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Agriculture in Nicaragua: Performance, Challenges, and Options

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PREFACE

This is an advisory report addressed to policy makers in Nicaragua and prepared as a basis for operationalizing the policy dialogue between the Government of Nicaragua, the World Bank Group, and other development partners. This work was prepared by the World Bank Group with contributions from the Swiss Development Cooperation (SDC) and the International Fund for Agricultural Development (IFAD).

Content and focus: This work summarizes background papers prepared for the World Bank Group with significant input from government counterparts and other development partners. It takes stock of major recent developments and argues that a lot has been achieved in the last decade in terms of production of commodities for export and food consumption, with favorable impact on rural poverty reduction. It also argues that the two factors driving the recent agricultural performance, namely favorable international prices and expansion of the agricultural frontier, have reached their limits. So while trade policies are broadly on target, much can be done by focusing on the productivity of small family agriculture and improving competitiveness by reducing transaction costs (logistics) affecting small, medium, and large commercial farms. In the short to medium term, the household income of the rural poor will continue to depend largely on agriculture. Thus interventions will need to take into account the heterogeneity of smallholder agriculture while simultaneously increasing its resilience to climate risks through climate-smart agriculture (CSA).

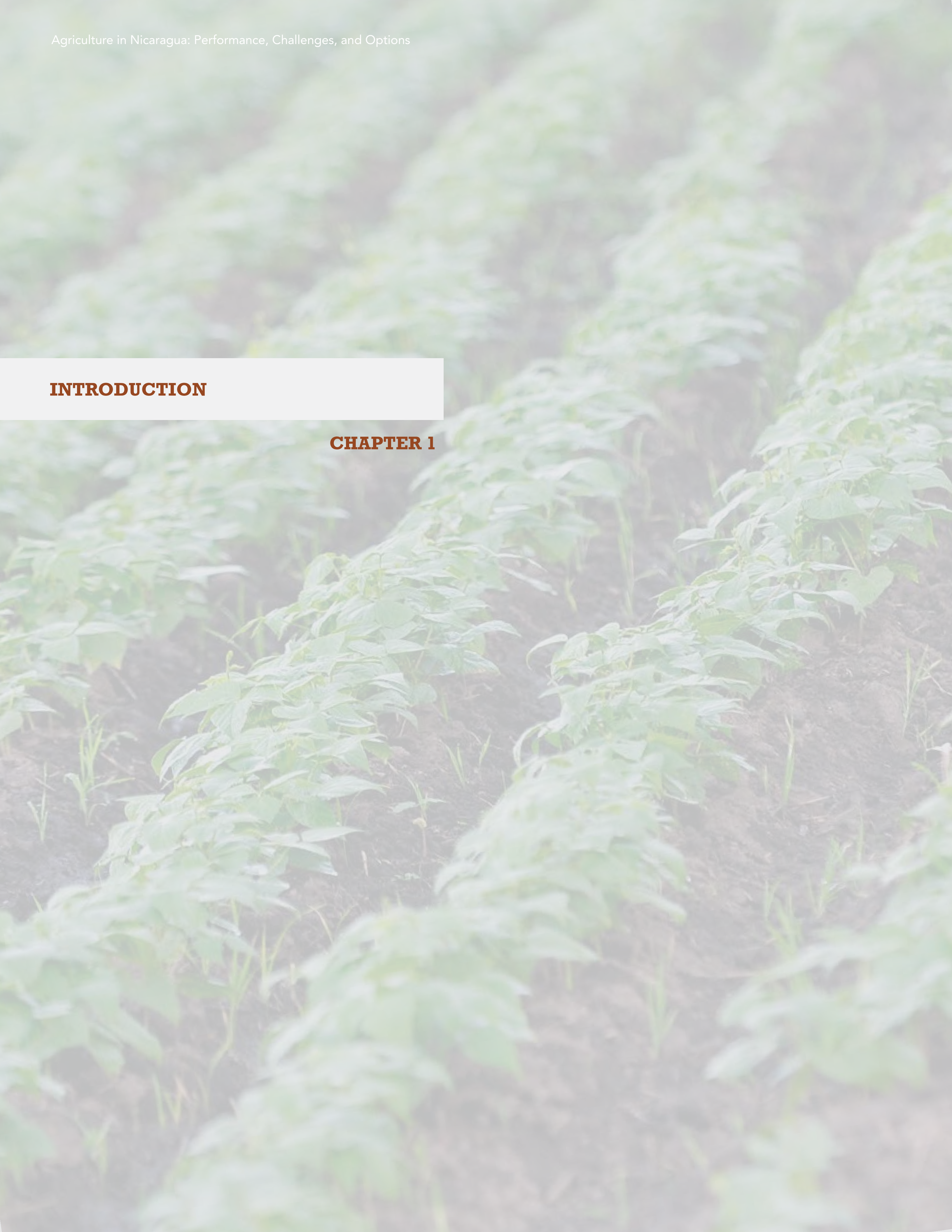
Organization: Following an introduction and a chapter that briefly reviews the recent positive performance of Nicaraguan agriculture, Chapter 3 makes the case for expanding public investment in agriculture by considering: its contribution to the overall economy; its positive impact on the rural poor; its role in preserving the environment and contribution to food security; and the overall economy's dependence on the impact of weather risks and climate change on the sector. Chapter 4 argues that despite a favorable policy environment, restrictions imposed by the high cost of domestic transport and logistics affect the competitiveness of Nicaragua's agricultural exports. It also examines the productivity performance of three major commodities. Chapter 5 looks at the duality of agriculture and the heterogeneity within smallholder agriculture and proposes a typology of producers to identify targeted interventions. Chapter 6 focuses on climate-related risks, gives examples of integrated risk management, and argues that the promotion of CSA can reduce these risks. Chapter 7 provides a road map for policy makers that includes specific key and other recommendations, while Chapter 8 offers some final considerations for agriculture in Nicaragua.

ABBREVIATIONS AND ACRONYMS

AOI	Agricultural Orientation Index
BCN	Nicaraguan Central Bank
C$	Nicaraguan cordoba (Nicaraguan domestic currency)
CAFTA-DR	Central America-Dominican Republic Free Trade Agreement
CIAT	International Center for Tropical Agriculture
CSA	Climate-smart agriculture
EA	Explotaciones agropecuarias (farm units)
ECLAC	Economic Commission for Latin America of the United Nations
ENSO	El Niño Southern Oscillation
ERP	Effective rates of protection
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
Gg	Gigagrams
GHG	Greenhouse gas
GPV	Gross production value
IFAD	International Fund for Agricultural Development
IOM	Input-Output Matrix
IMF	International Monetary Fund
INETER	Nicaraguan Institute of Territorial Studies
INTA	Nicaraguan Institute of Agricultural Technology
LAC	Latin America and the Caribbean
LPI	Logistics Performance Index
LSMS	Living Standards Measurement Survey
MAG	Ministry of Agriculture and Livestock
MARENA	Ministry of the Environment and Natural Resources
MIC	Middle-income countries
MIFIC	Ministry of Economics and Trade
MTI	Ministry of Transport
mz	manzana (a unit of area; in Nicaragua, 1 Hectare = 1.431mz)
NRA	Nominal rates of assistance
NRP	Nominal rates of protection
OECD	Organization for Economic Co-operation and Development

PRORURAL	Productive Rural Development Sector Program
SNIA	National System of Agricultural Research and Innovation
SPS	Sanitary and phytosanitary
TFP	Total factor productivity
UNAG	National Union of Agriculture & Livestock
VA	Value added
WDI	World Development Indicators.

Nicaragua by Neil Palmer / CC BY-SA 2.0



INTRODUCTION

CHAPTER 1

Nicaragua has experienced a decade of macroeconomic stability, relatively high economic growth, and expanded trade.

Increased public expenditures have been assigned to assist the most vulnerable households in rural areas. Overall poverty has decreased to an all-time low, shrinking from 42 percent in 2009 to 30 percent in 2014, and in rural areas from 63 percent to 50 percent (LSMS 2014). While these are encouraging results, a large number of Nicaraguans, especially in rural areas, remain stuck in poverty or are at risk of relapse. This calls for special attention to agriculture as the mainstay of the national economy, the major provider of food, nutrition, jobs, and export earnings, and ultimately the sector where further gains in reducing poverty can be made.

Agricultural policies aimed at benefiting the poor make economic sense for the government and society as a whole.

This paper makes the case that current public sector and agricultural policies have been broadly effective, but that additional measures can further promote robust economic growth, reduce the inequality gap, and build resilience to climate change and weather shocks. This can be achieved through targeted programs that recognize the diversity of production systems, sources of income, and livelihood strategies of family agriculture to promote economic and social welfare. Ultimately the paper advocates for an increasing shift toward securing a triple win by implementing agriculture and food production practices that boost productivity, enhance resilience, and lower greenhouse gas (GHG) emissions —the three simultaneous outcomes that form the basis of climate-smart agriculture (CSA).

This paper summarizes the results of three consultations with the Government of Nicaragua Production Cabinet, donors, and stakeholders to clarify key underlying issues and options. It also draws on a series of background papers.

Its goal is to provide compelling evidence and empirically assess how sustainable agricultural growth benefits the economy, the poor, and the environment but also how it is exposed to risks that need to be factored in while considering policy options to make agricultur After a brief review of the drivers of agricultural growth in Nicaragua, five areas of study are covered: *(i)* the rationale for investing in Nicaraguan agriculture; *(ii)* the promotion of competitiveness and efficiency gains; *(iii)* the dynamics of smallholder agriculture; *(iv)* the management of climate risks; and *(v)* a road map with areas for consideration. The paper is part of a package that also includes a PowerPoint presentation, a set of background papers, and a dissemination strategy. It is meant to contribute to the dialogue between government, society, and development partners.

Photo by Carlos Arce / World Bank

INTRODUCTION

WHAT DRIVES AGRICULTURAL GROWTH IN NICARAGUA?

WHY INVEST IN NICARAGUAN AGRICULTURE?

COMPETITIVENESS AND EFFICIENCY GAINS

FAMILY FARMING IN NICARAGUA

WEATHER RISKS AND CLIMATE CHANGE

A ROAD MAP FOR POLICY MAKERS

WHAT DRIVES AGRICULTURAL GROWTH IN NICARAGUA?

CHAPTER 2

While Nicaragua's economy is diversifying to manufacturing, construction, and services, agriculture continues to be the main engine of economic growth.

The sector accounts for 17 percent of gross domestic product (GDP) and 70 percent of total exports of primary products (including processed foods such as meat and sugar) (WDI 2012). The main exports include coffee (mainly produced by smallholders in agroforestry systems), livestock products (meat, dairy, and live cattle), sugarcane, peanuts, and beans (the basic staple food crop of the Nicaraguan diet). Agriculture is the major provider of employment, comprising more than 30 percent of the total labor force, twice the regional average of 15 percent, and is the main source of livelihood for 80 percent of the rural population.

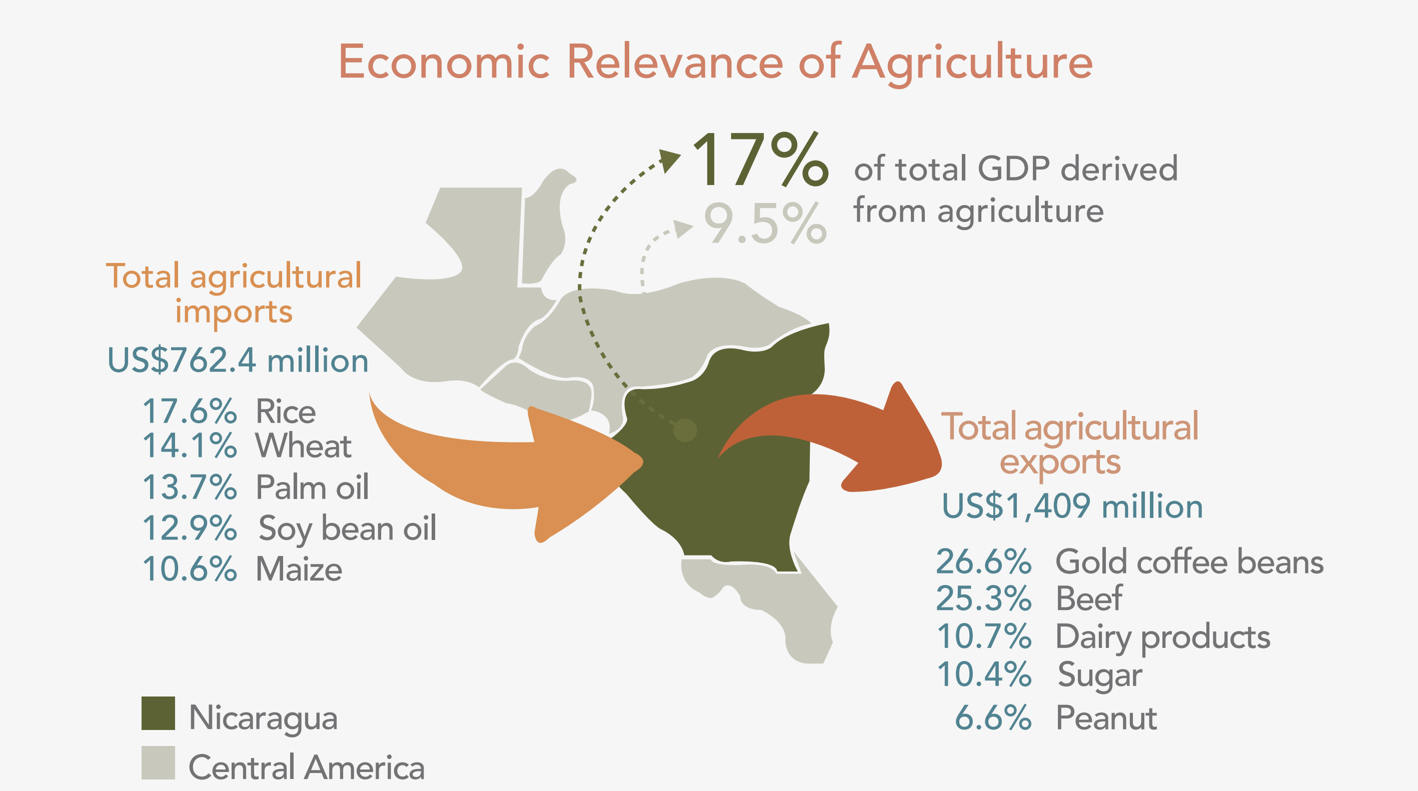
Nicaragua has experienced significant expansion in exports over the last several years, mostly driven by the agriculture sector.

Exports of leading commodities have grown significantly since Nicaragua joined the Central America-Dominican Republic Free Trade Agreement (CAFTA-DR) with the United States in 2006, which helped the country attract investment and promote economic development. The contribution of total exports to GDP increased from 27 percent in 2006 to 46 percent in 2012. Coffee, beef, peanuts, banana, lobsters, sugar, dairy products, beans, and sesame are the main export crops, accounting for 70 percent of Nicaragua's export earnings (WDI 2012). About half of all agricultural exports are produced by small and medium farmers, who are also responsible for producing 90 percent of the staple foods consumed. The remaining exports are concentrated in unskilled labor-intensive industries, such as clothing and light manufacturing.

The rural labor market has not changed significantly over the past decade: Nicaragua continues to be a dualistic rural economy dominated by unskilled agricultural labor.

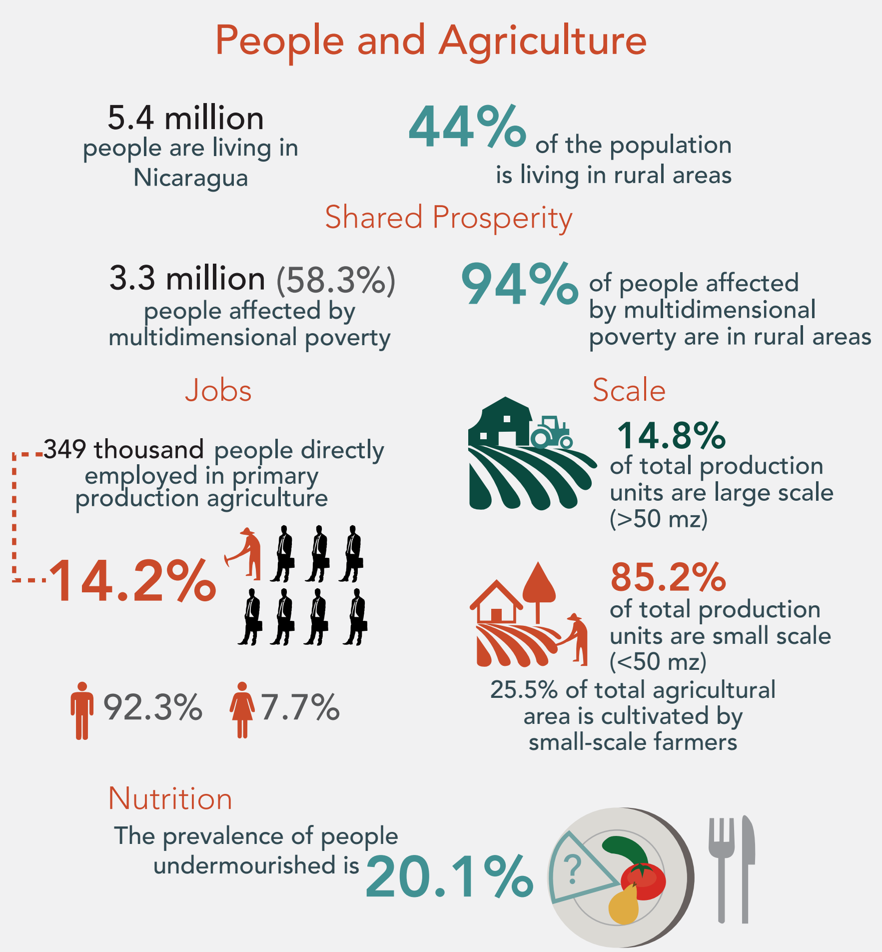
The majority of the poor (approximately 65 percent) and the extreme poor (80 percent) live in Nicaragua's rural areas. They are widely scattered throughout the country, have low education levels, and suffer from a scarcity of services and infrastructure. About 4 in 10 people (42.6 percent of the population) live in small, dispersed villages of less than a thousand inhabitants, located in areas that do not meet the minimum urban conditions, such as street layout, electricity, and normal commercial establishments (INIDE 2012). Their main livelihood is agriculture based on a combination of vegetable, livestock, and poultry systems and provision of labor to larger farmers. Part of the reason for the recent reduction of poverty rates in rural

Figure 2.1: Economic Relevance of Agriculture in Nicaragua



Source: CIAT 2015.

Figure 2.2: Economic Relevance of Agriculture



Source: CIAT 2015.

areas since 2008 is a significant increase in the prices of agricultural products and in the salaries of the poorest segments of the agriculture sector (World Bank 2013). Coffee and livestock contribute the highest percentage to agricultural exports and are also the greatest source of agricultural employment – most agricultural laborers are poor and have benefitted from better salaries. Coffee generates 300,000 direct and indirect jobs, representing 14 percent of total domestic employment (unskilled labor), while livestock accounts for more than 46 percent of rural employment, according to government statistics.

