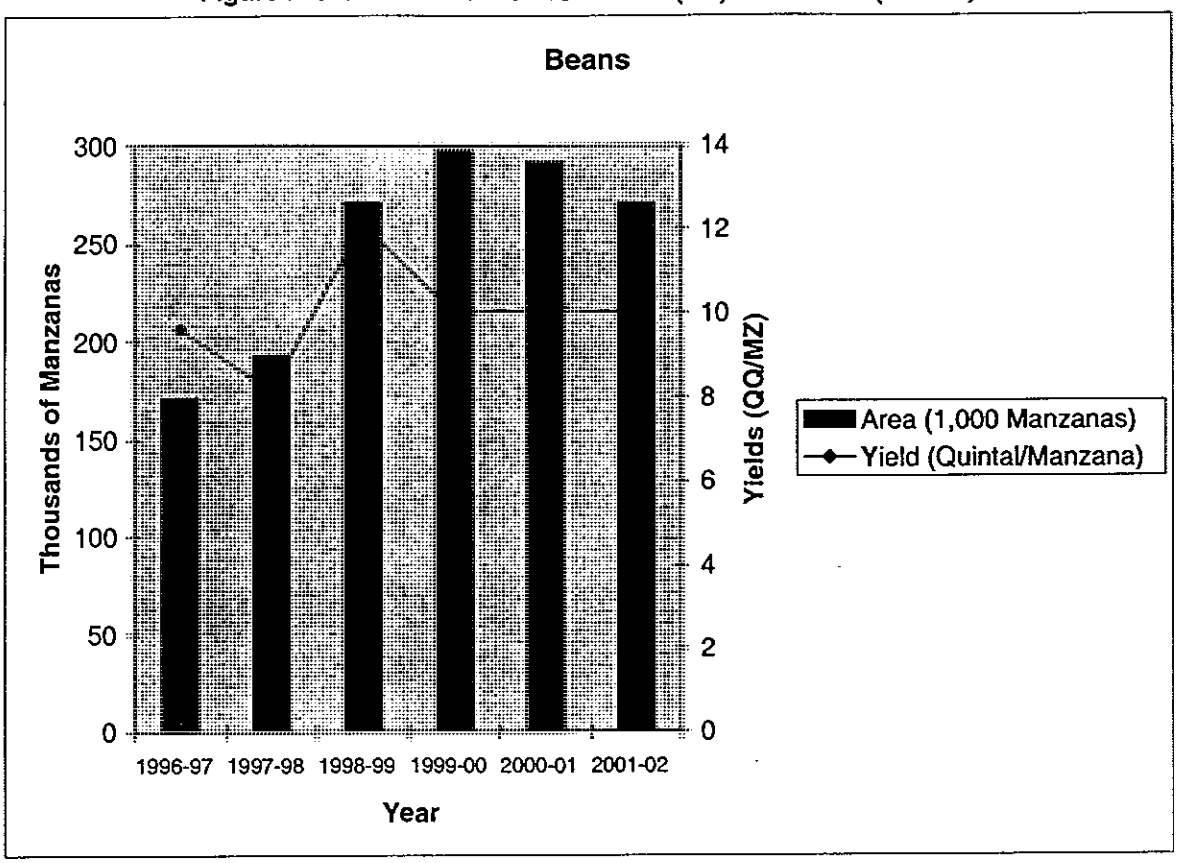
Source: MAG-FOR statistics

Figure A-8: Area of Maize Production (Mz) and Yields (QQ/Mz)



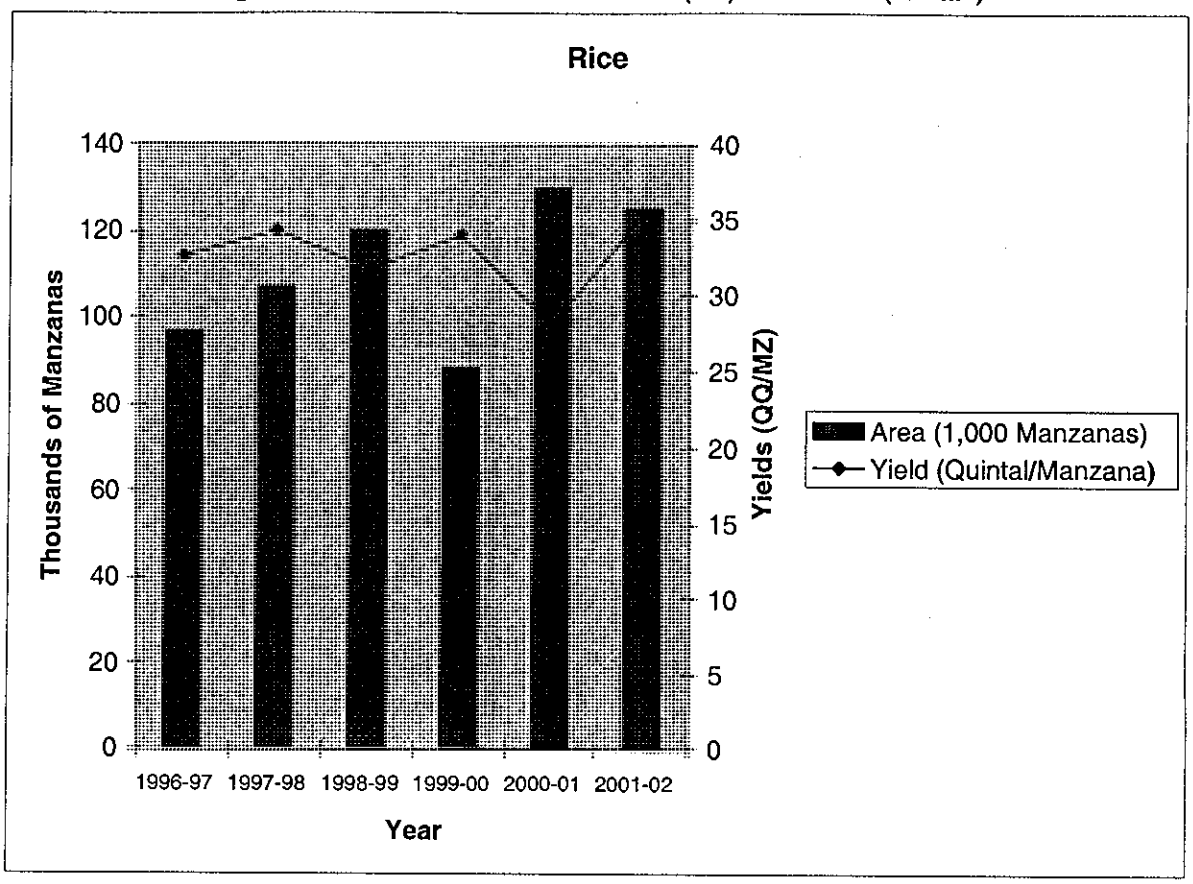
Source: MAG-FOR statistics

Figure A-9: Area of Beans Production (Mz) and Yields (QQ/Mz)



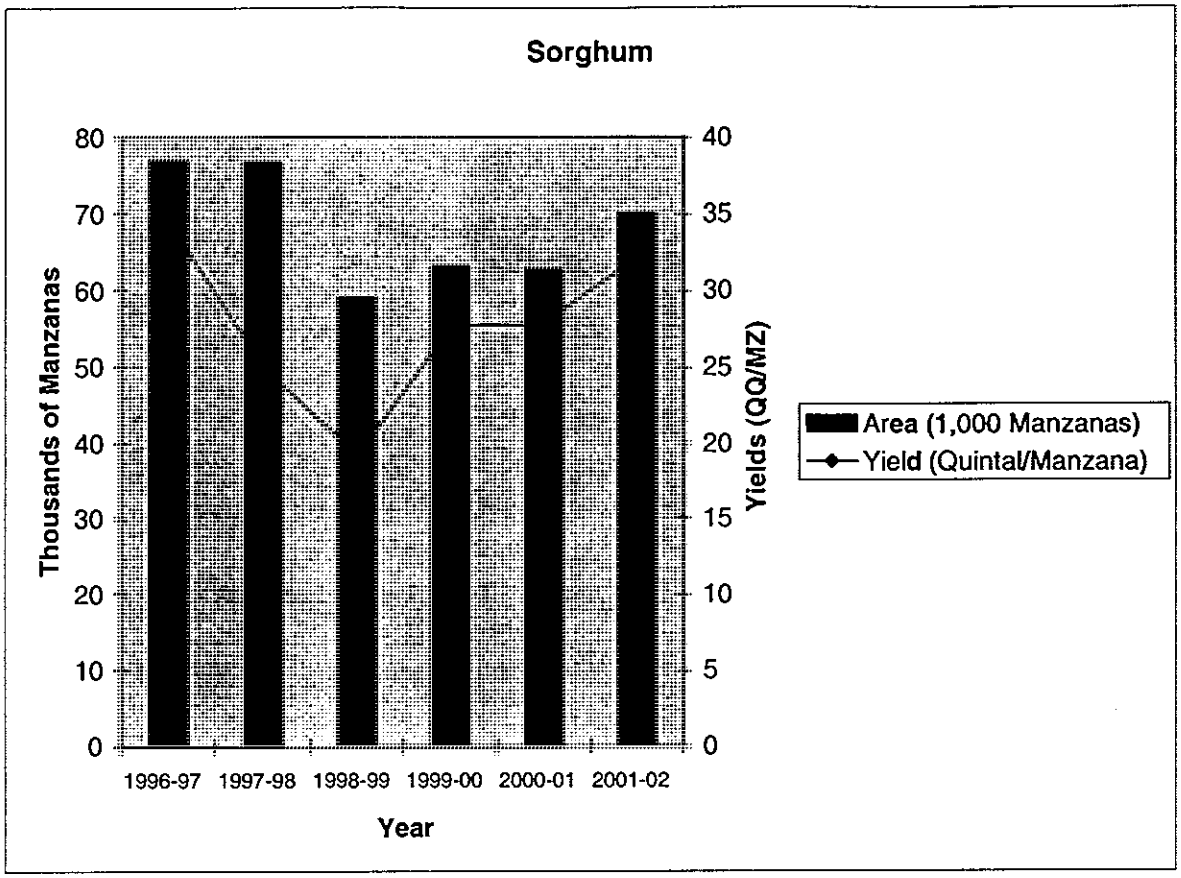
Source: MAG-FOR statistics

Figure A-10: Area of Rice Production (Mz) and Yields (QQ/Mz)



Source: MAG-FOR statistics

Figure A-11: Area of Sorghum Production (Mz) and Yields (QQ/Mz)