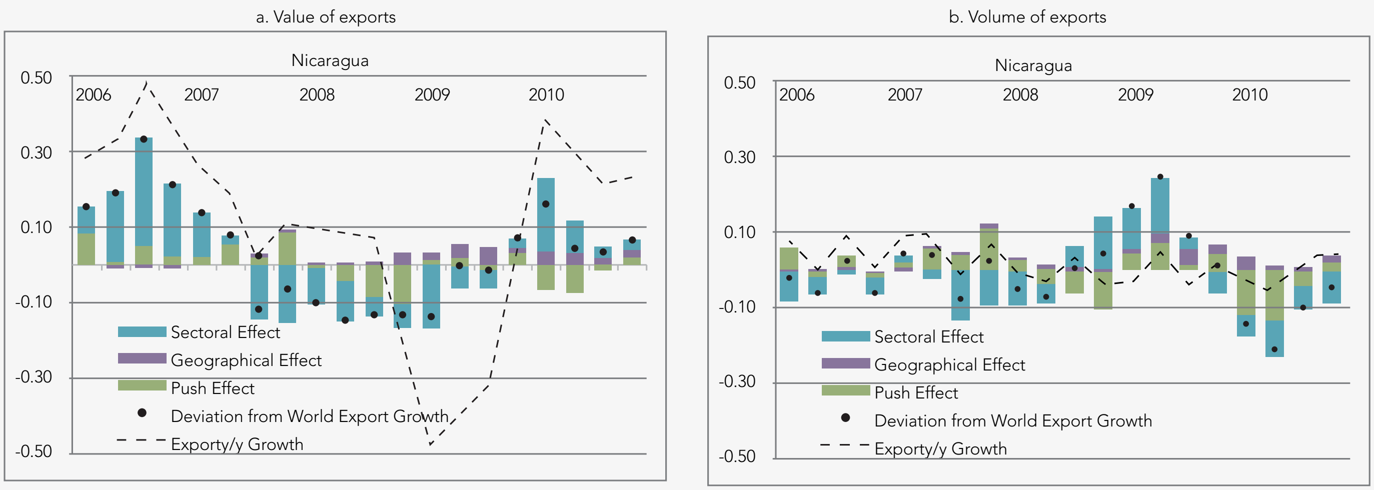
The growth in agricultural exports at the aggregate level between 2006 and 2012 was driven primarily by a rise in external prices rather than an increase in volume, however.

Figure 2.3 presents the annual growth rate of the value and volume of exports. World prices played a dominant role in the performance of exports during this period. At the same time, export values were more volatile than in the past, with strong increases in 2006-07 and 2010 and a severe fall during the global financial crisis of 2009. The black dots in each graph compare the growth of Nicaraguan exports with the global average. The growth rate for export value is 8 percent above the global average, while the growth rate for export volume is 5 percent below the worldwide average.

Growth in volume has been moderate, driven largely by the expansion of the agricultural frontier.

Nicaragua has lost more than 20 percent of its forest cover since 1990. Only 27.5 percent of the country is still covered by forests, as deforestation is advancing at a rate of 76,000 ha/year, the second highest rate of deforestation in Central Amer-

Figure 2.3: Breakdown of the Performance of Nicaraguan Exports, 2006-2010



Note: The methodology focuses on the exporters, and looks at their geographic specialization (Geographic Effect) and to their sector specialization (Sector Effect). Push factors refer to the dynamic of the supply side.

Source: World Bank. 2013

ica after Honduras (120,000 ha/year). The main driver of the expansion of the agricultural frontier is clearing for agriculture and extensive cattle grazing, followed by fires, natural disasters, and illegal logging. The continued eastward expansion of low-productivity, slash-and-burn systems across the agricultural frontier (the largest forests and protected areas are mainly located in indigenous territories in the eastern part of the country) is exacerbated by social pressure over the use of natural resources by poor families without land and settlers' invasions of indigenous territories and protected areas. Nearly two million hectares are being overexploited by farming activities across the country. In terms of potential use or land use change, agriculture has seized an estimated 40 percent of forest soils. *Figure 2.4* shows the progression of Nicaragua's agriculture frontier since 2000.

Productivity has made some gains but overall lags well below the regional average.

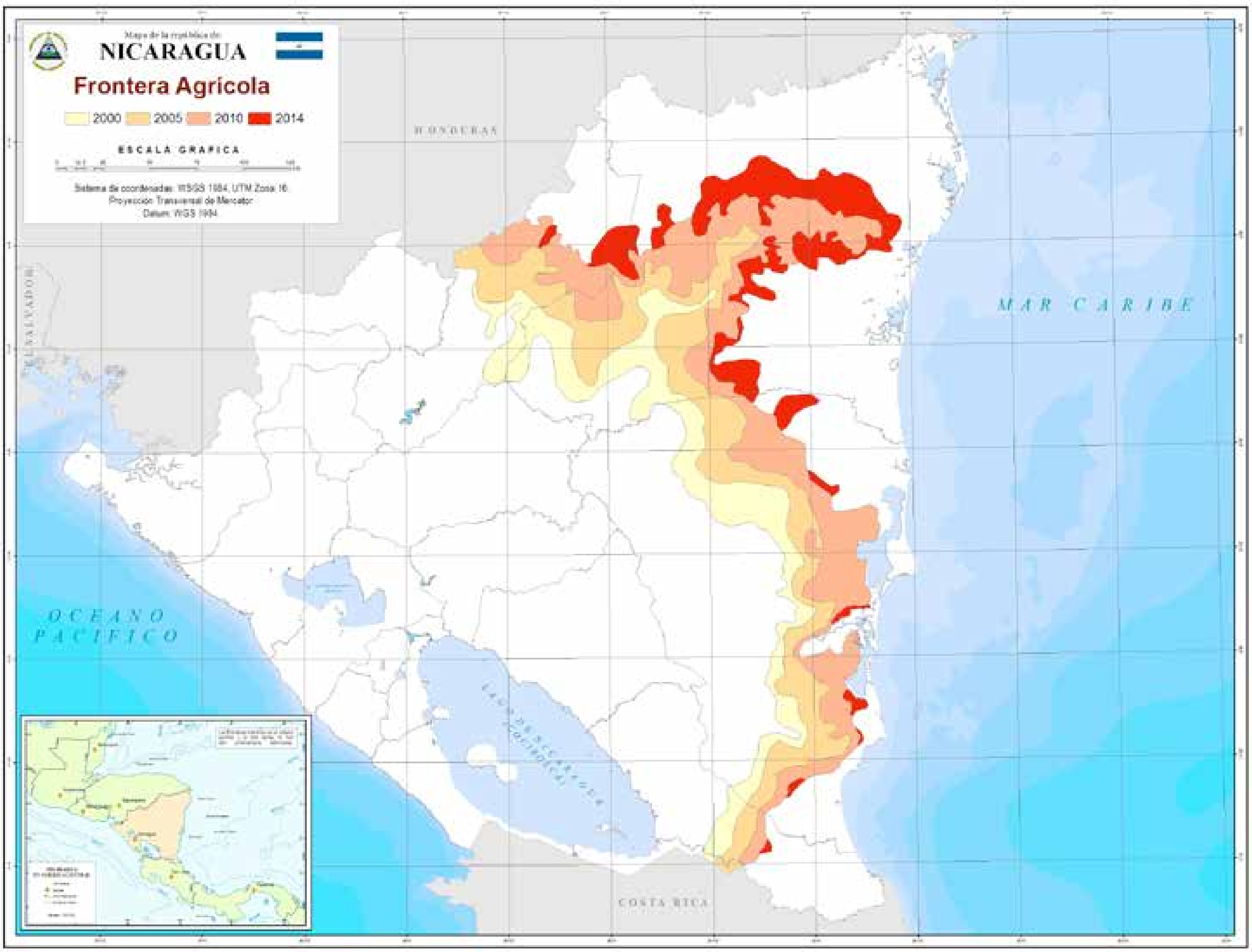
Current agricultural growth is well below Nicaragua's potential. Macroeconomic stability, the low cost of labor, the low incidence of violence, and land quality are all factors that should contribute to better performance. Some of the current constraints discussed in this document, such as high domestic transaction costs and vulnerability to weather and climate risks, can be successfully addressed. To effectively reduce poverty and income disparities, the sector will need to perform on a sustainable basis: with projected annual population and income growth rates of 1.5 percent and 4.0 percent, respectively, the resulting net annual per capita income growth of only 2.5 percent will make it hard for Nicaragua to reach the average annual income of the Latin America and the Caribbean (LAC) region anytime soon. It is encouraging, though, that even in the current context of projected overall deceleration in economic growth in LAC, Nicaragua shows the strongest performance after Panama and the Dominican Republic *(Figure 2.5)*.

The major challenge is that the Nicaraguan economy needs to grow at a higher rate to substantially reduce poverty.

Growth and poverty reduction are directly related in Latin America; that is, a correlation exists between higher rates of growth and lower levels of poverty, as evidenced by the statistics for several Latin American countries from 1990 to 2010 *(Figure 2.6)*.

Countries with higher efficacy in reducing poverty are below the trend line of the graph, for example Brazil and Paraguay, where a 1 percent increase in growth reduced poverty by 1 percent. Colombia, Chile, and El Salvador needed more than 2 percentage points in growth to obtain a 1 percent reduction in poverty. Countries with lower levels of efficacy, such as Costa

Figure 2.4: Expansion of Nicaragua's Agriculture Frontier, 2000-2014



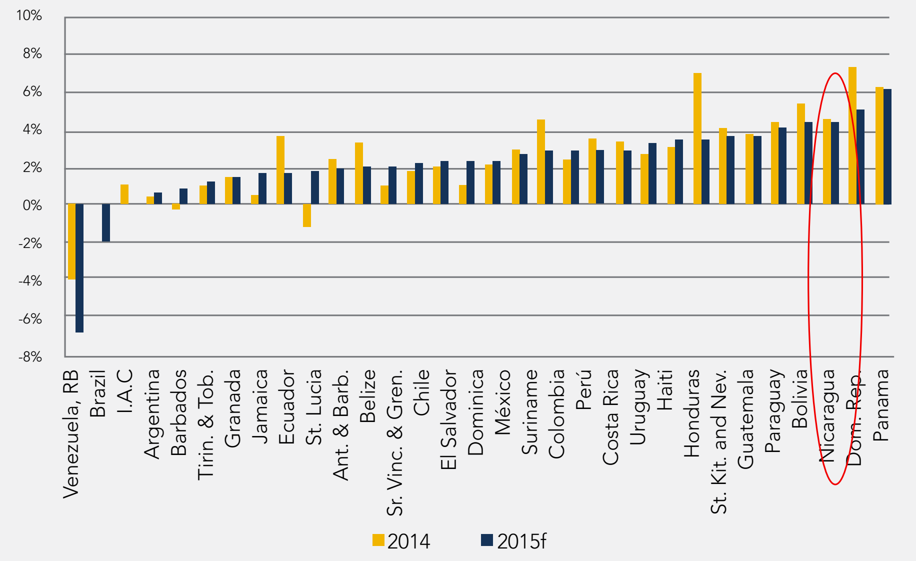
Source: MARENA 2015.

Rica, Mexico, and Panama, are above the trend line; for each percentage point in economic growth per capita, the reduction in poverty is less than proportional. Nicaragua falls into this category by a small margin; the reduction in poverty is less than proportional to the increase in economic growth. In such cases, higher rates of growth are needed to make an effective impact on poverty.[1] Since the agriculture sector is the largest generator of jobs and income for Nicaragua's rural poor, a well-designed incentives framework and wise investments are needed to achieve the higher rates of growth that can reduce poverty more effectively.

The growth policy challenge is accentuated by the presence of a sharp duality in Nicaragua's agriculture sector, which translates into two different worlds.

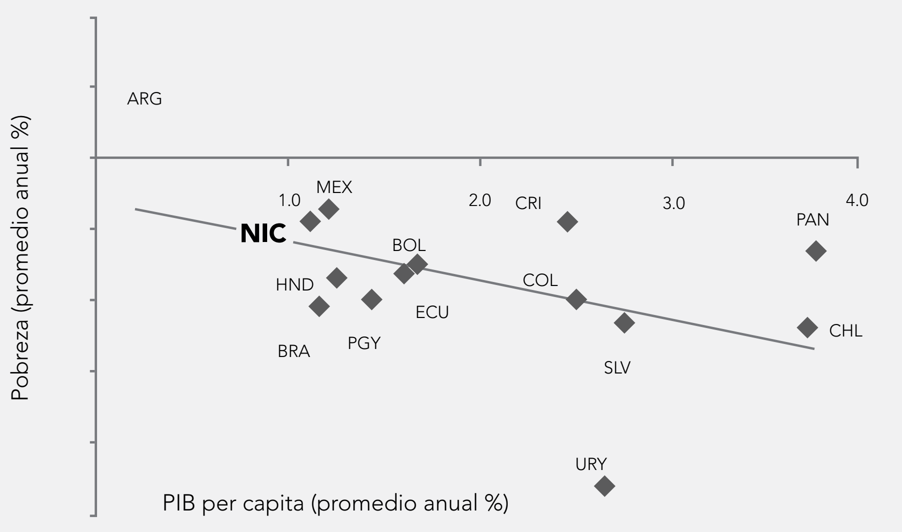
On one hand, a vibrant agricultural business sector is concentrated in a few traditional export products (coffee, peanuts, soy, sugarcane, rice, and livestock), which comprises around 18 percent of the total farms, contributes about 51 percent of the gross production value (GPV) of agriculture, and controls around 74.5 percent of the agricultural land in the country—10 percent of the largest farms own 63.5 percent of the land (CENAGRO 2011). This sector enjoys access to the means of production: capital, land, a labor force, modern technology, and high-value markets, all of which provide producers with ample opportunities to improve their levels of efficiency. On the other hand, the other face of agriculture comprises largely poor, small-scale producers of basic grains and coffee and other products for self-consumption and local markets (maize, beans, rainfed rice, sorghum, and livestock). This sector makes up around 81 percent of the total farms and contributes 49 percent of agricultural GPV. The majority of these small-scale farmers are occupied in subsistence agriculture, with limited access to means of production and high-value markets. Seventy percent of the smallest farms occupy only 10 percent of the land (CENAGRO 2011).

Figure 2.5: Projected Economic Growth in LAC Countries



Sources: Based on IMF's World Economic Outlook, July 2015

Figure 2.6: Latin America: Economic Growth and Poverty Reduction, 1990-2010



Source: World Bank Development Database 2011.

1 Castro-Leal and Laguna (2015) in a background paper for the World Bank.

Photo by Neil Palmer / CC BY-SA 2.0

WHY INVEST IN NICARAGUAN AGRICULTURE?

CHAPTER 3

Nicaragua's agriculture sector is the mainstay of the national economy. Agriculture is a major provider of food, nutrition, jobs, and export earnings, and the sector is key to improving stewardship of the environment. Investing resources to support steady, sustainable agricultural growth in Nicaragua makes economic, social, and environmental sense for four key reasons: (i) because agriculture's contribution to the economy extends far beyond the nominal agricultural GDP, with a multiplier effect that permeates deep into the rest of the economy; (ii) because agriculture farming is the main livelihood of rural families and the key to poverty reduction; (iii) because agriculture, natural resources, and climate change are inextricably interwoven and play a major role in the overall economic stability of Nicaragua; and (iv) because in Nicaragua, food and nutrition security depends on agricultural performance. These four aspects are the focus of this chapter.

Reason #1: Because Agriculture is the Main Driver of the Economy

What is the real size of agriculture in Nicaragua?

The system of national accounts assigns a specific value added (VA) to the principal sectors of the economy and any activity conducted outside the precise confines of agricultural farming operations is reported as part of another sector (e.g., manufacturing, trade, transportation, etc.). While this approach obeys national accounting conventions, from a policy perspective it vastly underestimates the larger role that agriculture plays in the economy.

Agriculture is not isolated from the rest of the economy; on the contrary, it is deeply intertwined with all other sectors to which it contributes.

Through a multiplier effect, agriculture influences domestic economic growth beyond what is reported in the national accounts, which measure agricultural output and sales at the level of the primary productive unit and thus do not take into account the backward and forward linkages with agroindustry, the service and trade sectors, and the rest of the economy in general.

To estimate the expanded VA of Nicaragua's agriculture sector, calculations were made to take the forward and backward linkages into account; the results are revealing.[2]

Using the Input-Output Matrix (IOM) for 2006 generated by the Central Bank of Nicaragua, the expanded agricultural VA estimate for the primary sector rises from 17.48 percent to 22.52 percent of total VA, or 5.04 percentage points, as compared to the national accounts. This calculation includes coffee, sugar, live animals, forestry, fishery, and basic grains *(Table 3.1).*

A further calculation was made considering the extended primary sector, including (in addition to agriculture, livestock, fishery, and forestry) those sectors that transform raw materials—like the agro-industrial sector— hence adding meat, sugar, dairy, and other foods from industrial sources, plus the tobacco, wood, and wood product sectors *(Table 3.2).*

Table 3.1: Expanded Value Addition for the Agriculture Sector

	Agricultural VA	Forward Linkages	Backward Linkages	Total
Cordobas (millions) for 2006	18,879	4,440	1,005	24,324
Share of total VA	17.48%	4.11%	0.93%	22.52%

Source: Authors, derived from the Central Bank of Nicaragua's IOM for 2006.

Table 3.2: Expanded Value Addition for the Extended Agriculture Sector

	Agricultural VA	Forward Linkages	Backward Linkages	Total
Cordobas (millions) for 2006	25,344	2,654	1,466	29,463
Share of total VA	23.47%	2.46%	1.36%	27.28%

Source: Authors, derived from the Central Bank of Nicaragua's IOM for 2006.

2 Herrera (2015) in a background paper for the study of Nicaragua's agriculture sector for the World Bank, applying the methodology designed by Foster and Valdés (2013).

Table 3.3: Estimates of Expanded Value Added, Disaggregated by Sector

	Value added	Linkage value		Total	Participation in Total VA	Participation in VA		Sum	Participation in extended VA
		Forward	Backward			Forward	Backward		
Agriculture	9,479	1,485	569	11,534	8.8%	1.4%	0.5%	1.9%	10.7%
Livestock	7,068	2,130	311	9,509	6.5%	2.0%	0.3%	2.3%	8.8%
Forestry	1,440	521	42	2,004	1.3%	0.5%	0.0%	0.5%	1.9%
Fishing	891	302	83	1,277	0.8%	0.3%	0.1%	0.4%	1.2%
Total	18,879	4,440	1,005	24,324	4.1%	4.1%	0.9%	5.0%	22.5%

Source: Authors, derived from the Central Bank of Nicaragua's IOM for 2006..

When the extended primary sector is taken into account, the expanded agricultural VA rises to 27.28 percent, an increase of 9.8 percent over the official estimate for agricultural GDP. (table 3.2)

This is important because it not only realistically estimates the annual growth of agricultural GDP (e.g., in this case from 2 percent to 5 percent), but also how it determines growth in the rest of the economy beyond what is reflected by measuring the percentage of the agriculture sector's contribution in the national accounts. Conversely, a deceleration in agricultural performance will result in an economic contraction at the national level greater than the official calculation (17.48 percent) of agricultural GDP, with greater repercussions on employment and rural poverty. By the same token, agricultural policies and programs will indirectly influence change (positive or negative) for a broader spectrum of the economy than indicated by the percentage of official GDP assigned to agriculture.