Source: MAG-FOR statistics

Figure A-12

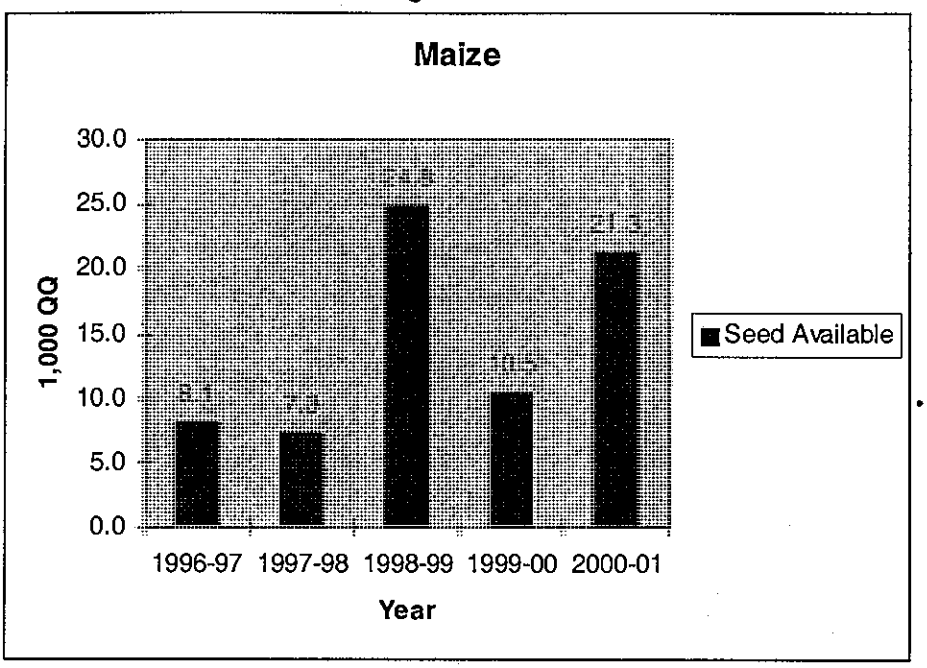


Figure A-13

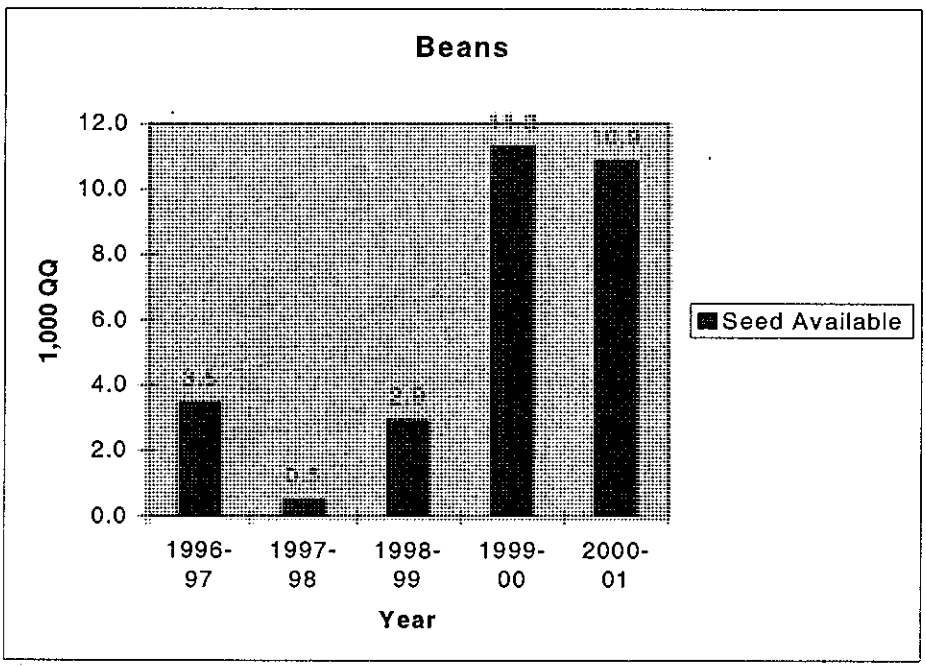


Figure A-14

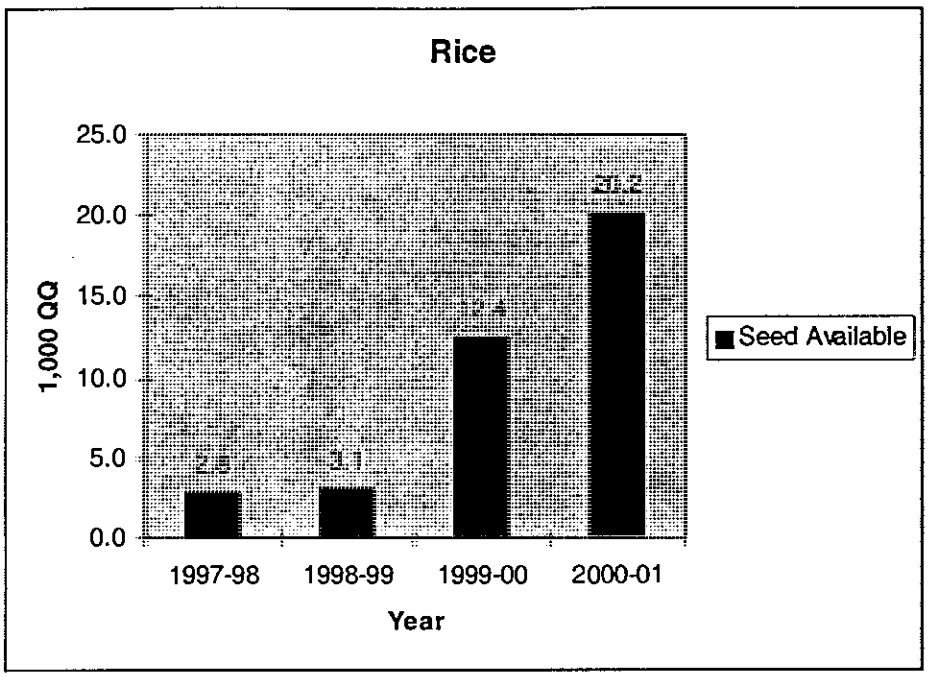
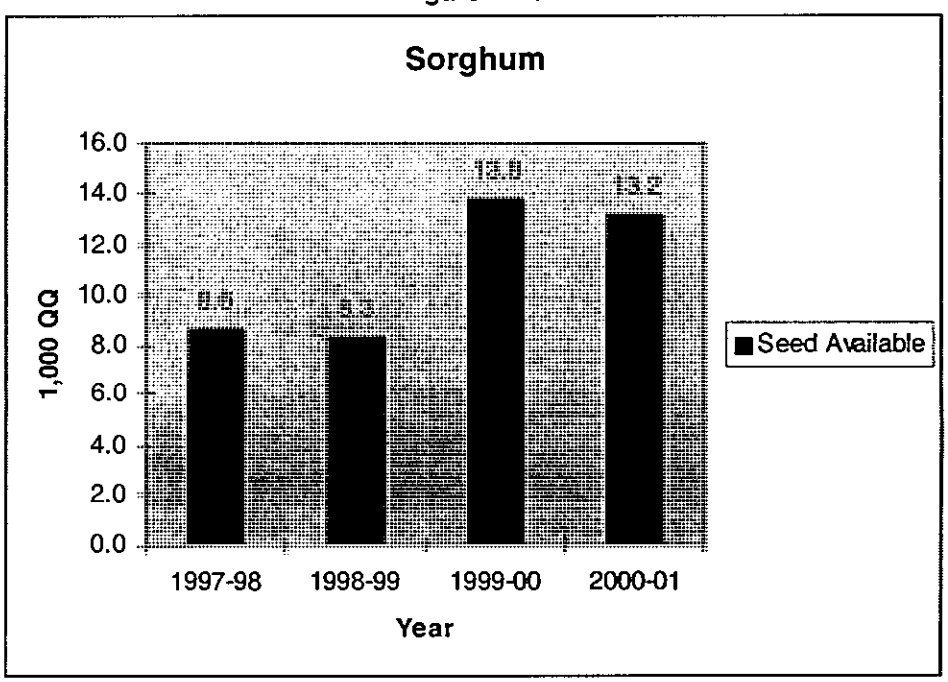


Figure A-15



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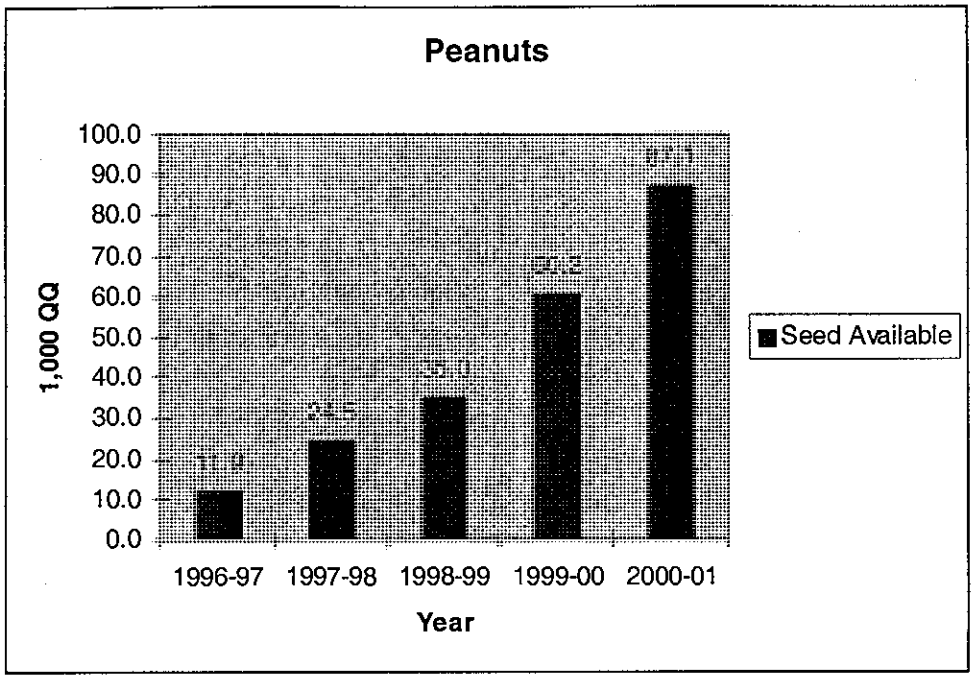