Agro-industrial activities have the highest percentages of forward linkages and, in turn, contribute more than 90 percent of the total value of the forward linkages.

The most significant aspect of the estimates in Table 3.3 is the part that measures the forward linkages, which is to be expected given the importance of the agro-industrial sector. The carry-over effects of agriculture, livestock, fishery, and forestry are all influenced to a great extent by the agro-industrial sector.

Reason # 2: Because Agriculture is the Main Source of Income for the Rural Poor and the Key to Poverty Reduction

Income inequality is an important item of Nicaragua's national development agenda, particularly with regard to the poorest households.

Rapid growth in agriculture affects poverty reduction in a positive manner in three main ways: (i) it increases employment and wages of unskilled workers in all sectors of the economy, not just in agriculture; (ii) it increases the incomes of the poorest agricultural producers, given their contribution to sectoral growth; and (iii) it increases consumers' real disposable income as food becomes less expensive. Obviously there are effects mediated by the market in addition to those associated with agriculture. Considerable variance in the findings of studies carried out for LAC also exists with regard to the effect of agricultural growth on poverty. This report argues that in Nicaragua, agricultural growth plays and will continue to play a key role in reducing poverty and improving incomes at least for the short to medium term.

Rural poverty has fallen sharply in the past few years, with the largest absolute income gains for the rural poor attributable to agriculture.

A comparison of the income changes between 2005 and 2009 and between the rural poor and non-poor reveals interesting patterns (LSMS 2009). While the real average per capita income of poor rural households rose 12.6 percent, the average income for rural non-poor households remained unchanged. See Box 2.1 for yhe implications of the findings of the LSMS 2014. All income sources but remittances increased in absolute terms among the poor, with over half of the total gains coming from income gains from either wages or self-employment in agriculture. For the non-poor, positive changes in income occurred in off-farm activities and were more than offset by a drop in income from self-employment in agriculture (Figure 3.1). The increase in agricultural income, combined with the fact that a large majority of the rural poor are involved in agriculture, seems to account for most of

Box 2.1 Poverty in Nicaragua

Poverty and extreme poverty have consistently declined in Nicaragua from 1993 to 2009 and again to 2014 at the national level and for urban and rural areas. Trends indicate an acceleration of poverty reduction from 2009-2014 in contrast to 1993-2009. A finding of particular relevance to this report is that although poverty declined, both in urban and rural areas, poverty and extreme poverty continue to be overwhelmingly rural (see Table x.x below). Because of this, the overall storyline of this report and its main findings with regards to rural poverty and smallholders have most likely not changed.

Table x.x Nicaragua: Incidence of Poverty in 2014 by Geographic Region

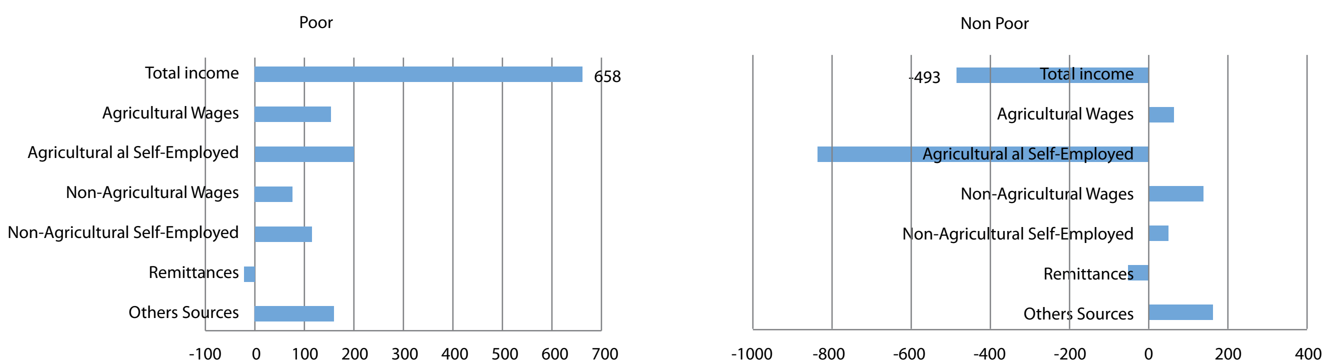
	Extreme Poor	Poor
National	**8.3**	**29.6**
Urban	2.4	14.8
Rural	**16.3**	**50.1**
Managua	1.8	11.6
Pacific	3.8	18.5
Central	13.9	44.4
Atlantic	11.5	39.0

Source: INIDE (October 2015)

The most recent poverty numbers come from the latest Living Standards Measurement Survey (LSMS) of 2014, just released by the Government of Nicaragua in October 2015 and they were not available while this report was being produced. Incidence of poverty numbers are public at the National Institute of Information for Development (INIDE) website (see source below), however the micro data is still not available at the time of completion of this report.

Source: INIDE (October 2015) link to the presentation with poverty numbers
http://www.inide.gob.ni/Emnv/RESULTADOS%20DE%20POBREZA%202014%20I%20INIDE.pdf

Figure 3.1: Absolute Income Changes of Rural Households by Source, 2005 and 2009



Note: Others sources include income from food (donations/gifts), pensions, institutional donations, rent, interest, dividends, and educational transfers, among others.

Source: World Bank 2013, based on LSMS 2005 and 2009.

the fall in rural poverty. Agricultural employment and income are likely to have benefitted from a sharp increase in world prices for agricultural products. However, analysis on the net effect shows that high food prices contributed to higher poverty rates in Nicaragua., particularly among urban consumers (Robles and Torero 2010).[3]

Agriculture in Nicaragua was the main source of job creation for both the poor and non-poor for the periods 2001-2005 and 2005-2009.

Agriculture generated half (2001-2005) and more than a third (2005-2009) of all new jobs. To a great extent, this accounted for the reduction in the level of poverty during these periods (Table 3.4). An agriculture sector with higher output does indeed have a multiplier effect.

Table 3.4: Change in Employment by Sector, 2001-05 and 2005-09

Sector	Annual growth in employment (%)		Contribution to total employment generation (%)		Change in contribution to total labor force (%)	
	2001-05	2005-09	2001-05	2005-09	2001-05	2005-09
Agriculture	3.38	1.86	49.78	33.64	1.32	-0.14
Mining	-3.51	6.19	-0.79	1.30	-0.11	0.06
Manufacturing	8.91	-3.57	43.61	-25.67	2.74	-2.89
Construction	-2.13	-0.26	-5.18	-0.64	-0.92	-0.39
Trade	1.49	1.20	12.60	11.65	-0.60	-0.54
Transport	-1.28	8.30	-3.94	26.31	-0.94	1.46
Financial Services	5.55	6.97	6.01	9.97	0.30	0.52
Government Services	2.41	3.49	9.08	15.59	0.03	0.50
Community Services	-2.53	6.48	-11.17	27.84	-1.82	1.41
Total Employment	2.32	1.96	100.00	100.00		
Labor Force	2.42	1.05				

Source: LSMS 2001, 2005, and 2009.

3 The study finds that poverty increased much more in urban areas (5.5 percent) than in rural areas (2.2 percent).

Box 2.2 Nicaragua Agriculture Public Expenditure Review (AgPER), 2013

At the request of the Ministry of Agriculture and Forests (MAGFOR) and the group of donors of PRORURAL Incluyente, the World Bank produced an AgPER, which was concluded in 2013.

Trends in public spending. Nicaragua had comparatively and historically low public spending on agriculture, but spending on rural development was higher, and it had been rising. This phenomenon appeared to be parallel with the acceleration in rural poverty reduction during 2005-09, which was primarily based on pro-poor agricultural growth. The policy shift toward food security after 2006 was fully reflected in spending patterns, which also indicated a strong, albeit more tacit, policy shift toward public spending on private goods. This has also been mirrored by the rise of official development assistance (ODA) directly to the agricultural private sector.

Targeting. The AgPER found that PRORURAL spending tended to be higher where technical efficiency was lower, which is in line with the concept that a well-targeted spending program should be biased in favor of those regions that have agricultural benefit potential, but are lagging in efficiency and productivity. In terms of distributive impacts, the review found an increasing poverty focus of agriculture programs over time but with each program showing large leakages to wealthier households. The report recommended explicit targeting strategies that would be put in place, and that remaining tariff and non-tariff trade barriers that increase domestic food prices should be re-evaluated. Several countries had substituted price supports by decoupled payments that did not affect prices and supported certain public policy goals, such as environmental sustainability.

Forestry. Public spending on the forestry sector remained low in Nicaragua in comparison to other countries in the region and in relation to the sector's economic importance and environmental risks. The review stresses that the growing economic potential from Nicaragua's tropical hardwoods was further raising these risks if forest management was not improved rapidly. In this context, the AgPER recommended to (i) improve both levels and quality of spending on the sector; but also to (ii) rationalize the incentive structure. The Government was recommended to continue to mobilize external resources for forest management in the short term and consider increasing general revenue funds over the medium term, which would be critical to support the improvements in enforcement and producer services while the impact of user fees and other incentives gradually would take force.

Food security. Nicaragua had made progress on reducing malnutrition and establishing the main elements for food security. In 2009, the Government reinforced its efforts by passing a law and establishing an umbrella program for food security (SSAN), and added the objective of food sovereignty aimed at promoting import substitution. PRORURAL food security programs represented approximately 42 percent of this spending and a very broad range of programs across several ministries and agencies was established. However, many program lines showed large volatility from one period with some programs disappearing and reappearing over time. For areas such as crop management, seed production and product development which were likely to see their structural impact only in the medium to long term, such large fluctuations in available resources would limit their impact. The AgPER recommended to build a national consensus on the direction some of these smaller, but crucial, programs may help to maintain the strategic focus across political administrations and ensure a steady flow of resources over longer periods of time.

Expenditure systems. The government's introduction of the Medium-Term Expenditure Framework was a big step toward performance budgeting—and away from program budgeting. But budget preparation had no common guidelines for setting budget ceilings in advance, and most resources were communicated to PRORURAL entities close to the annual deadline. Budget revisions were not generally based on technical program reviews that are virtually absent. It would have been best practice, if MHCP and sectoral entities would have tightened the link between planning and budgeting. For the financial management information system, the review recommended that policy makers used only one single information solution for public financial management and ensure integration between M&E and budgeting systems. Off-budget funding was hard to account for it in overall sectoral planning and all types of ODA, including programs channeled off-budget to the private sector, were recommended to report openly their development results.

In addition to providing employment to more than half of the poor, Nicaragua's agriculture sector employs nearly a fifth of the non-poor.

Table 3.5 shows that its importance extends far beyond merely providing livelihoods for poor, small-scale producers. Moreover, these numbers do not include the multiplier effects when the agriculture sector's forward and backward linkages are accounted for; as already noted, these are particularly significant in the agro-industries of coffee, livestock, and sugarcane.

Reason #3: Because Agriculture, Natural Resources and Climate Change are inextricably linked

Nicaragua is faced with serious vulnerabilities arising from its high dependence on an agriculture sector that is particularly exposed to external weather shocks and changes in climate.

Droughts, floods, and the effects of increases in temperature increasingly represent a difficult challenge for Nicaragua's agricultural systems and the economy as a whole. Deforestation is aggravating the effects of temperature changes and rainfall precipitation in various micro climates (Figure 3.2).

At the same time the need for increased agricultural production is the main cause of deforestation and a major contributor to GHG emissions.

Erosion and soil degradation can simultaneously be the cause and effect of low agricultural production, in a vicious cycle based on common agricultural practices in Nicaragua. These practices expose soil to wind and water erosion, leading to deterioration of soil's physicochemical properties, which in turn reduces productivity, promoting further changes in soil use. Changing soil use by deforesting and establishing new crops and pastures on unprotected soil compounds the imbalance on the ecosystem. The predominant economic activity on most of these lands is a combination of basic grains and extensive livestock systems, which is strongly correlated with overgrazing, stomping, and GHG emissions. Once soil is unprotected, natural disasters like hurricanes and storms can severely affect the ecosystem even further.

Between 1990 and 2009, GHG emissions in Nicaragua increased by an annual average of 3.24 percent[4]

The agriculture sector contributes 12 percent of total GHG emissions in the country; the remaining 79 percent comes from land-use change and forestry, mainly due to the loss of forestland converted to other uses such as agricultural crops and extensive livestock systems. Nitrous oxide (N2O) emissions from nitrification and denitrification, mostly coming from crop residues and related processes in agricultural soils, represent 47 percent of total agricultural GHG emissions, while methane (CH4) emissions from livestock enteric fermentation make up another 41 percent (Figure 3.4). Other sources of agricultural emissions include manure management (5

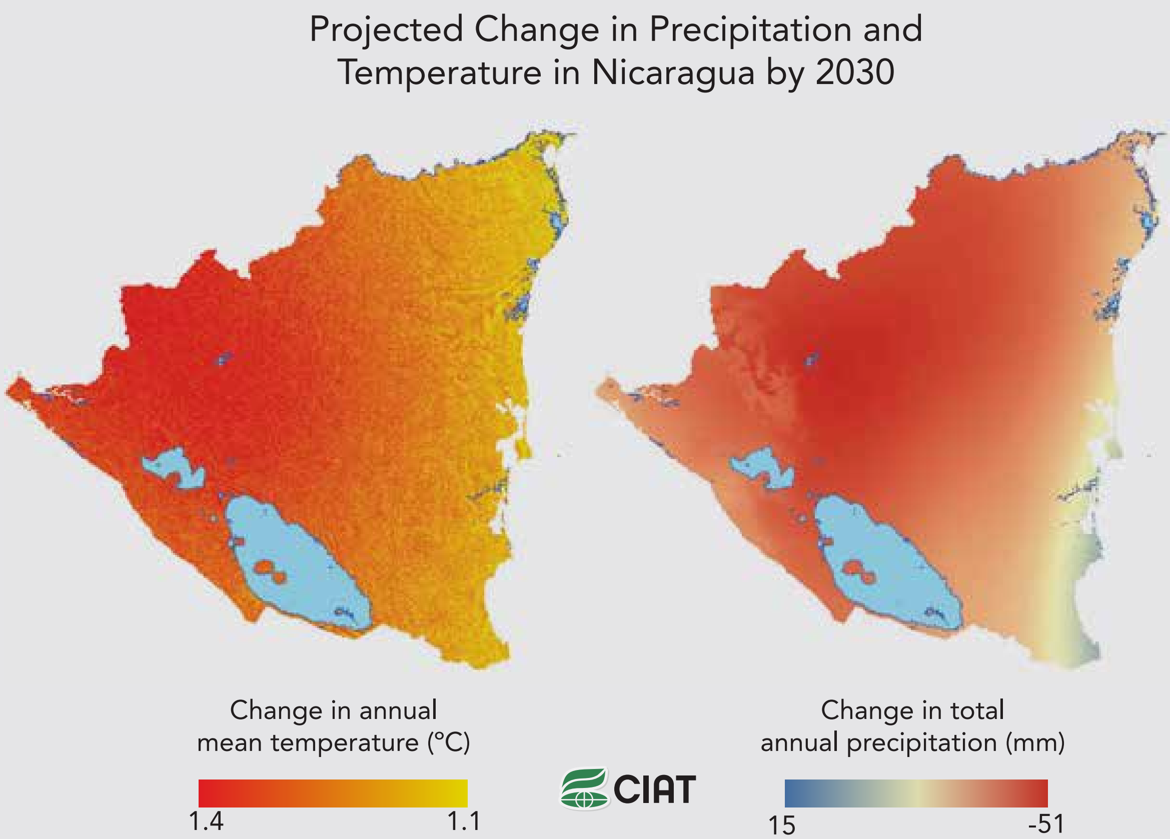
Table 3.5: Sectoral Contribution to Total Employment by Poverty Level (%), 2001, 2005, and 2009

Sector	Poor			Non-Poor			Total		
	2001	2005	2009	2001	2005	2009	2001	2005	2009
Agriculture	56.1	58.7	58.3	18.5	19.0	21.1	34.2	35.5	35.4
Mining	0.7	0.6	0.5	0.4	0.3	0.5	0.5	0.4	0.5
Manufacturing	8.2	10.7	8.9	13.6	16.6	12.7	11.4	14.1	11.2
Construction	4.7	3.6	3.7	6.3	5.5	4.8	5.6	4.7	4.3
Trade	11.3	9.8	11.1	25.6	25.6	23.1	19.6	19.0	18.5
Transport	3.8	3.3	3.4	9.6	8.3	10.3	7.2	6.2	7.7
Financial Services	1.0	0.9	1.4	3.6	4.1	4.5	2.5	2.8	3.3
Government Services	3.6	4.0	3.6	12.4	12.2	12.8	8.7	8.8	9.3
Community Services	10.7	8.5	9.1	9.9	8.4	10.3	10.2	8.4	9.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: LSMS 2001, 2005, and 2009.

4 ECLAC (2013)

Figure 3.2: Climate Projections Based on an Emissions Trajectory with a Representative Concentration Pathway (RCP) of +4.5



Source: CIAT 2015.

percent), rice cultivation (3 percent), and field burning of crop residue (3 percent) (CIAT 2015).

Within the agriculture sector, livestock is the main contributor to GHG emissions, with 80 percent (143 Gigagrams ,Gg) of the total CH4 emissions.

Methane's heat trapping properties are 30 times greater than that of CO2 and livestock is a major contributor to the production of this gas, which occurs from the fermentation of starch in livestock's rumen.