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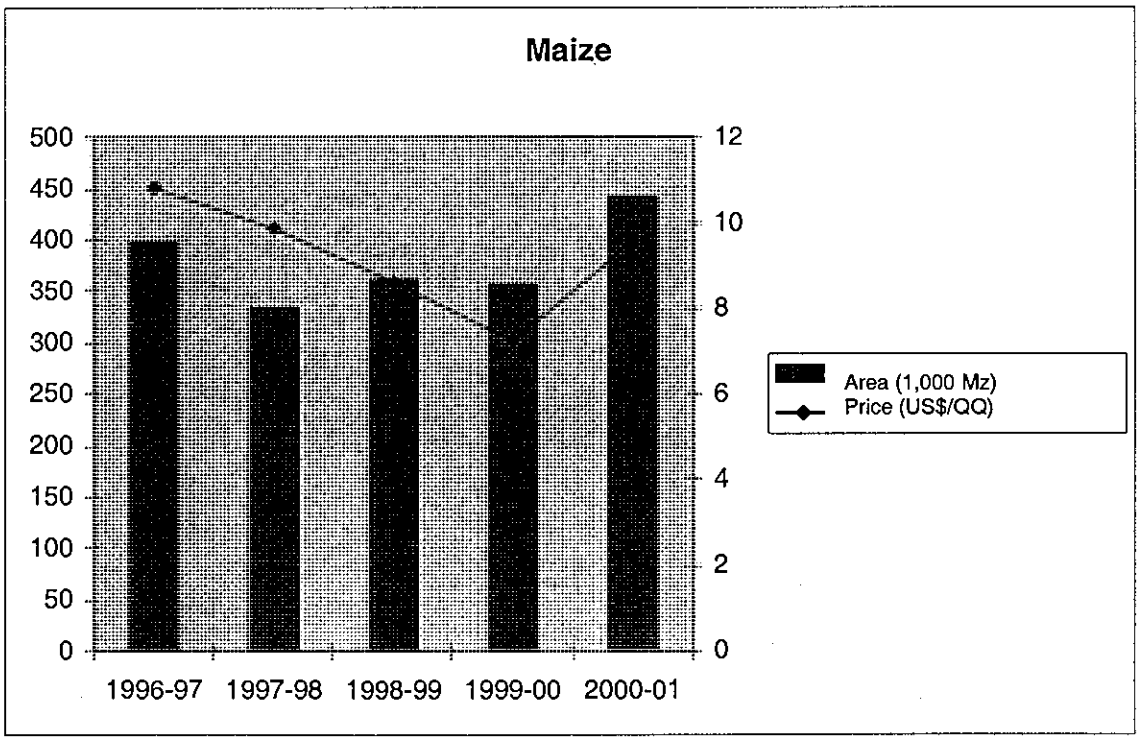

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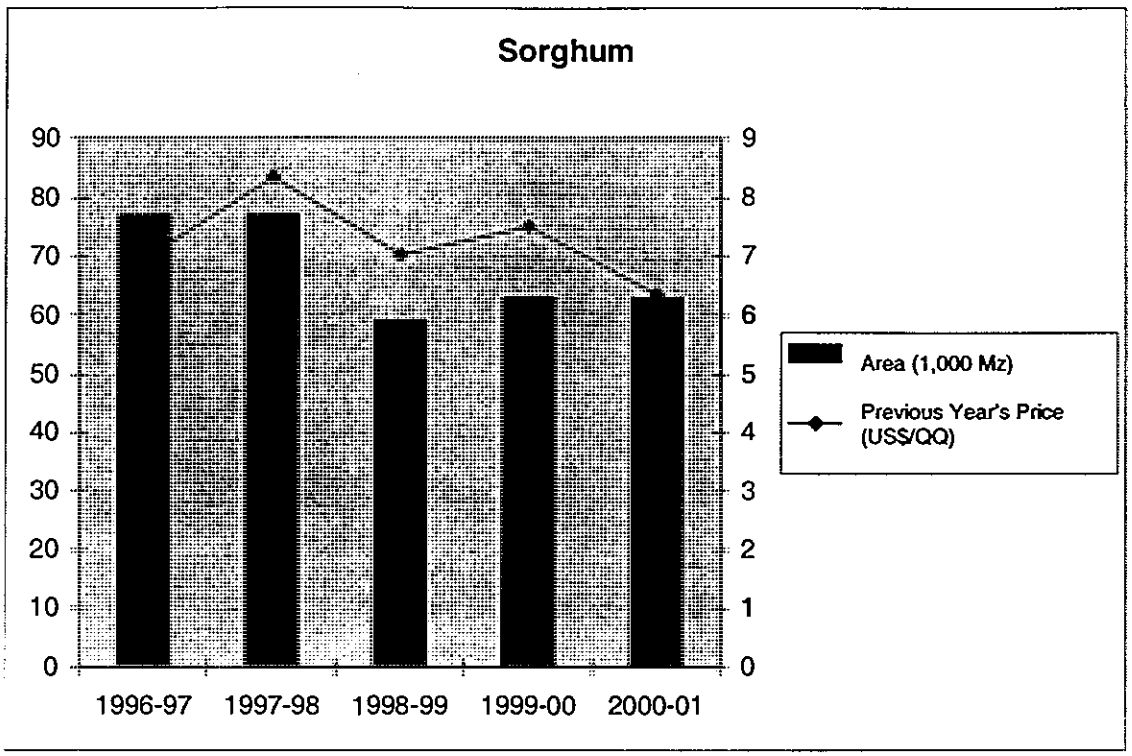