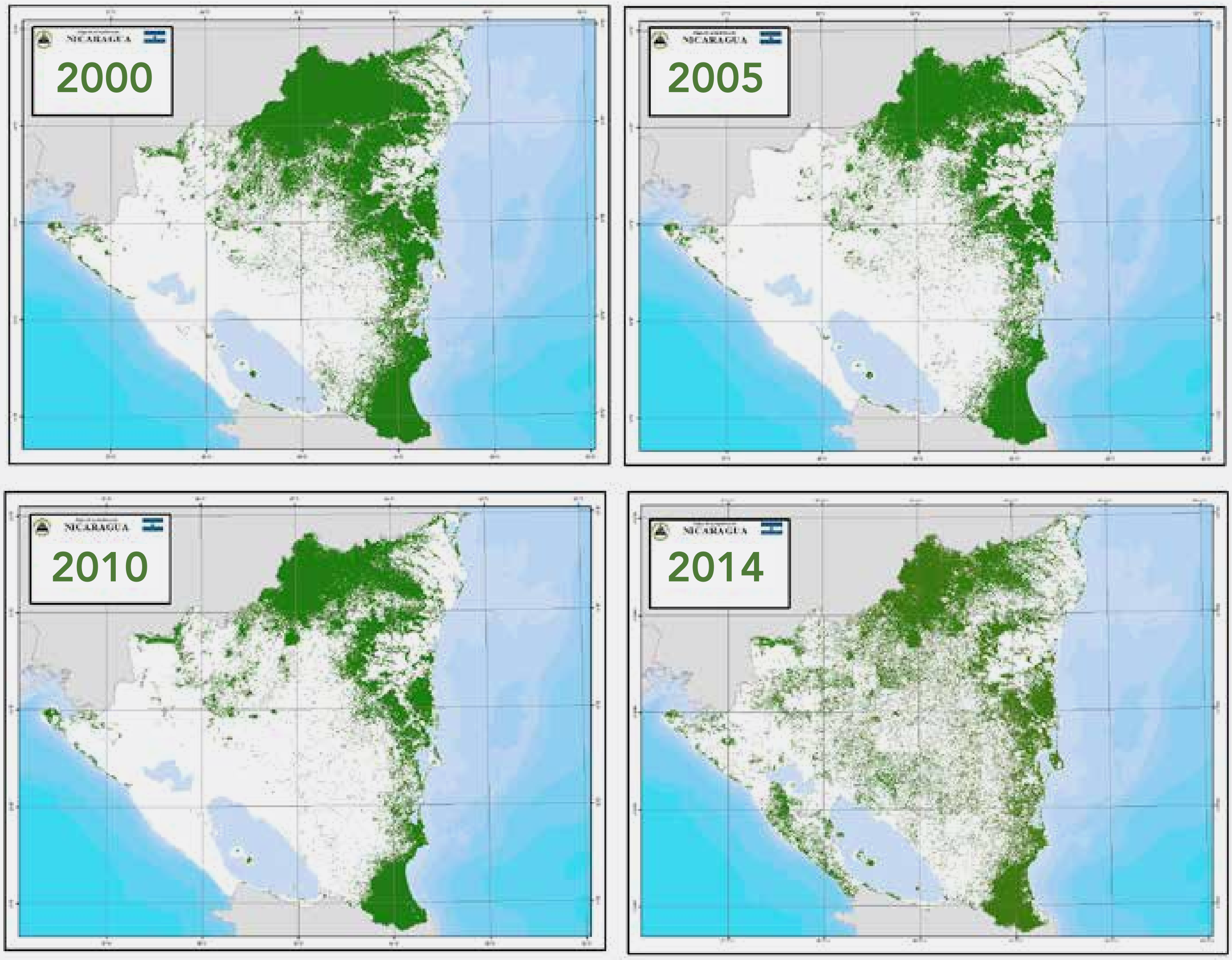
Roughly 25 percent of total land and about 60 percent of agricultural land in Nicaragua is dedicated to extensive livestock production based on extensive grazing with low technology and low land productivity.

In the last 10 years, meat and dairy production in Central America increased significantly, with pasture area expanding from 3.5 to 9.5 million hectares and cattle inventory increasing by almost the same proportion. Nicaragua has been the main livestock producer and exporter. This trend is expected to continue as global demand continues to grow, posing a key challenge for decision makers.

The main causes of biodiversity loss are changes in ecosystems through deforestation, fires, and contamination of water sources through unsustainable agricultural practices.

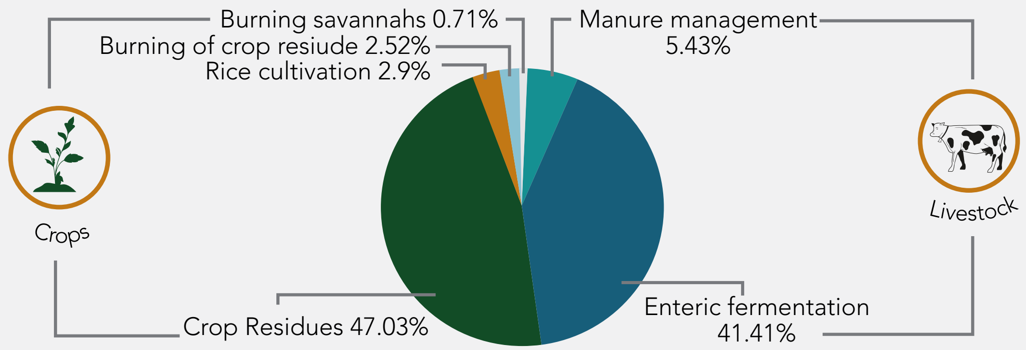
Deforestation is a major cause of biodiversity loss in the humid tropics of Nicaragua. Birds are the most biologically diverse group of vertebrates at the global level, widely used for monitoring biodiversity. A study in one of the most important agricultural regions of the country (i.e., Boaco, Chontales, Rio San Juan) measured changes in biodiversity due to changes in land use in 64 years from 1940 to 2004; of 27 key species of birds originally found in this region, none was observed (Belli 2010). Of five original key amphibians species,

Figure 3.3: Changes in Forest Cover in Nicaragua, 2000-2014



Source: MARENA 2015.

Figure 3.4: Methane Emissions (Gg) by Agricultural Subsector in Nicaragua



Source: CIAT 2015

only one was observed. From a baseline of three mammals, none was observed, and the same result was found for key species of butterflies. And a study in 2010 found the natural capital index (ICN) to have decreased from 64 percent in 1950 to 46 percent in 2010 (Belli et. al 2010) (Figure 3.5).

Despite being a major factor in environmental degradation, agriculture can be the solution to environmental stewardship

Investing in research and innovation in agricultural systems to make them more productive and profitable and conserve environmental resources is feasible and advantageous for the Nicaraguan society, as demonstrated by many promising ongoing initiatives. Agroforestry and silvopastoral systems increasingly play a key role in stabilizing the ecosystems in the buffer belts of Nicaragua's protected areas, such as the Bosawás Biosphere Reserve, strategic for biodiversity conservation. Sustainable agricultural practices and integrated systems can preserve soil fertility, increase water source sustainability, maintain biodiversity, and contribute to climate change mitigation.

One key strategy for mainstreaming resilience in farming systems is the concept and practice of climate-smart agriculture (CSA).

CSA is an approach for transforming and reorienting agricultural systems to revert environmental degradation under the new realities of climate change. It aims to achieve three simultaneous outcomes: (i) increased productivity; (ii) enhanced resilience; and (iii) reduced GHG emissions. A wide range of practices and innovative approaches can increase the "climate-smartness" of production, from agroforestry to rangeland management to climate and weather information services.

Reason #4: Because Nicaragua Food and Nutrition Security depends on agricultural performance

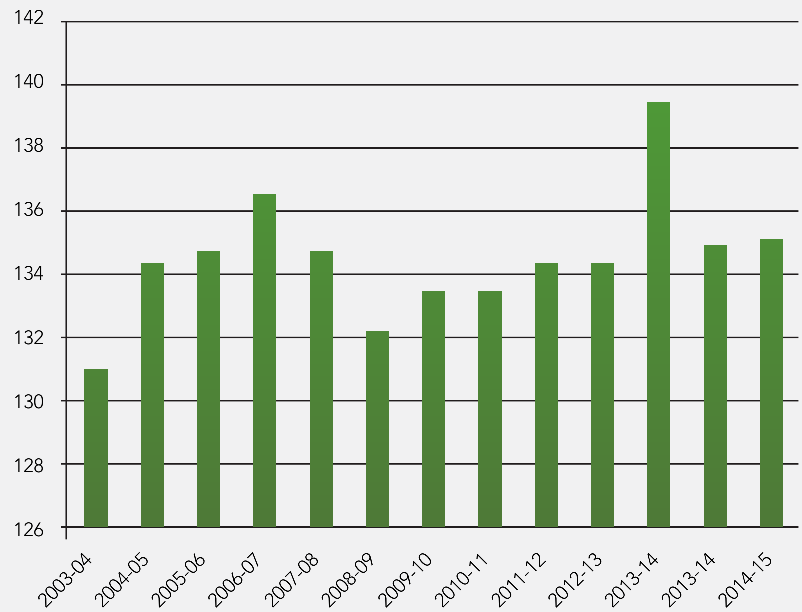
Availability of—and access to—food are necessary but not sufficient conditions for nutrition security. The latter is achieved when secure access to food is coupled with a sanitary environment, adequate health services, and knowledgeable nutrition care. Children and women of reproductive age are especially vulnerable given their particularly high nutrient requirements. Undernourishment taxes current and future economic growth by increasing mortality and susceptibility to diseases and by lowering labor productivity. The resulting decline in cognitive development in children, increased susceptibility to infection and chronic diseases for children and adults alike, and diminished labor productivity undermine human capital development critical for future economic growth.

Food and nutrition security are high on the agenda of the Nicaraguan government. Between 2003 and 2014 Nicaragua has consistently increased its aggregated availability of staple products (rice, maize, beef, chicken, and wheat). The production of cereals has been driven by smallholders and has been particularly dynamic, to the extent that beans exports are ranked in 7th place as Nicaraguan export products, without having affected the availability for domestic consumption. Nicaragua has also managed to increase cereals consumption vis-á-vis population growth, showing even upwards tendencies in per capita consumption (Figure 3.6). Despite repeated climate shocks during last years that negatively affected cereals production, Nicaragua has not requested emergency food aid since 2009 showing resilience and ability to achieve self-sufficiency and food security objectives. Higher food prices have two main effects on net buyers of food: an income effect through decreases in purchasing power of poor households and a substitution effect through shifts to less nutritious food.

Even with increased volatility in 2008, and again in 2011 higher food prices have not lead to higher levels of undernourishment. However, increased food availability can to a large extent be explained by the expansion of agricultural area advancing towards the agricultural frontier towards the Caribbean coast. These increases in area with only marginal increases in productivity might prove insufficient to keep with the per capita consumption levels for a population growing at 1.47 percent annually. In addition the agriculture sector has to meet the challenge of improving the quality of food consumption the traditional food diet of the rural households relies heavily on the consumption of rice, maize, and beans, wheat bread, sugar, and coffee, and to a less extent legumes. The contribution of carbohydrates to the total energy requirement is predominant, and the contribution of proteins and fats is low (Bonermann et al, 2013).

As changing trends in climate and continued environmental degradation will put further stress on food and nutrition security, a "business as usual" approach to agriculture will not automatically translate into improved nutritional outcomes for vulnerable groups of the population, nor will it necessarily be sustainable. In agriculture, specific nutrition-sensitive actions such as investing in agricultural research targeting female smallholder farmers, including biofortified crops, and improving nutrition knowledge to enhance dietary diversity must continue to be pursued to achieve full food security, including nutrition security.

Figure 3.5: Nicaragua Cereals Consumption per capita (Kg/yr)



Source: Authors based on FAO statistics.

SUMMARY OF REASONS TO INVEST IN NICARAGUAN AGRICULTURE

In the short to medium term, several valid reasons explain how agriculture can positively impact national development:

(i) the multiplier effects of the agriculture sector extend throughout the whole domestic economy via backward and forward linkages. In Nicaragua, an increase of 1 percent in agricultural GDP produces an increase of 0.6 percent in non-agricultural GDP, quite high relative to other Latin American countries; (ii) while the manufacturing and construction industries do not absorb workers from the agriculture sector, agriculture is still the largest employer of labor (especially of nonskilled workers), providing employment to more than half of the poor and around a fifth of the non-poor. Agriculture also provides a buffer for the poor: 65 percent of those living in poverty and 80 percent of those living in extreme poverty are in rural areas and subsist mainly from agricultural activities; (iii) given the inextricable links between climate change and agriculture, this sector is where gains can best be made in sustaining natural resources such as soil, water, and biodiversity and in mitigating climate change. At the same time, building resilience through adaptation and managing agriculture exposure to climate risks will continue to be high on the country's agenda as droughts, floods, and rising temperatures are reducing crop yields, endangering the food, fish, and meat supply, and threatening to push poor people deeper into poverty; and finally (iv) As changing trends in climate and continued environmental degradation will put further stress on food and nutrition security, a "business as usual" approach to agriculture will not automatically translate into improved nutritional outcomes for vulnerable groups of the population, nor will it necessarily be sustainable. In agriculture, specific nutrition-sensitive actions such as investing in female smallholder farmers, biofortified crops, and improving nutrition knowledge to enhance dietary diversity must continue to be pursued to achieve full food security, including nutrition security. These reasons support the argument that investing in agriculture makes social, economic, and environmental sense.

Despite the significant contribution of agriculture to the domestic economy and to society as a whole, the percentage of expenditures allocated to the agriculture sector in the national budget is only one-seventh of its contribution to GDP.

One way to evaluate the level of support from the public sector is the Agricultural Orientation Index (AOI),[5] which measures the relationship between spending on agriculture in the public budget and the contribution of agricultural GDP to national VA. Measurements higher (lower) than 1.0 indicate that a country spends proportionally more (less) on agriculture than the sector's contribution to the national economy. It should be noted that the AOI only analyzes agriculture's importance to the economy relative to total expenditures, and does not reflect the efficacy of how the money is spent or whether it improves productivity or reduces poverty.

The AOI indicates that over the last decade, the level of overall spending on rural development (rural infrastructure and agricultural universities) increased, but expenditures specifically aimed at agriculture (i.e. agricultural innovation systems) continued to fall, as illustrated by the case of PRORURAL, Nicaragua's main program for agricultural development. In 2011, the AOI was 0.62 for rural public spending, but only 0.21 for PRORURAL (Figure 3.6).

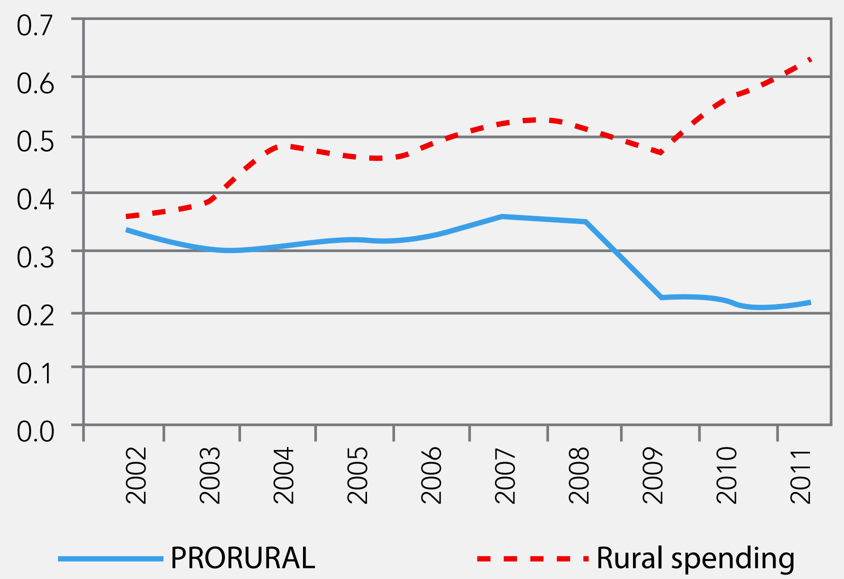
Renewed attention to the delivery of public goods would generally benefit a broader swathe of producers and could help to reverse the declining productivity in some agricultural products.

Finally, the agriculture sector's sharp duality presents a public policy challenge as Nicaragua find itself at a crossroad: the two main factors that have driven agriculture performance (favorable international prices and expansion of the agricultural frontier) are either circumstantial or reaching their limits.

With respect to the modern agricultural business sector, it raises the challenge of how to create an incentive framework by lowering transaction costs to attract investment (both domestic and foreign) to boost productivity and increase competitiveness. The modern business agriculture sector accounts for around 32 percent of the exports of primary products and has a greater capacity to respond to global markets and take advantage of the opportunities that international commercial integration has to offer. For policy makers, meanwhile, the more complex challenge is how to support the undercapitalized, heterogeneous, and fragmented family-based agriculture sector by formulating policies and targeting programs to small-scale family farms to optimize the generation of positive externalities associated with poverty, food security, and the environment.

To gain more insights into major constraints impeding Nicaragua from taking better advantage of trade opportunities and reducing poverty, Chapters 4, 5, and 6 address issues related to competitiveness, inclusiveness, and weather- and climate-related production risks. The findings of these three sections are later wrapped up in a final chapter with suggested areas for intervention.

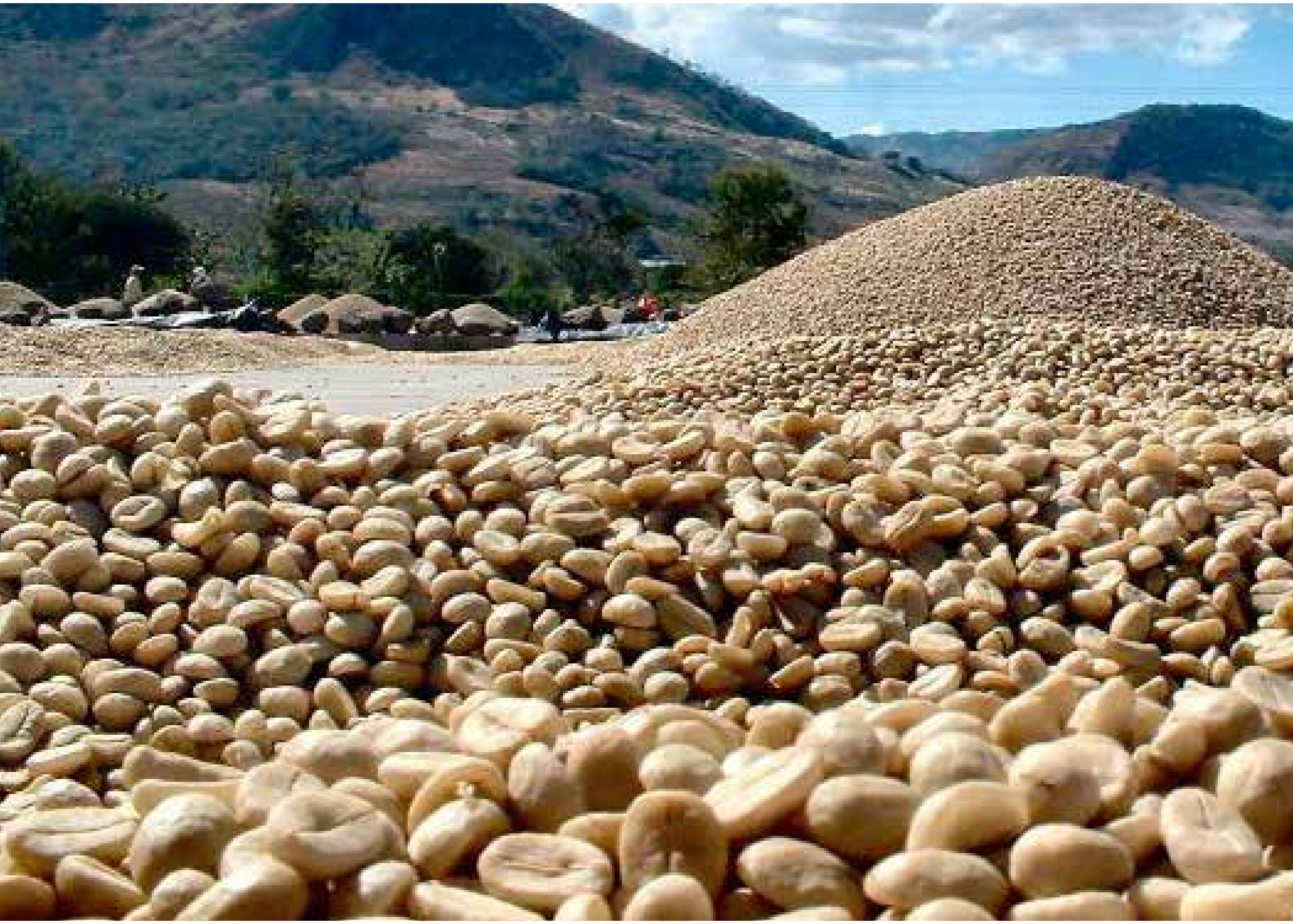
Figure 3.6: Agricultural Orientation Index of Public Spending in Nicaragua, 2002–2011