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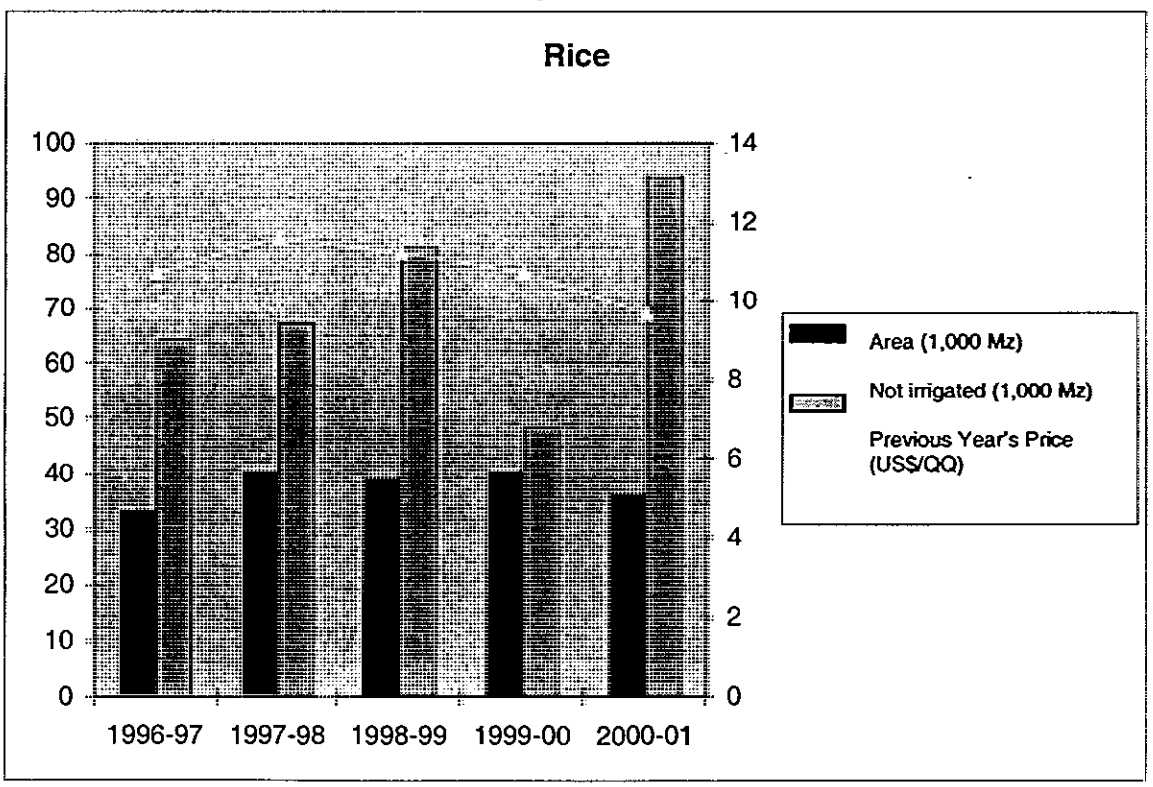
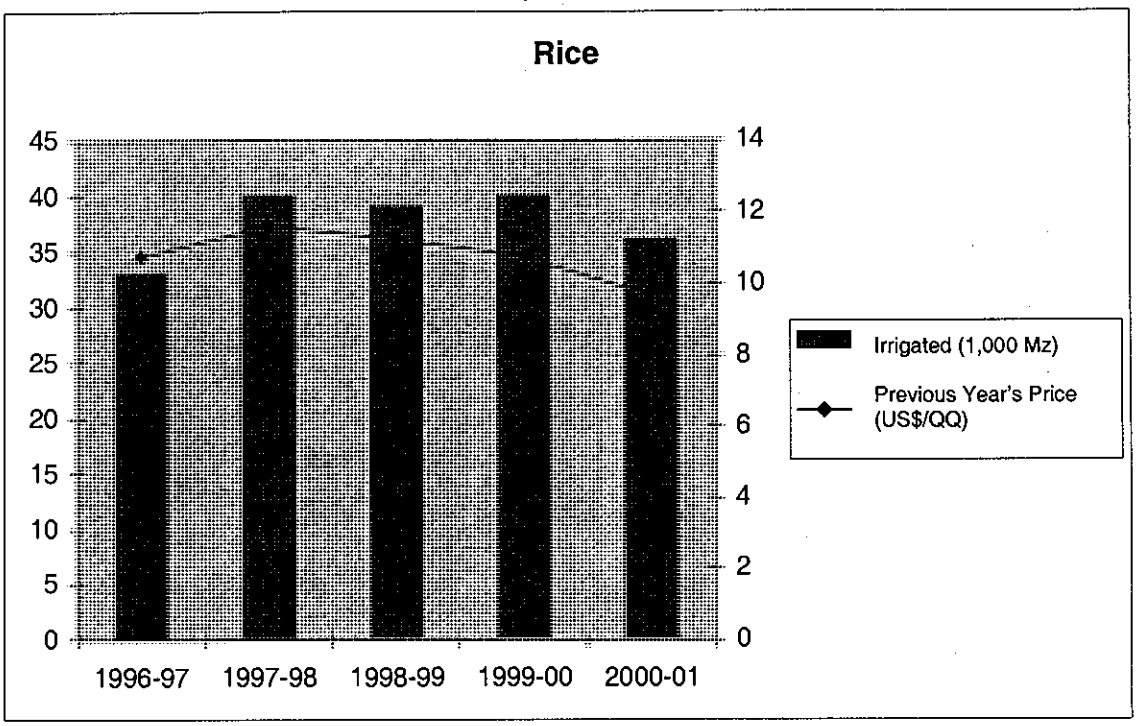