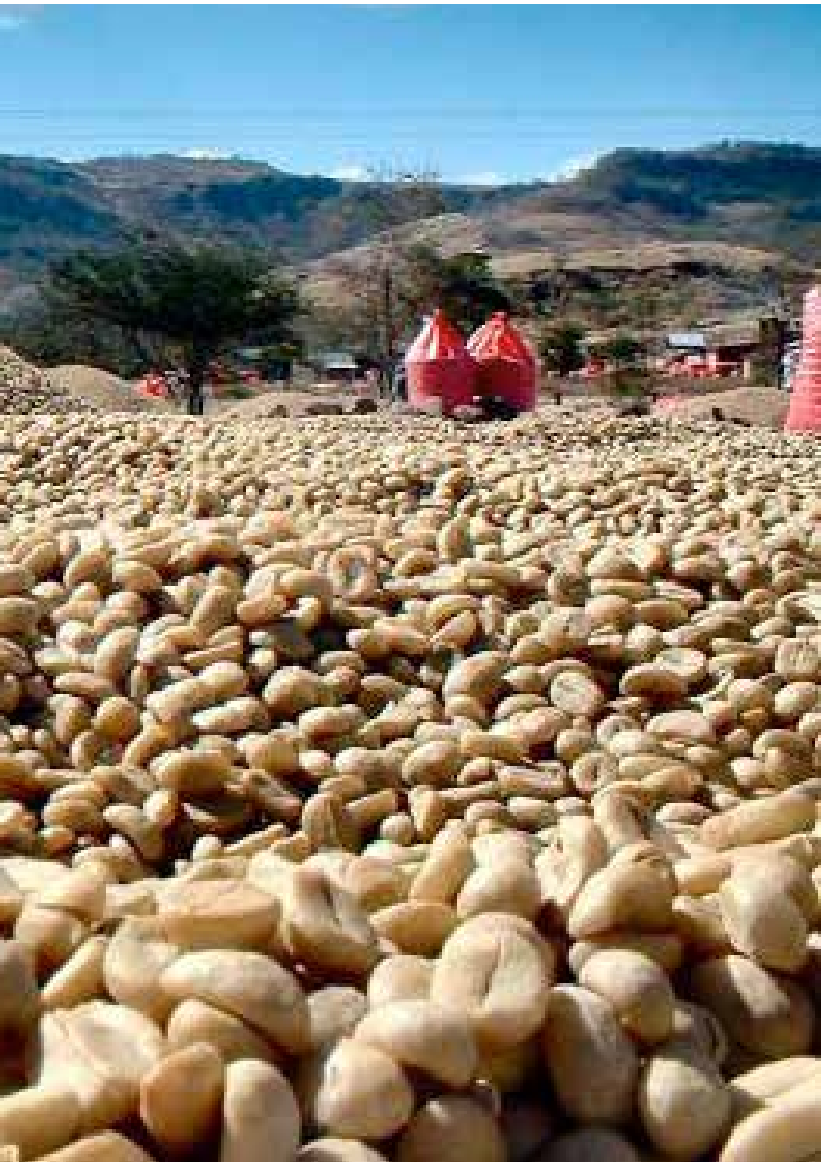
Note: For more consistent accounting over time, spending on rural roads and electrification was subtracted from PRORURAL totals. Rural spending here includes PRORURAL, rural infrastructure, and agricultural universities.

Source: World Bank 2014.

5 The AOI is calculated by dividing spending on agriculture as a percent of total public spending by agricultural GDP as a percent of total GDP.



Fair Trade Coffee Beans by William Neuheisel / CC BY 2.0



COMPETITIVENESS AND EFFICIENCY GAINS

CHAPTER 4

As an agriculture-led export economy, Nicaragua places a high priority on increasing competitiveness in the agriculture sector.

Foreign trade policies, regulations, assistance programs, and strategies to develop infrastructure have improved agricultural performance overall. However, breeding greater integration among the so-called "mega blocks" in the process of negotiations could erode the advantages for Nicaraguan exports with regard to market access of its exports to the European Union (EU) and the United States. The mains blocks in the process of advanced international negotiations are the EU/United States, the Transpacific Partnership (TPP), and the Regional Comprehensive Economic Partnership (the RCEP—the ASEAN[6] pact plus China, India, Japan, South Korea, New Zealand, and Australia). The EU/United States and the TPP are the critical ones for Nicaragua. Should Nicaragua participate in or remain outside these agreements? Should Nicaragua become a member of the Pacific Alliance, which could be a step towards eventually joining the TPP? Although the answers to these questions will ultimately be determined by the government's trade strategy, the choices will have major implications for agricultural exports.

4.1 TRADE INCENTIVES FRAMEWORK

An analysis of how current policies influence agricultural incentives is presented below. The levels and changes in the nominal and effective rates of protection are estimated from 2005 to 2010 for the main agricultural production commodities in Nicaragua, excluding livestock.[7] This is because given the high tradability of the sector and the small size of the economy, Nicaraguan agriculture is strongly affected by international prices (as a price taker), but these effects are mitigated by foreign trade policies, subsidies, and taxes that directly influence domestic prices. Policies involving incentives can be positive, benefiting farmers by reducing costs, or negative, equivalent to taxing farmers.[8]

4.1.1 Key findings of the Nominal Rates of Protection analysis

The analysis distinguishes between the impacts of trade and price policy on the domestic prices of export- and import-competing products received by producers and paid by consumers. Indicators influencing the nominal rates of protection (NRP) are presented at two levels: one, the simplest to interpret, is at the border level, which directly captures the tariffs and subsidies that reflect public sector trade policies; the second involves a direct comparison of border prices with respect to those received by producers (or paid by them for inputs) and corresponds to what in the literature on international trade is referred to as "tariff equivalent," expressed in percentage as a proportional tax (instead of a specific one). Its interpretation poses an important question about the impact of high domestic margins observed in the process of their estimation: relatively high margins reduce the effective price received for exportable products and raise the local costs of the inputs of imported agricultural products; that is, the higher prices of inputs (fertilizers, fuel, agrochemicals) represent a "tax" to farmers but also provide "natural protection" to producers of import-competing products by raising the reference benchmark price, and imply higher prices paid by consumers. It is worth mentioning that during the period examined, Nicaragua did not implement direct price policy interventions in the form of price controls for producers or consumers; hence, given world prices and the exchange rate, the two forces determining the observed price gaps vis-à-vis the relevant border prices are trade policy and the internal market structure, which affects gross margins, mainly transport costs and uncompetitive margins.

High protection of staple grains protects domestic production, benefitting small producers and increasing fiscal revenues but penalizing urban consumers.

Maize, rice, and sorghum show high protection via tariffs, on the order of 15, 60, and 20 percent, respectively (Table 4.1). These measures benefit the government accounts by generating revenues from tariffs and the higher domestic prices benefit producers of maize, rice, and sorghum. But these high prices penalize urban consumers. For example, as an approximation, with an NRP of 20 percent, low-income families who allocate 30 percent of their family expenses to food would see a loss of approximately 6 percent of their real disposable income. On the other hand, revenues generated from tariffs can potentially be used to support rural households, with a redistributional urban/rural impact. Tariffs also allow producers of these commodities (mostly small farmers) to achieve a better price (and therefore income).

6 Association of Southeast Asian Nations.

7 This analysis was carried out by Narváez (2015) in a background paper for the World Bank.

8 In studies that examine the impact of the policies that affect incentives, the indicators most used are nominal rates of protection (NRP), effective rates of protection (ERP), nominal rates of assistance (NRA), and the Producer Subsidy Equivalent (PSE) developed by the OECD, although the PSE also measures the impact of transfers and taxes, such as those used in the EU and the United States.

Current trade policies have managed to virtually eliminate the anti-export bias of the earlier decade from Nicaragua's commercial policy, making Nicaragua overall more competitive.

A study for the period 1991-2004 reported negative nominal rates of assistance (NRAs, similar to NRPs) for all exports except sugar for practically the entire period (Bethelon, Kruger, and Saavedra 2008). A similar analysis for the purpose of this study covering 2005-2010 estimates that the NRP at the border price level has reduced to virtually zero.

Table 4.1: Nominal Rates of Protection (%) at the Border Price Level (tariff on imports)

Product	2005	2006	2007	2008	2009	2010
Maize	15	15	15	15	15	15
Rice	60	60	60	60	60	60
SORGHUM	20	20	20	20	20	20
SOY	0	0	0	0	0	0

Source: Authors, based on Central American Tariff System

Table 4.2: Nominal Rates of Assistance (%) for Agricultural Commodities, 1991-2004

Product	1991	1991-94	1995-99	2000-04
Exports[a]	-15	-14.9	-29.1	-18.1
Coffee	-44	-33.1	-50.5	-22.8
Sugar	2	36	61.2	40.1
Sesame	-39	-10.6	-34.2	-40.5
Groundnuts	0	-9.1	-27.0	-34.5
Red beans	10	15.6	-6.7	-20.3
Beef	-10	-17.6	-32.4	-22.4
Milk	n.a.	n.a.	n.a.	--
Import-competing[a]	12	12.5	17.5	24.9
Maize	2	19.9	18.4	15.6
Rice	-10	-9.5	19.0	47.0
Sorghum	-33	-19.6	-11.5	-10.0
Soybeans	31	25.1	-16.2	--
Milk	65	28.6	13.5	26.2
Chicken	94	85.8	40.6	-9.9
Total covered products[a]	-8	-7.1	-16.4	29.8
Dispersion, covered products[b]	42	40.1	35.7	29.8
% coverage, at undistorted prices	80	83.9	86.9	86.2

Note: n.a. = not applicable (no data available); [a] Including product-specific subsidies; [b] Dispersion is a simple five-year average of the annual standard deviation around the weighted mean.

Source: Berthelon, Kruger, and Saavedra 2008.

The comparison of farm gate prices with border prices adjusted for margins shows that producers of export commodities receive prices between 30-40 percent below the farm gate price (Table 4.3).[9]

This result warrants close attention as it shows room for improving the competitiveness of Nicaragua's foreign trade. The observed margins are not influenced by the trade policy as such, rather they possibly reflect a domestic trade structure with high concentration and limited competition (oligopsony) as well as high domestic transport and transaction costs.[10] A deficient road system substantially increases the cost of transport from the farm to the point of shipment and vice versa.

4.1.2 Key findings of the Effective Rates of Protection analysis

The effective rates of protection (ERP) report the effect on producers' net income (VA) by capturing the joint (net) impact of interventions on the prices of products and tradable inputs, reflecting the VA per ton. Producers' net income is the most influential factor when they decide whether or not to increase or reduce their investment in a particular activity. The value of the ERP reflects the relationship between the VA per ton obtained by producers compared with the VA that would have obtained in the absence of intervention (free trade); it can be positive, zero, or negative. The ERP includes the impact of tariffs not only in the final product but also in the price of the traded inputs, hence its relevance in estimating the impact of policies on producers' income. ERPs are valuable for analytical purposes since they indicate the comparative advantages of the sector and provide comparisons of products, which generate a ranking of the most competitive activities relative to the international markets. "High" ERP values indicate low competitiveness.

For most of the products and years covered in the studies, the ERP calculations indicate a range of disincentives to production.

Overall ERP calculations show that the generation of VA at farm gate prices is low due to the high participation of

Table 4.3: Estimates of the Nominal Rates of Protection (%) at Farm Gate Price

Year	Import-competing				Exports			
	Maize	Rice	Sorghum	Soy	Beans	Green Coffee	Peanuts	Sesame
1994	31%	-23%	-16%	10%	-19%	-41%	-17%	29%
1995	2%	19%	-22%	15%	-6%	-61%	-25%	-37%
1996	17%	-3%	-24%	-38%	-15%	-36%	-14%	-30%
1997	27%	25%	-5%	-38%	-10%	-52%	-32%	-14%
1998	33%	34%	0%	-23%	15%	-58%	-33%	-44%
1999	22%	30%	-6%	-2%	-5%	-42%	-11%	-41%
2000	58%	73%	6%	-7%	-12%	-30%	-14%	-46%
2001	14%	51%	-1%	-5%	-27%	-13%	-40%	-30%
2002	14%	65%	-25%	-23%	-13%	-5%	-26%	-38%
2003	-11%	24%	-18%	-32%	-29%	-43%	-38%	-42%
2004	10%	37%	-20%	-54%	-1%	-17%	-33%	-42%
2005	8%	186.9%	45%	-96%	n.a	-5%	-43%	-31%
2006	-15%	5.9%	n.a	42%	n.a	-9%	-37%	-48%
2007	45%	4.9%	300%	-38%	n.a	-14%	-46%	-36%
2008	n.a	16.0%	n.a	-89%	-30%	-2%	-62%	-26%
2009	3%	85.3%	-21%	-91%	-28%	-22%	-33%	-19%
2010	-13%	33.7%	29%	-79%	-5%	-21%	-39%	-19%

Note: The period 1994-2004 was estimated by Berthelon, Kruger, and Saavedra 2008.

Source: Authors, based on information from the Central Bank and other sources.

9 The direct price comparison estimates the border price equivalent at farm gate price (to compare the effective price received by the producer), thus adding measurable margins like transport, packing, logistics, commissions, etc.. In importables, they are added to the border price without tariffs. In exportables, they are deducted from the border price without taxes.

10 Relevant empirical evidence on market structure as impediments for an efficient price transmission can be found in World Bank (2011c)

intermediate inputs in the cost structure, or that the price of the final product is low. This does not imply that producers' income is negative (in which case there would be no production). Rather it reflects that producer's income, measured by VA per ton, is lower than it would be in the absence of interventions in border prices (considering the interventions for the final product and for the inputs; see Table 4.4).

These numbers raise a flag and should be carefully monitored, as experiencing long periods under such a state of "desprotection" is equivalent to imposing an implicit tax on production. It has an adverse effect on investment, innovation, and modernization in the agriculture sector and reduces producers' incomes.

Some exceptions to the pattern were found, as maize and rice had positive ERPs for some years.

The ERP for maize has both negative and positive values. These changes can be accounted for by the price variations for final products, since the expenses for intermediate goods are very similar in both at domestic and at international prices. The fluctuations in product prices were already captured in the NRP results at domestic prices and confirmed by the results of the ERP. Rice also has both negative and positive ERP values. In 2005, its ERP was 97 percent, meaning that producers' incomes or the VA were higher than in the international market. This value was directly influenced by the prices of the final product, as producers were paid C$182.35 per quintal of rice, while the price on the international market was C$95.51. This price differential increases the gross value of production appraised at domestic prices and makes the domestic VA higher than that appraised at international prices. Since intermediate consumption of agrochemicals did not vary much in either market, the results of the ERP were determined by the price of the final product, not by the price of intermediate goods. However, in 2006, 2007, 2008, and 2010, rice production was "unprotected" with respect to the border price, as a result of increases in international prices of the final product, which were not reflected in an increase in domestic prices.

Table 4.4: Estimates of the Effective Rates of Protection (%), 2005-2010

Product	2005	2006	2007	2008	2009	2010
Maize	19	-26	108	n.a.	6	-22
Rice	97	-38	-40	-35	15	-21
Sorghum	-256	n.a.	-227	n.a.	-37	190
Soy	-97	52	-41	-90	-92	-80
Red Beans	n.a.	n.a.	n.a.	-48	-213	-30
Green Coffee	-66	-74	-73	-68	-75	-75
Peanuts	-44	-38	-47	-63	-33	-39

Source: Authors, based on information from the Central Bank and other sources.

4.2 CONSTRAINTS TO COMPETITIVENESS[11]

What prevents Nicaragua from taking greater advantage of commercial opportunities to increase agricultural productivity?

The answer lies in a combination of factors that limit its economic performance. Nicaragua owes its comparative advantage in agricultural production to a stable macroeconomic framework, low rates of crime and violence, a low-wage labor force, and the quality and abundance of its land. However, it faces serious challenges with regard to improving its infrastructure, training a skilled labor force, providing core services (electricity and financial services), and developing its transport and logistics services.

Given that economic growth in Nicaragua has largely been driven by the export sector, transport and logistics have played and will continue to play a critical role in agricultural development.

With the advent of free trade agreements, logistics costs became increasingly important. According to World Bank studies on agriculture in Latin America, logistics costs now represent a greater barrier to trade than import tariffs. Transport and associated logistics services play an important role in driving competitiveness and inclusive growth. Bottlenecks exist in the different aspects of the logistics system in Nicaragua, including infrastructure, services, and procedures. Successful trade, especially for perishable products, depends on the ability to move products from producers to final consumers at low cost. Achieving this depends on the efficiency of the related logistics systems and the ability to connect effectively and reliably to global supply chains. A holistic and multipronged approach -- one that would aim to improve these three interrelated areas -- would work best to improve Nicaragua's logistics system.

11 This section heavily relies on the findings of World Bank (2013).

Nicaragua has consistently received very low performance scores on macro indicators related to transport and logistics, although they have improved in recent years.

According to the World Economic Forum's World Competitiveness Index, Nicaragua is rated lowest in Central America in terms of general infrastructure, although it does seem to have made notable recent progress.[12] Similarly, the World Bank's Logistics Performance Index (LPI) points out Nicaragua's relative disadvantage in terms of infrastructure quality. On a scale of 1 to 5, Nicaragua received an overall LPI score of 2.54, ranking 107th (out of 155 countries) in 2010 (Table 4.5).[13] Overall, Nicaragua trails the averages for Central America, LAC, and lower-middle-income countries (MIC). Apart from low infrastructure quality, the LPI suggests that Nicaragua has considerable room for improvement in other logistics components, especially in "Customs" and "Logistics Competence." Nicaragua's progress in recent years is evident, however, as it moved up from the 122nd place overall in 2007 to the 107th place in 2010.

Overall, transport and logistics costs account for a significant portion of final prices of goods in Nicaragua (48 percent in the case of corn imports).

Since high transport and logistics costs primarily affect traditional import and export products, they have direct implications for trade competitiveness. Small and medium enterprises (SMEs) and the rural poor are disproportionately affected by high transport and logistics costs. SMEs typically face considerably higher logistics costs due to scale disadvantage and longer distances. Box 4.1 presents a case study of Nicaragua's meat supply chain.

Table 4.5: Comparison of Logistics Performance Scores in Central America, 2010

Rank	Country	LPI Score	Customs	Infrastructure	International Shipments	Logistics Competence	Tracking/ Tracing	Timeliness
51	Panama	3.02	2.76	2.63	2.87	2.83	3.26	3.76
56	Costa Rica	2.91	2.61	2.56	2.64	2.80	3.13	3.71
70	Honduras	2.78	2.39	2.31	2.67	2.57	2.83	3.83
86	El Salvador	2.67	2.48	2.44	2.18	2.66	2.68	3.63
90	Guatemala	2.63	2.33	2.37	2.16	2.74	2.71	3.52
107	Nicaragua	2.54	2.24	2.23	2.63	2.31	2.51	3.21
	CA Avg*	2.80	2.51	2.46	2.50	2.72	2.92	3.69
	LAC Avg*	2.74	2.38	2.44	2.70	2.61	2.83	3.41
	Low MIC*	2.59	2.23	2.27	2.66	2.48	2.58	3.24
	HIC	3.55	3.36	3.56	3.28	3.50	3.65	3.98

Note: *Excludes Nicaragua.

Source: Logistics Performance Index (International LPI), World Bank.

12 Survey respondents were asked: "How would you assess general infrastructure in your country?"

13 The International LPI provides both quantitative and qualitative evaluations of countries in six areas: i) efficiency of the clearance process (speed, simplicity, and predictability) by border control agencies; ii) quality of trade and transport-related infrastructure (roads, ports, railroads, and IT); iii) ease of arranging competitively priced shipments; iv) competence and quality of logistics services (transport operators, customs brokers); v) ability to track/trace consignments; and vi) timeliness of shipments in reaching destination within the scheduled delivery time.

Box 4.1: Logistic Costs in Nicaragua's Meat Supply Chain

Beef is Nicaragua's second-largest export by value (after coffee) and by volume (after sugarcane), so logistic bottlenecks in this sector can produce large effects on the economy. This supply chain study focused on exports to the United States -- the main destination for frozen ground beef exports for the past seven years. In Nicaragua, 65 percent of the bovine population resides on small (less than 16 animals) and medium (between 16 and 60 animals) farms, which together represent 94 percent of the country's total farms.

Upon leaving the slaughterhouse, most beef exports travel 800 kilometers over land to either Puerto Cortés in Honduras or Puerto Limon in Costa Rica.[14] Between 2006 and 2010, the proportion of total beef exports traveling through the border crossing at Peñas Blancas and on to Limon more than doubled. Shipping agencies' route preferences reflect changes in destination markets in recent years. In addition, the route to Limon may be preferred due to shorter crossing times at the Costa Rican border, and due to security concerns on the road to Cortés. Figure A illustrates the ways beef exports traveled out of Nicaragua in 2010, while Figure B shows the route chosen for this supply chain -- from Juigalpa to Puerto Cortés.

In the supply chain for meat, the route from farm to port can be divided into two parts: (i) from the farm to the slaughterhouse, and (ii) from the slaughterhouse through the border crossing and to the port. Long distances, poor roads, and delays in receiving the animals at the slaughterhouse can more than triple transport expenses during the first part of the journey. Furthermore, the animals may be forced to go without feed for two extra days, which directly affects their weight and, in turn, producers' margins. For example, it takes 3-15 hours to pass through the border crossing of Las Manos. After crossing into Honduras, the truck has to travel another 427 km to arrive at Puerto Cortes, running the risk of highjacking and robbery along the way. Delays at weigh stations result in more lost time and the possibility of incurring fines, which range from US$16 per container (for the first offense) to more than US$1,000 (for recurring offenses). Logistics costs for the route from Juigalpa to Puerto Cortes are US$0.40 per kilogram, or 11 percent of the wholesale price for a kilogram of frozen ground beef. In some cases, total logistics costs, after accounting for time and additional expenses, run nearly double this, reaching as high as US$0.77, or 21 percent of the final price (World Bank, 2013).

14 Beef containers that cross the border through Las Manos usually head towards Cortés and onto a final destination on the east coast of the United States. Containers that travel through El Guasaule or El Espino often travel towards Puerto Acajutla in El Salvador, where they will proceed on to Pacific destinations (either Los Angeles or Asia). Beef containers that travel south into Costa Rica through the Peñas Blancas border crossing mostly head to Puerto Rico, Venezuela, or the United States.

Border crossings represent the biggest constraint for cost-effective and reliable delivery of Nicaraguan imports and exports.

Although some important progress has been made in recent years to facilitate the crossing of borders, plenty of room remains for improvement. Some of the main issues include a lack of coordination between border agencies, burdensome processes and procedures, and antiquated equipment or systems to carry out inspections. Consequently, delays and uncertain waiting times at borders can significantly increase transport and logistics costs (World Bank 2013).[15]

A holistic approach – one that deals with the main logistics bottlenecks described in this analysis -- would work best to improve Nicaragua's logistics system. Results from this report's analyses point to the following priorities for Nicaragua's logistics agenda: (i) logistics services; (ii) infrastructure; and (iii) institutions and regulations. Suggestions for strengthening this approach are detailed in Chapter 7.

4.3 AGRICULTURE PRODUCTIVITY IN NICARAGUA: INSIGHTS FROM KEY SUBSECTORS

Nicaragua has a large untapped potential to increase its agricultural production through intensification, optimization of land uses, and sustainable expansion of the agricultural frontier. Among Latin American nations, Nicaragua has the eighth lowest proportion of cultivated land to arable land (land suitable for growing crops/grazing, respectively, excluding forest and protected areas). Nicaragua's "performance gap" (i.e., the difference between real and potential production) is the third highest in the region (World Bank 2011).

While overall productivity in Nicaraguan agriculture as measured by total factor productivity (TFP) has somewhat improved, it remains well below its potential compared to that of the top performer in Central America.

As illustrated in Figure 4.1, the pattern of growth in agriculture TFP in Nicaragua during the decade of the 1990s was positive. The coffee crisis from 2000 to 2004 produced a deceleration, but this was followed by a significant recovery. Overall, Nicaragua's TFP trends exhibit similar patters to those of El Salvador and Guatemala (although in these countries the impact of the coffee crisis at the beginning of the 2000s was less pronounced),however the gap between the TFP of the top performer (Costa Rica) and the rest of the countries in the region remains very wide (Figure 4.1).[16]

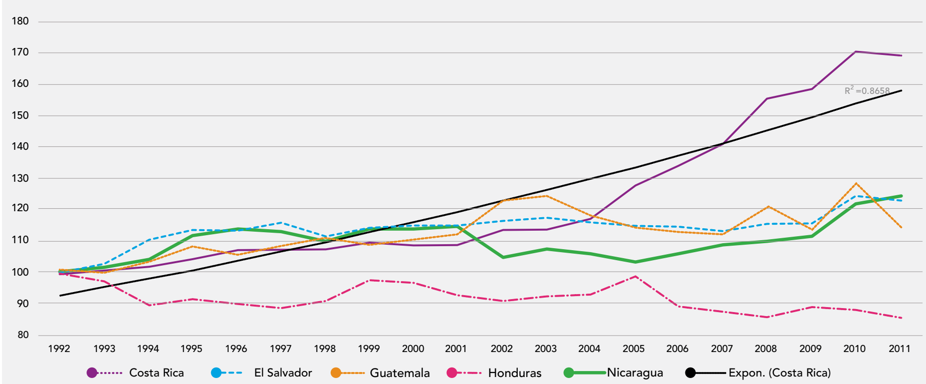
Nicaragua's land productivity growth is the lowest among regional peers and remains a significant challenge to sectoral growth and achievement of further gains in poverty reduction.

In Nicaragua, the average value generated is only US$717/ha (constant US$); this is between 40-60 percent of average figures for Honduras, El Salvador, and Guatemala, and only 16 percent of Costa Rica's value of land productivity. Even Honduras produces twice the output per hectare in value terms, despite showing lower overall TFP (Figure 4.2). Examples of productivity gaps for specific crops/livestock between Nicaragua and regional averages expressed in yield/area are presented in Table 4.6.

On the other hand, recent regional estimates of agricultural TFP for the period 1991-2011 indicate that Nicaragua is second after Costa Rica (USDA/ERS 2013).

Agriculture labor productivity in Nicaragua has increased, although at a lower rate than has occurred in Costa Rica (Figure 4.3). In Nicaragua, the gains can be explained by the increasing agricultural output –mainly due to agriculture area ex-

Figure 4.1: Annual Indices of TFP for Agriculture in Central America



Source: USDA/ERS 2013.

15 The new border crossing being constructed near Santa Fé has the potential of facilitating trade flows and tourism along the border with Costa Rica and will likely reduce logistics costs by shortening the distance and transport times between production zones in the area and Costa Rican ports. The new facility will likely reduce the heavily congested Peñas Blancas crossing. If border procedures remain inefficient, however, the potential of this substantial infrastructure investment to promote trade could be undermined.

16 Cervantes-Godoy & Dewbre (2010) conducted a study of twenty countries that were able to significantly reduce poverty the past few decades. In the case of Nicaragua, they found that growth in the agricultural sector was an important factor in reducing poverty; positive rates of growth in TFP was a contributing factor.

pansion– and reduction in number of people employed by the sector.

These findings reinforce the concern that the current model of increasing agricultural output via land expansion is unsustainable.

Improvements in productivity through investments in research and extension services aiming at agricultural intensification are needed to support a more sustainable pattern of sectoral growth and support poverty reduction objectives. To contribute to more informed decision making, the levels of productivity and efficiency in the agriculture sector are examined below, with a specific focus on productive efficiency in three key subsectors: coffee, milk, and red beans.

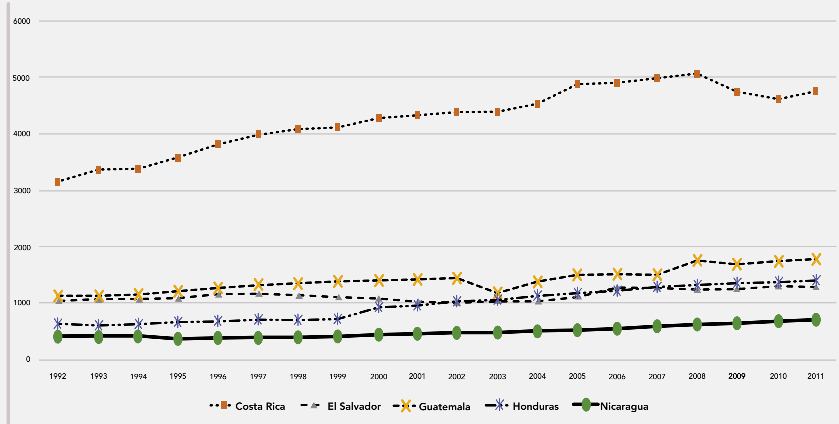
4.3.1 Productivity in coffee, dairy, and red bean production

This section presents an analysis of efficiency in the use of resources for the production of coffee, dairy, and read beans. These sub-sectors were selected due to their economic and social relevance, including the involvement of a large number of small-scale producers.[17] The analysis seeks to identify entry points to improve the effectiveness of interventions supporting competitiveness gains at the sectoral level, as well as those focusing more on improving opportunities for small-scale farmers.

The analysis of production efficiencies suggests that a large gap in productivity exists across subsectors.

The analysis of production efficiencies focused on assessing productivity gaps, calculating the functions of productive and technical efficiency.[18] According to the findings, a highly efficient coffee producer

Figure 4.2: Land Productivity (constant US$/ha), Select Central American Countries



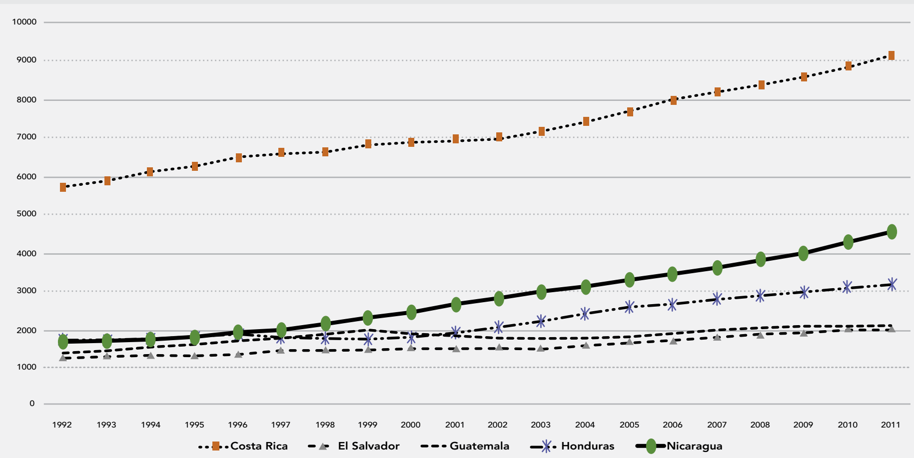
Source: USDA/ERS 2013.

Table 4.6: Productivity (yield/ha) of Key Commodities in Central America and Nicaragua

Product	Central America (average)		Nicaragua vs Central America
	Nicaragua	Central America	
	kg/live animal		Contribution
Meat	151.8	192.2	0.79
Milk	748.1	1,272.0	0.59
	kg/ha		Contribution
Sugarcane	46,614.4	70,406.9	0.66
Beans	315.4	783.3	0.40
Rice	2,500	3,100	0.81
Coffee	388.6	689.2	0.56
Maize	529.8	2,205.8	0.24
Sorghum	829.0	1484.9	0.56
Cacao	362.7	930.3	0.39

Source: Martínez Valle 2015.

Figure 4.3: Labor Productivity (constant US$/PEA occupied in agriculture), Select Central American Countries, 1991-2011

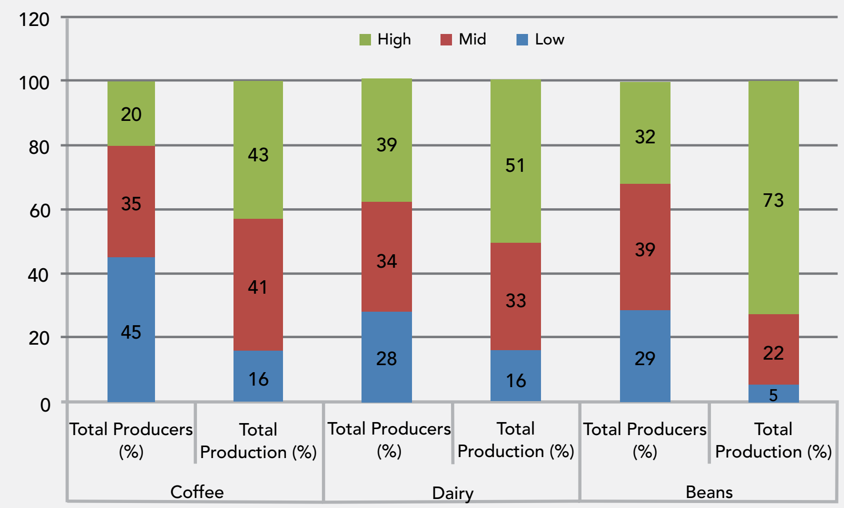


Source: USDA/ERS 2013.

17 It is estimated that in 2014, the contributions to agricultural GDP by the livestock, coffee, and grain subsectors were 35.2 percent, 11.8 percent, and 12.4 percent, respectively. It is also estimated that of the 262,564 agriculture producers in Nicaragua, about 44,519 are involved in coffee production, while the figures for livestock and beans production are 137,879 and 99,222, respectively.

18 Stochastic frontier analysis carried out by Rodríguez and Pérez (2015) in a Background Paper commissioned by the World Bank for this sectoral study. Coffee, beans, and dairy were also the subsectors with enough information to identify the determinants of productivity using CENAGRO 2011.

Figure 4.4: Levels of Productive Efficiency in Coffee, Dairy, and Bean Production as a % of Number of Producers and Total Production



Source: Authors based on data from CENAGRO 2011

Table 4.7: Estimates of Land and Labor Productivity and Levels of Efficiency

Product	Level of efficiency	Yield (kg/mz)/ (liters/cow)	Productivity of permanent labor force (kg/UTP)	Productivity of temporary labor force (kg/UTP)
Coffee	High	500	1,951	210
	Medium	280	1,274	133
	Low	97	452	59
	Aggregate	354	1,765	250
Dairy	High	4.03	54.45	11.43
	Medium	3.57	30.11	5.75
	Low	2.8	12.28	2.3
	Aggregate	3.4	29.93	5.82
Beans	High	588	3,376	462
	Medium	325	1,060	150
	Low	132	335	51
	Aggregate	242	1,114	127

Source. Authors' estimations based on CENAGRO 2011

reaches 77 percent of productive capacity, as defined by the production function; for milk, the figure is 81 percent, and for beans, 62 percent.

The gap between producers displaying high efficiency and those with low efficiency levels is significant, reflecting the duality that characterizes the sector.

An important proportion of the productive units in the three subsectors displayed low levels of production efficiency (Figure 4.4), meaning they achieved less than 25 percent of productive potential as a function of resources invested. In coffee, for example, productive units displaying high efficiency levels produced on average 5.2 times more output per land unit, 4.3 times more output per permanent worker, and 3.6 times more output per temporal worker than those with low efficiency levels. As a function of resources invested, and for the year of analysis, coffee reached only 37 percent of its potential, beans 41 percent, and dairy 47 percent.[19]

The analysis of labor (seasonal and permanent) and land factors suggests that even among those producers displaying high efficiency levels, room exists for improvement *(Table 4.7).*

For coffee, land productivity among low productive efficiency units was 19 percent of those displaying high productive efficiency levels; for beans the figure was estimated at 22 percent. For dairy production, labor productivity had a higher relevance, explaining the disparities between efficiency levels. For example, in the case of seasonal labor, producers displaying low efficiency levels had a productivity of only about 20 percent of those with high efficiency levels. This figure was 22.5 percent for permanent labor. This could be explained by the scale of dairy produc-

19 When interpreting these figures, it is important to take into account that other variables relevant to the determination of productivity levels (e.g., related to natural capital - soil quality, microclimates, geographical aspects, etc.) were not considered in the study.

tion, as 48 percent of the units displaying low efficiency levels had a herd of 10 or less head of cattle and 91.5 percent had 50 or less.

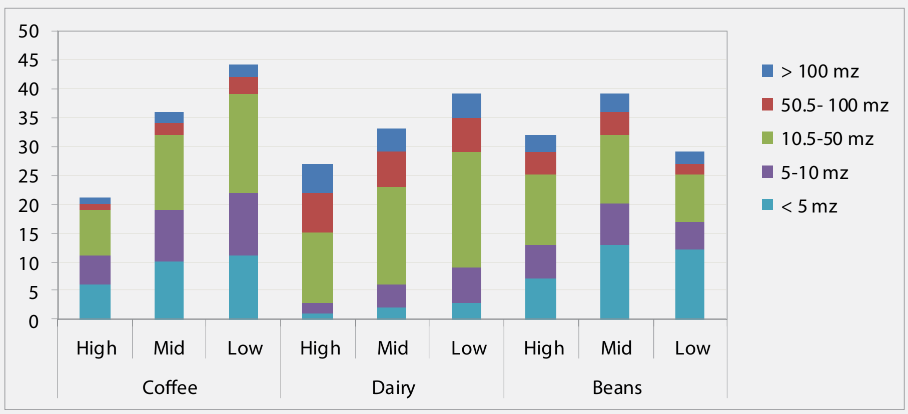
The size of the productive unit is a differentiating variable in the level of efficiency for dairy and bean production, but not for coffee production, suggesting that economies of scale might be less relevant in the latter.

Production units with less than 10 mz[20] represented less than 15 percent of the high efficiency units for coffee and bean production; for dairy, the figure was only 3 percent. The shares of production units smaller than 10 mz, of the total units reporting low productive efficiencies, were 22 percent and 17 percent for coffee and beans, respectively. Although the size of the productive unit is a differentiating variable in the level of efficiency for dairy and beans—subsectors with clear economies of scale— low efficiency levels are observed throughout the spectrum of production units, regardless of their size *(Figure 4.5).*

Low to medium levels of productive efficiency are not exclusive to transitional or subsistence producers.