Figure A-20



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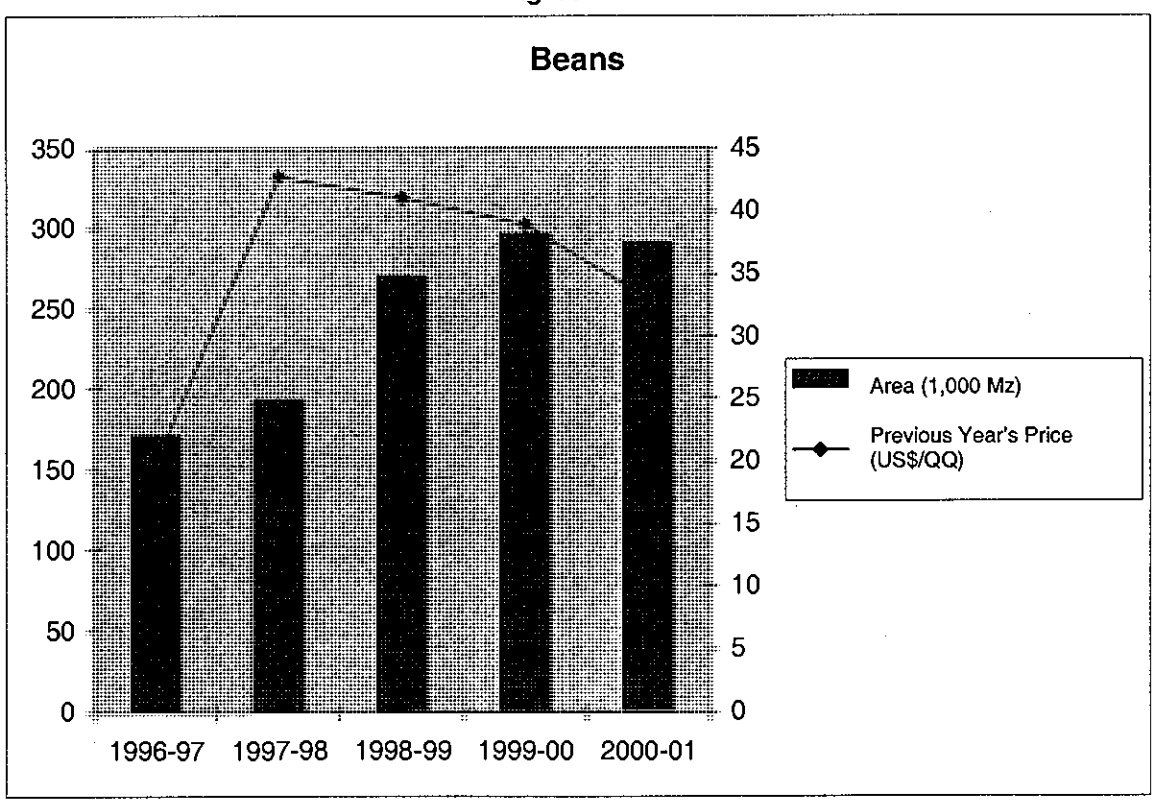

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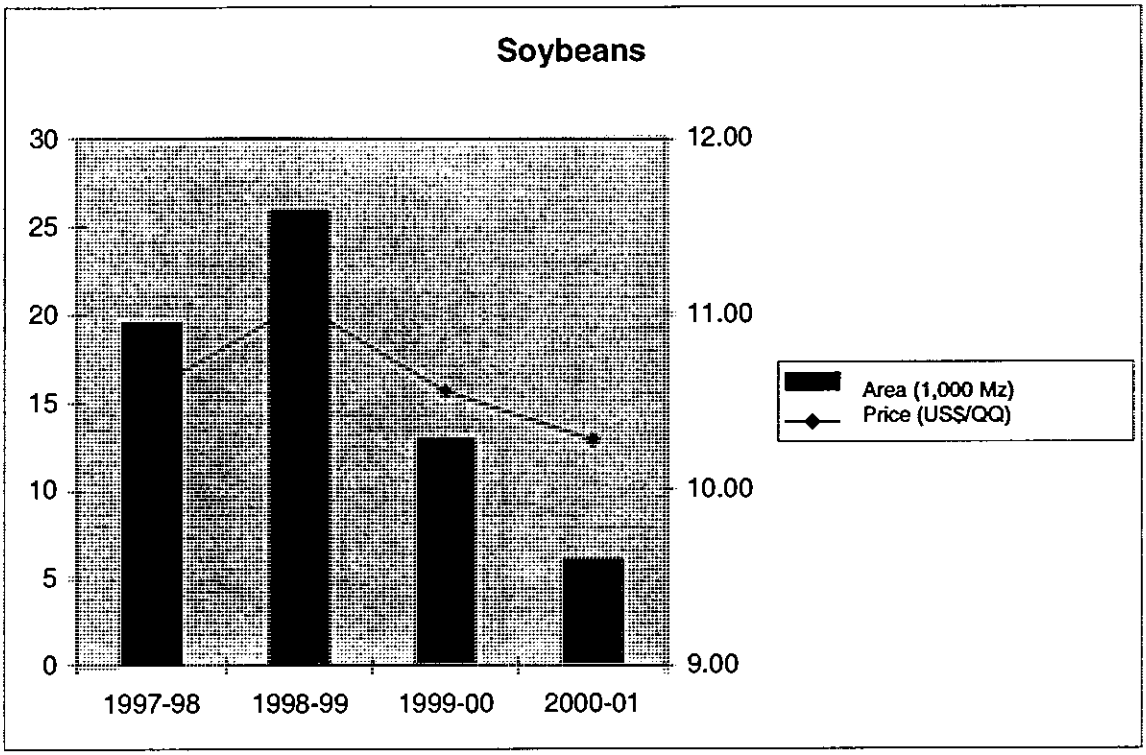
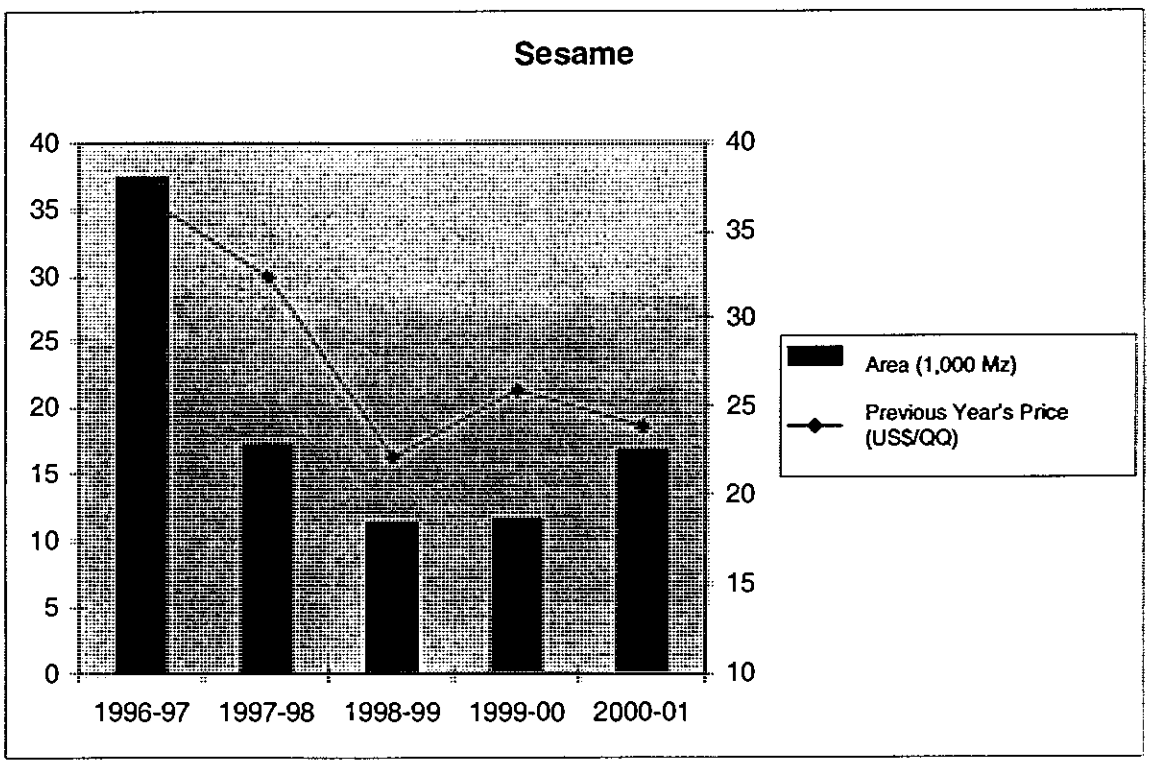


Figure A-23



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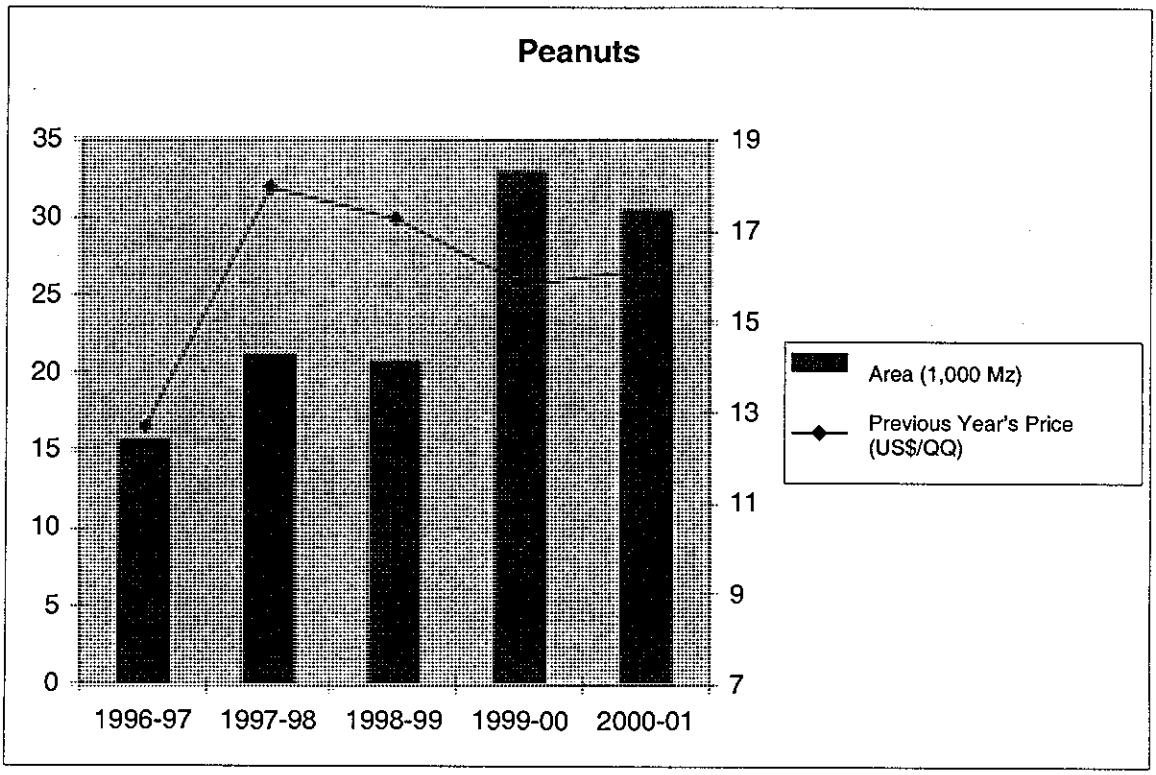
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Area (1,000 Mz)
Previous Year's Price (US$/QQ)