For the analysis, family agriculture was characterized into three types (subsistence, transitional, and commercial) versus one single type of business agriculture (Chapter 5 contains details of the methodology and typology). The results displayed in Table 4.8, found that in the three subsectors analyzed , a proportion of between 17-35 percent of subsistence and transitional producers displayed high levels of efficiency,; thus suggesting that subsistence and transitional producers can in fact be efficient in the use of resources Among subsistence producers, the largest proportion of inefficient farmers are found in the dairy sector (50 percent). The data also suggest that large inefficiencies exit at the level of more commercial/business oriented farmers. For dairy and coffee, a large proportion (42.8 percent for milk and 47 percent for coffee) of business agriculture displayed low levels of efficiency; in coffee and dairy in particular, the results are shocking, only 19 and 25 percent of the business oriented farmers displayed high levels of efficiency. Consequently, the overall data suggest that important productivity gains can be achieved through efficiency improvements among all segments of farmers; however, in consideration to the weight of family farming (subsistence, transitional, and commercial producers) in the total number of producers in the three sub-sectors analyzed, efficiency improvements in these segments are particularly critical to support liveli-

Figure 4.5: Productive Efficiency Levels Relative to Land Size (%)



Source: Authors' estimations based on CENAGRO 2011

Table 4.8: Levels of Productive Efficiency by Producer Typology (%)

Type of producer	Subsistence			Transition			Commercial			Business Agriculture		
Efficiency	High	Med.	Low	High	Med.	Low	High	Med.	Low	High	Med.	Low
Coffee	22.1	36.3	41.6	17.0	31.9	51.2	22.5	36.7	40.8	19.7	33.3	47.0
Beans	23.0	40.7	36.3	35.0	38.8	26.1	37.3	38.2	24.5	35.5	36.6	27.9
Dairy	17.5	32.5	50.0	28.1	33.9	38.0	29.4	33.2	37.4	25.3	31.9	42.8
Average	20.8	36.5	42.7	26.7	34.9	38.4	29.7	36.0	34.2	26.9	33.9	39.2

Source: Authors' estimations based on CENAGRO 2011

20 Mz: manzana, unit of measure equivalent to 0.7 hectare.

Table 4.9: Levels of Productive Efficiency by Poverty Category (%)

Poverty	Cluster Red Beans				Cluster Dairy				Cluster Coffee			
	High	Med.	Low	Total	High	Med.	Low	Total	High	Med.	Low	Total
Extr. poor	3.8	6.3	5.7	15.8	1.9	3	4.5	9.5	2	4	6.1	12
Poor	8.9	12.7	10.7	32.2	5.5	8.4	11.4	25.2	5.7	11	15.5	32.3
Non poor	19.5	20.2	12.3	52	20.2	22.2	22.9	65.3	12.7	19.8	23.2	55.7
Total	32.1	39.2	28.7	100	27.6	33.6	38.8	100	20.4	34.8	44.8	100

Source: Authors' estimations based on CENAGRO 2011

hood improvements. Furthermore, as illustrated in Table 4.9, although high levels of efficiency are displayed predominantly among non-poor producers, the data suggest that higher efficiencies in the use of productive resources can also be found at the level of poor producers. For example, about 9 percent of bean producers categorized as poor (non-extreme) display high efficiency levels. In coffee, less than a sixth of producers (2 percent of the total) living in extreme poverty displayed high efficiency. Many lessons could be learned from in-depth case studies of the determinants of high efficiency among these types of producers. Among non-poor producers, the most inefficient producers were those in the dairy and coffee sectors. Critical determinant factors of productive efficiency include technology adoption, economies of scale, and the level of producers' collective action and market integration. Box 4.2 presents a summary of the findings.

Box 4.2: Efficiency in Resource Use in Coffee, Dairy, and Bean Production

Coffee: The size of the replanted coffee area was a determining factor in differentiating efficiency levels. Producer efficiency increased in relation to the size of the replanting area—producers with 3 mz of coffee less than 4 years old displayed higher efficiency levels. Other factors that enhanced the level of productivity included having proper equipment (e.g., milling equipment) and belonging to a producers' organization (association/cooperative).

Dairy: The logic of establishing production systems with dual purposes, without a specialized focus in either milk or meat production, affects the performance of dairy production. At the aggregate level, investing in the purchase of animals was a main determinant of efficiency. Highly efficient producers averaged 43.6 head of cattle, of which 10.4 were milk cows. In contrast, producers with low efficiency averaged 21 head of cattle, of which only 3 were milk cows. The gap in the average land under pasture between the segments of high efficiency (average 45.9 mz) and low efficiency (27.9) tended to be high, and even higher in relation to improved pastures (among high efficiency producers, the average area under improved pasture was 13.3 mz versus 7.9 mz for in those with low efficiency).

Beans: The capacity to expand cropping area through the use of technology was a determining factor for productive efficiency. Highly efficient producers planted an average 4.1 mz throughout the year (two production cycles/year). The availability of equipment such as plows and the use of certified seed (used by only 5.3 percent of producers) were determining factors with regard to efficiency levels.

Collective action across subsectors: Belonging to a producer organization was a differentiating factor for coffee and dairy, evidenced by the development of cooperatives/associations in both subsectors in the last decades. This factor was not significant for bean producers, however.

Access to credit and technical assistance were determining factors in all three subsectors.

4.3.2 Policy implications

Improving the productivity of the subsectors analyzed here involves proper targeting in alignment with specific strategic objectives.

For example, in the context of strategic objectives aligned with higher rates of sectoral growth and productivity (at an aggregated level), targeting dairy producers displaying low to medium level efficiencies (particularly those productive units above 10.5 mz) would yield higher returns. In beans, significant aggregate gains in productivity could be made through efficiency improvements along the three efficiency levels, but particularly among producers with the capacity to scale up/expand production. In coffee, improvements at the three levels of efficiency could translate into important aggregate gains at the sectoral level. Although, improving the efficiency of producers with small production areas in the three subsectors would have less impact at the aggregate sectoral level (with the exception of coffee), it will be crucial to support objectives of inclusive growth, food security, and poverty reduction.

In the analyzed subsectors, ample opportunities exist to improve productive efficiency, but the approaches vary among subsectors.

Productive improvements associated directly with production (technological adoption and scale of production) are relevant for beans, while for dairy and coffee production, there is a greater need to complement productive improvements with those supporting collective action among farmers (particularly small-scale farmers) and vertical links with markets.[21] In doing so, the convergence of public and private sector efforts is critical. For example, in dairy production, private incentives to drive improvements upstream in the chain have been important but limited. The formal processing sector contributes only 15 percent of total dairy production. The prospects for new, large processing companies entering the quality market could create important incentives for productive improvements. For coffee, some private efforts are supporting important productivity improvements; for example, ECOM Trading with the support of multilateral banks (International Finance Corporation and Inter-American Development Bank), is providing financial incentives for the renovation/replanting of coffee. The Government of Nicaragua, on the other hand, has articulated a series of programs with clear targeting and differentiated support. For example, the 10-year plan for the transformation of the coffee sector includes differentiated support according to targeted producer typologies; similarly, the recently formulated 16-year plan for the competitive reconversion of the livestock sector targets three differentiated groups of producers. Platforms for the coordination of public and private efforts in the implementation of these strategies/plans are gradually being established; their future consolidation will be critical to ensure gains at the sectoral and farm levels.

Focusing efforts geographically, and under several other considerations including environmental and future climate impacts, will be needed to materialize gains in productivity and/or support diversification of livelihood strategies.

The analysis found clusters of municipalities with a higher concentration of producers with low to medium efficiency (Box 4.3). Climate projections forecast a significant reduction in production viability of coffee and beans in some areas— for example, coffee production in the 365 to 1000 masl (meters over sea level) range will be severely affected by expected increases in temperature, involving several areas in the departments of Jinotega and Matagalpa (which contain about 58 percent of the coffee-producing units countrywide). Therefore, conversion to other types of crop production and livelihood strategies will be needed. Red beans are produced in about 87 percent of the country's municipalities, but 30 percent of the production units are concentrated in 12 municipalities located in the northern Caribbean (9) and southern Caribbean (3). Most low-efficiency production units are concentrated in the southern Caribbean and Las Segovias dry corridor, where several areas are low and not suitable for bean production and are highly vulnerable, given persistent drought. Both areas demand strategies to increase resilience to climate variability, for example through water harvesting. In some cases, diversification of production and of livelihood strategies, rather than productivity improvements, might be priority considerations. For dairy production, sustainable intensification of production in municipalities concentrating productive units displaying low to medium efficiencies via productivity improvements could significantly contribute to environmental sustainability by reducing the pressure to replace forestland with pastures (Box 4.3).

Finally, the appropriate incentive policy framework and investment will be key to improving productivity and sectoral competitiveness.

For example, restrictions on imports/exports of beans have proven to have implications for sectoral productivity and competitiveness. In coffee, recent major reforms related to the regulatory and institutional framework ("The Coffee Sector Law," enacted in 2013) represent important opportunities to improve productivity and sectoral competitiveness, but the strong commitment of both public and private sector actors will be critical for their successful implementation. Investment

21 The significant levels of collective action experienced in the coffee sector through the consolidation of producers' cooperatives/associations has allowed higher levels of market integration, a higher share of the export price, and higher prices.

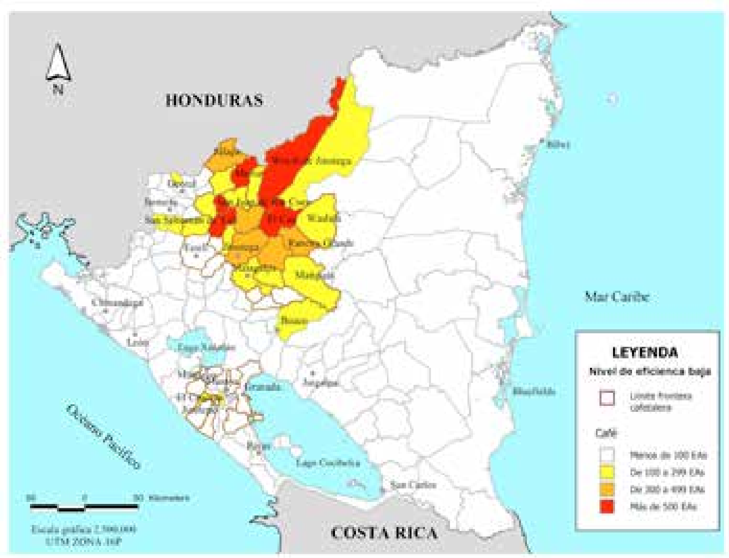
in key rural infrastructure and innovation systems are also essential to support productivity increases and facilitate livelihood diversification strategies. The latter is particularly relevant among those segments of producers where increasing productive efficiencies alone will contribute only marginally to overall livelihood improvements.

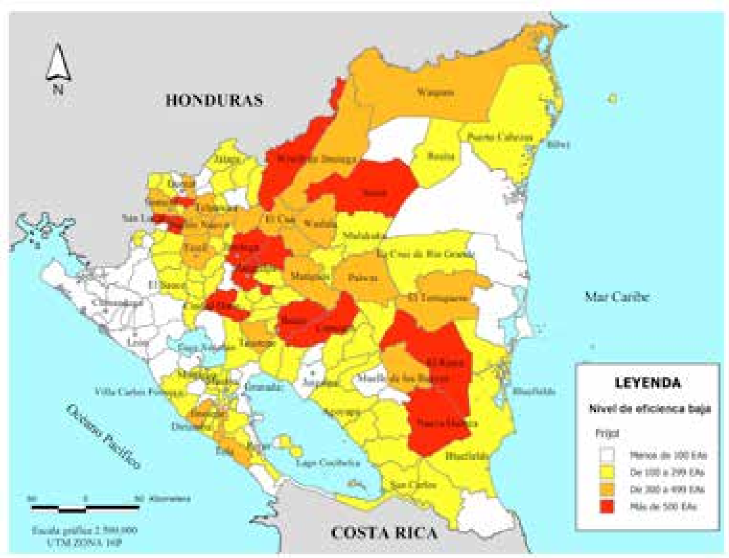
Box 4.3: Clusters of Low to Medium Productive Efficiency Levels for Selected Subsectors

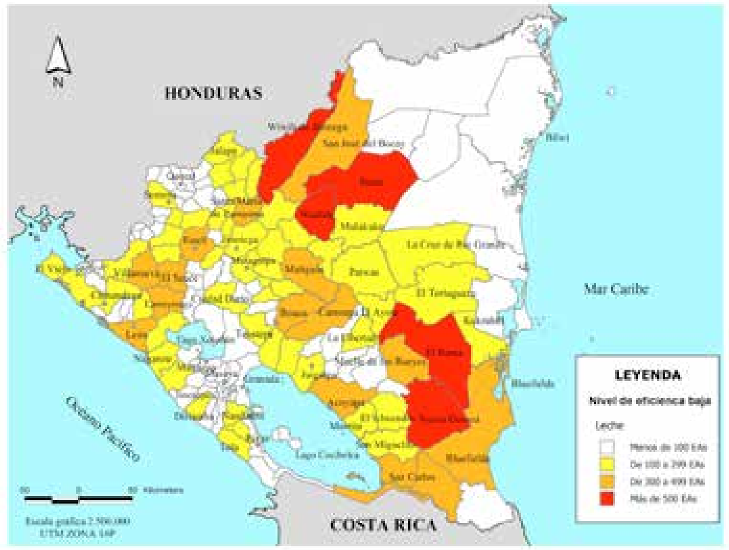
Coffee: Cluster of municipalities with a high proportion of low efficiency productive units in the central corridor toward the end of the agricultural frontier: Jinotega, Pantasma, El Cúa, and Wiwilí. A group/block of areas also exists in Jalapa: Murra and San Sebastián de Yalí-San Juan de R.C.

Dairy: Cluster of municipalities with a high proportion of low efficiency productive units, including Wiwilí, Jinotega, Bocay, Waslala, Siuna, the northern Caribbean coast and El eje San Carlos, Bluefields, Nueva Guinea, Rama and Muelle; this follows the expansion of the agriculture frontier, with high pressure on the natural forest.

Beans: Cluster of municipalities with a high proportion of low efficiency productive units including agricultural frontier municipalities in the departments of Matagalpa and Jinotega and the Alto Coco and the mining region in the north Caribbean and Axis New Guinea - Tortugero / Paiwas in the Southern Caribbean. Caribbean areas tend to be low altitude areas, which makes them marginal for bean production.







Source: Authors

San José, Matagalpa by Sven Hansen / CC BY-NC-ND 2.0

INTRODUCTION

WHAT DRIVES AGRICULTURAL GROWTH IN NICARAGUA?

WHY INVEST IN NICARAGUAN AGRICULTURE?

COMPETITIVENESS AND EFFICIENCY GAINS

FAMILY FARMING IN NICARAGUA

WEATHER RISKS AND CLIMATE CHANGE

A ROAD MAP FOR POLICY MAKERS

FAMILY FARMING AGRICULTURE IN NICARAGUA

CHAPTER 5

Smallholder agriculture, known in Nicaragua as *agricultura familiar,* poses a particular challenge in Nicaragua and around the world due to its diversity and relevance to family livelihoods for the majority of rural inhabitants.[22]

Policy design and effective program intervention can be complex, but good practice examples exist in other countries, as discussed in the next section. Development strategies for family farming in Nicaragua and elsewhere have recognized that: (i) agricultural production is not always an exit strategy out of poverty for everyone; (ii) agriculture provides other functions beyond production, namely jobs, food security, and nutrition; and (iii) agriculture plays important social and environmental roles. Therefore, the public sector must determine first the roles agriculture plays in family-based farming and then design agricultural policies accordingly. In this way, multiple interventions in rural areas can be more effective for sectoral productivity and poverty reduction.

5.1 A TYPOLOGY OF FAMILY FARMING IN NICARAGUA

Family farming in Nicaragua encompasses the vast majority of producers in number, land holdings, and agricultural production. In number, family agriculture incorporates 98 percent of all producers. In land area, family farming comprises 90 percent of agricultural land. In agricultural production, their output value comprises 89 percent of the total. Their relevance for food security is irrefutable. Family farms contribute an estimated 60 percent of agricultural GDP from production of basic grains (maize, rice, beans, and sorghum) and livestock (Ortega et al. 2013). Similarly, environmental sustainability continues to be determined by use of land by smallholders. This large group of smallholders is very heterogeneous, however, posing an undeniable challenge to policy making.

To support the design of appropriate public sector interventions that can address this diversity, this chapter elaborates a typology of family farms in Nicaragua that clusters them into groups with similar characteristics. The typology distinguishes among smallholders that are foremost engaged in subsistence agriculture from those consolidated that find agriculture as a viable business choice, and those in between these two and who are mostly in transition towards a more commercial agriculture. The different types have distinct roles and contributions to the agriculture sector, and from a poverty reduction perspective respond differently to programmatic interventions.

The proposed typology distinguishes family farms by combining two major aspects, an agriculture unit classification and a poverty classification. The typology's decisive aspects are if the producer lives on the farm, does other work, hires labor permanently or seasonally, manages the farm, land size, how limited or regular food consumption is, and if there is access to water on the farm. The family farm typology uses the Agricultural Census of 2011 (CENAGRO) and consists of (as shown in Table 5.1): (i) subsistence farms (40.6 percent); (ii) transitional farms (42.8 percent); and (iii) commercial farm (14.8 percent). The rest of the farms (1.8 percent) are categorized as business farms.

As family farming is vastly heterogeneous, public policy and investments must be differentiated accordingly.

Heterogeneity prevails in production systems, sources of income, and livelihood strategies. The findings detailed below stress the relevance of adopting differentiated policies and interventions to promote economic and social welfare for all according to their needs and abilities. The variety and appropriateness of such programs may include a wide range, from the provision of social protection transfer programs to devising measures for addressing market failures, all the way to promoting agricultural business strategies. The characterization that follows carefully examines the different groups of producers to identify more specific public sector interventions. A set of maps identifying the prevalent location of each type complements the characterization.

Table 5.1: Family Farm Typology in Nicaragua

Typology of producers	Number of farms	%
Family Farms		
- Subsistence	105,578	40.6
- Transitional	111,374	42.8
- Commercial	38,519	14.8
Business Farms	4,819	1.8
Total	260,290	100

Source: Authors, using CENAGRO IV 2011 and Ortega 2013.

22 The regionally accepted term of Family Farming is used in this document to refer to farm systems operated by smallholder family members using mostly family labor, as defined by FAO in: http://www.fao.org/family-farming-2014/home/what-is-family-farming/es/

5.2 CHARACTERIZATION OF FAMILY FARMING IN NICARAGUA

5.2.1 Type 1: Subsistence family farms

Subsistence family farms (40.6 percent) cannot exit poverty by relying only on agriculture.

This group is the most challenging for policy-makers. It has been observed that the number of small-scale subsistence farms smaller than 2 mz has about doubled in just 10 years (Table 5.2, last two rows). This is particularly acute among the poor (Table 5.2, first two rows), for whom a pattern is observed of an increasing share of agricultural units less than 2 mz and 2-5 mz and a declining share of those 5-20 mz and 20-50 mz. Consequently, subsistence farms are unable to provide a sustainable livelihood for farmers, regardless of efficiency levels or extension support.

Subsistence family farms perform a crucial social role for the majority of the rural poor.

They provide basic food and unskilled employment and maintain family assets (land, animals, trees, etc.). Agriculture often provides a social safety net that keeps small-scale farmers from falling into extreme poverty. However, subsistence farming produces little marketable food and generates scant benefits for others, including the landless and the urban poor. The characterization of subsistence farming as depicted in Table 5.2 and Table 5.3 indicates that they live for the most part in the farm but engage the most in other work (on or off the farm), hire fewer workers, manage the farm themselves, live in farms around 2 mz, must skip meals or eat less in harsh times, and have the lowest access to water on the farm.

Subsistence smallholders have traditionally been marginalized in various ways, such as by ethnic and/or cultural discrimination or simply by living in places with poor infrastructure and social services, limiting opportunities for change. They are oftentimes located far away from population centers, which could potentially provide a chance for income diversification by means of non-agricultural jobs. Their traditional livelihood strategies hinder them from entering a virtuous circle of capital accumulation. Subsistence farmers' assets are typically limited, especially with regard to land and adequate infrastructure.

Table 5.2: Agricultural Units by Welfare Level (share of agricultural producers)

Poverty	Year	Size of agriculture unit (mz)					
		<2	2 to 5	5 to 20	20 to 50	>50	Total
Poor	2001	16.7	22.1	36.4	24.7	0	100
	2011	43.3	32.7	21.2	2.9	0	100
Non poor	2001	0	0	0	0	100	100
	2011	0	0	30.1	30.4	39.5	100
Total	2001	12.3	16.3	26.9	18.2	26.2	100
	2011	25.4	19.2	24.9	14.3	16.3	100

Source: Authors, using CENAGRO IV 2011 and Ortega 2013.

Table 5.3: Agriculture Farming Typology

Smallholder type	Family agriculture			Business agriculture	Total
	Subsistence	Transition	Commercial		
Units (farms)	105,578	111,374	38,519	4,819	260,290
UA (%)	40.6	42.8	14.8	1.8	100
Average size (mz)	1.9	38.9	71.7	175.9	31.3
GPV (average, in dollars)	1,141	8,991	21,237	52,276	8,421
Total size	201,550	4,331,128	2,763,655	847,621	8,143,954
GPV Total (dollars)	120,500,706	1,001,364,272	818,046,719	251,918,465	2,191,830,162

Source: Authors, using CENAGRO IV 2011 and Ortega 2013.

Table 5.4: Agriculture Typology Characterization

Farm Typology	Family Farms			Business Farms	Total
	Subsistence	Transitional	Commercial		
Producer lives in UA (%)	83.7	79.9	72.0	20.4	79.1
Producer manages farm (%)	97	96	90	0	94
Hired labor (%)	21	37	100	100	41
Permanent workers (number)	2.0	2.0	3.8	5.8	3.2
Temporary workers (number)	4.7	4.0	12.3	19.7	7.9
Did other work (%)	38.7	17.4	2.7	0.0	23.5
Access to Credit (%)	10.5	14.1	31.5	19.5	15.3
Access to Water (%)	74.1	89.1	91.1	94.5	83.4
Producers' Organization (%)	5.9	8.6	17.5	13.4	8.9
Access to Techn. Assistance (%)	12.3	13.5	22.8	23.1	14.6
Training received (%)	12.9	14.1	22.3	18.0	14.9
Members with complete primary education or more (%)	30.1	25.4	31.7	37.9	28.2

Source: Authors, using CENAGRO IV 2011 and Ortega 2013.

The most effective interventions for subsistence 1 farmers are assistance programs,

as emphasized by the Millennium Development Goals 2030 agenda, such as income support and conditional cash transfers oriented towards families trapped in poverty in rural areas, complemented by basic infrastructure food security programs and livelihood strategies not necessarily related to agriculture but that can include agriculture. In Nicaragua, *Hambre Cero* and *Usura Cero* are good assistance programs for these farmers. Other initiatives to help subsistence farmers develop a "social safety net" or network of contacts to provide support if needed. These can be oriented towards families trapped in extreme poverty in rural areas.

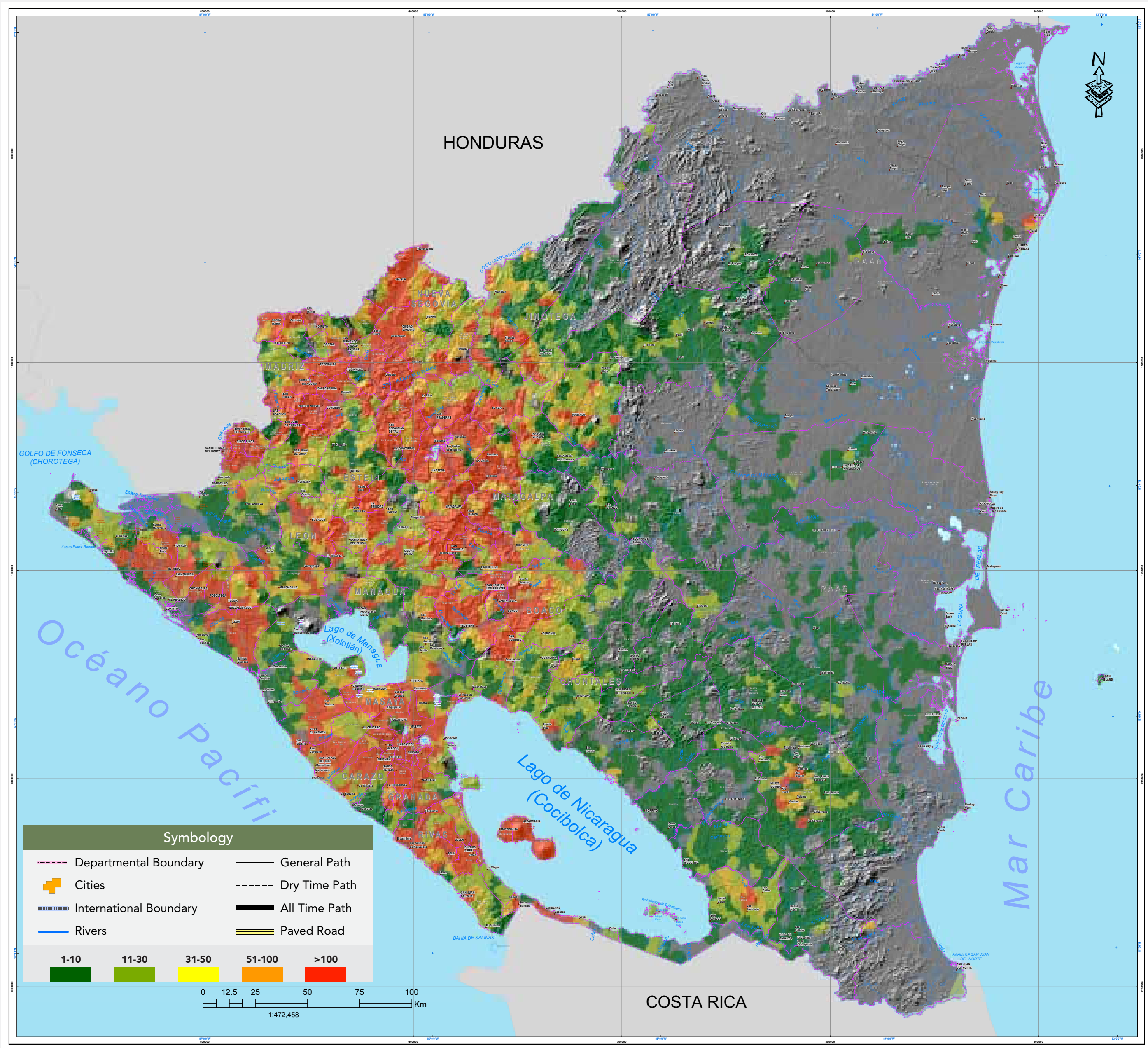
5.2.2 Type 2: Transitional Family Farms

Transitional smallholders (42.8 percent) take advantage of opportunities outside of agriculture as they recognize their agricultural incomes are insufficient to sustain their families. The characterization of transitional family farming detailed in Tables 5.2, 5.3, and 5.4 indicates that they live on the farm and limit other work (on or off the farm); close to half hire workers; they manage their farm, live in farms about 40 mz, must eat less food in harsh times, and have access to water on the farm; some use credit and are linked to markets. This group commonly makes use of both family labor and temporary hired workers during intense activity seasons. Most of their production is for self-consumption, and surpluses are either bartered or destined to market. Transitional farmers complement their wellbeing with family members' salaries from agricultural and non-agricultural labor off the farm, including remittances. They may also improve family wellbeing by completely abandoning the farm. Oftentimes young, better-educated family members migrate to urban areas or other countries. The older and less educated are most likely to remain dependent on agriculture. In the long run, most transitional farmers diversify and lessen their dependence on agriculture. Domestic economic growth and resulting opportunities accelerate the pace of transitioning off the farm for those motivated to engage in other sectors.

Public sector strategies to link transition farmers with market activities have proven to be successful in other countries.

Effective public sector programmatic interventions to integrate transition farmers into value chains for those able to/interested in moving up towards commercial activities include: (i) improving access to agricultural productivity by enhancing services such as research and extension, financial services, titling, etc.; and (ii) assisting farmers in acquiring other sources of income, such as facilitating access to funding for business startups (rural livelihood programs), retraining, and other agricultural and non-agricultural programs to facilitate diversification (Foster et al. 2011). Optimal interventions for transitional farmings are agricultural productivity programs such as those promoting productive rural livelihoods and productive alliances. Agricultural programs directed at family

Figure 5.1: Geographic Distribution of Type 1 – Subsistence Family Farms



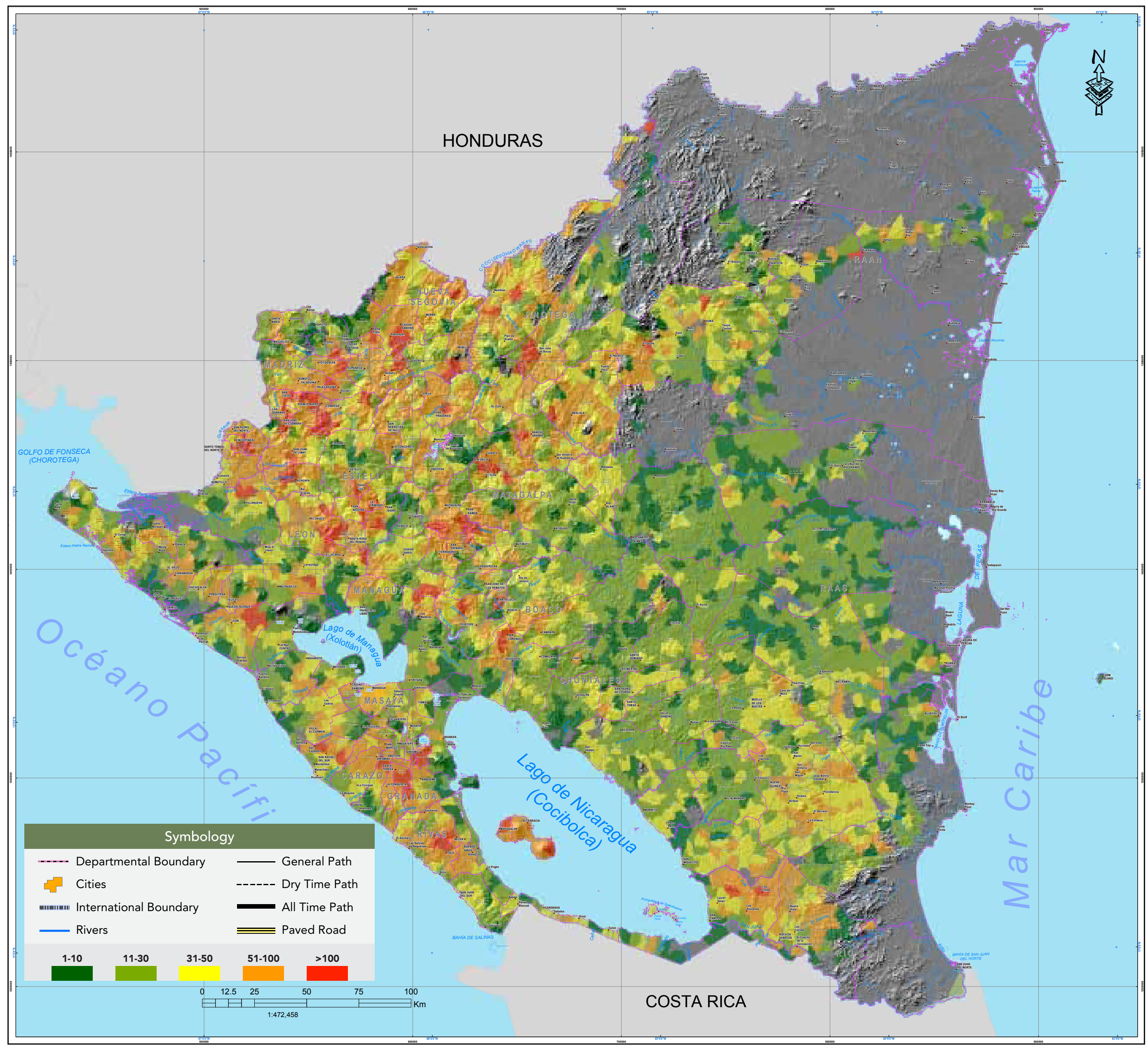
Source: Authors based on CENAGRO 2011

farming in Colombia, Honduras, and Bolivia, for example, promote partnerships and associations for boosting competitiveness. This allows transition farmers to enter new markets, build their capacity, create social capital, and take advantage of economies of scale.

5.2.3 Type 3: Commercial Family Farms

Commercial smallholders (14.8 percent) have access to basic inputs of labor, land, and capital and are commonly located in geographic areas with higher productive potential and linked to agriculture value chains. The characterization of commercial family farming included in Tables 5.2, 5.3, and 5.4 shows they live on the farmland and limit other work (on or off the farm), hire an average of 15 workers, manage the farm, live on larger farms of around 70 mz, eat well all year round, and have access to water on the farm. Almost one in three

Figure 5.2: Geographic Distribution of Type 2 – Transitional Family Farms



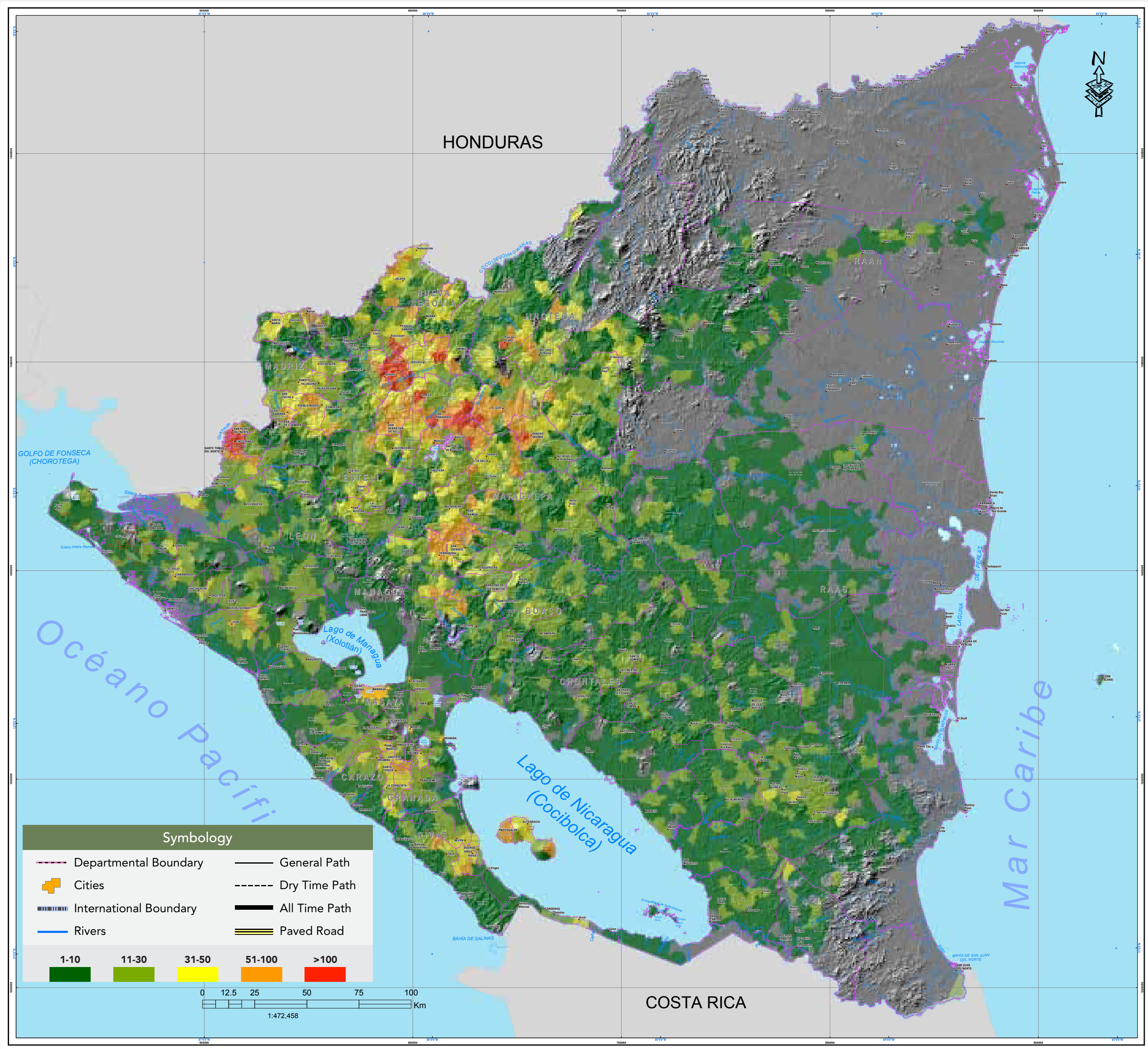
Source: Authors based on CENAGRO 2011

use credit and one in five receive technical assistance or training and belong to a producers' organization.

Agriculture is a viable business choice for this type family farming.

They are market-oriented and thus generate market surpluses and diversify the rural economy. Often they help keep food prices within reach for urban consumers and contribute to rural economic growth by creating jobs in agriculture with enhanced backward and forward linkages to non-agricultural rural sectors. They are full-time farmers and their family livelihood continues to depend on agriculture. They own assets to potentially transition into viable commercial enterprises. Their production is oriented towards the market and they usually exhibit product specialization.

Figure 5.3: Geographic Distribution of Type 3 – Commercial Family Farms



Source: Authors based on CENAGRO 2011

Commercial family farms require less direct state intervention.

Often the best way to support commercial family farming is by simply promoting economic activity in general, developing rural infrastructure services and a framework of incentives that enhances competitiveness and encourages entry into foreign markets. This group is self-motivated to increase productivity and less likely to fall into poverty traps. Public investments effectively targeting this group have a multiplier effect in both rural and urban areas, benefiting many landless farmers. The public sector can play an important role in dealing with market failures such as access to credit, agricultural technology, logistics services, and the overall incentive framework as discussed in Chapter 4. In addition, the state can support national branding and tourism related to specific products such as specialty coffee and cocoa.

5.3 POLICY IMPLICATIONS

Smallholder agriculture requires differentiated policies and interventions that take into account a typology of producers, in order to be more effective for sectoral productivity and poverty reduction.

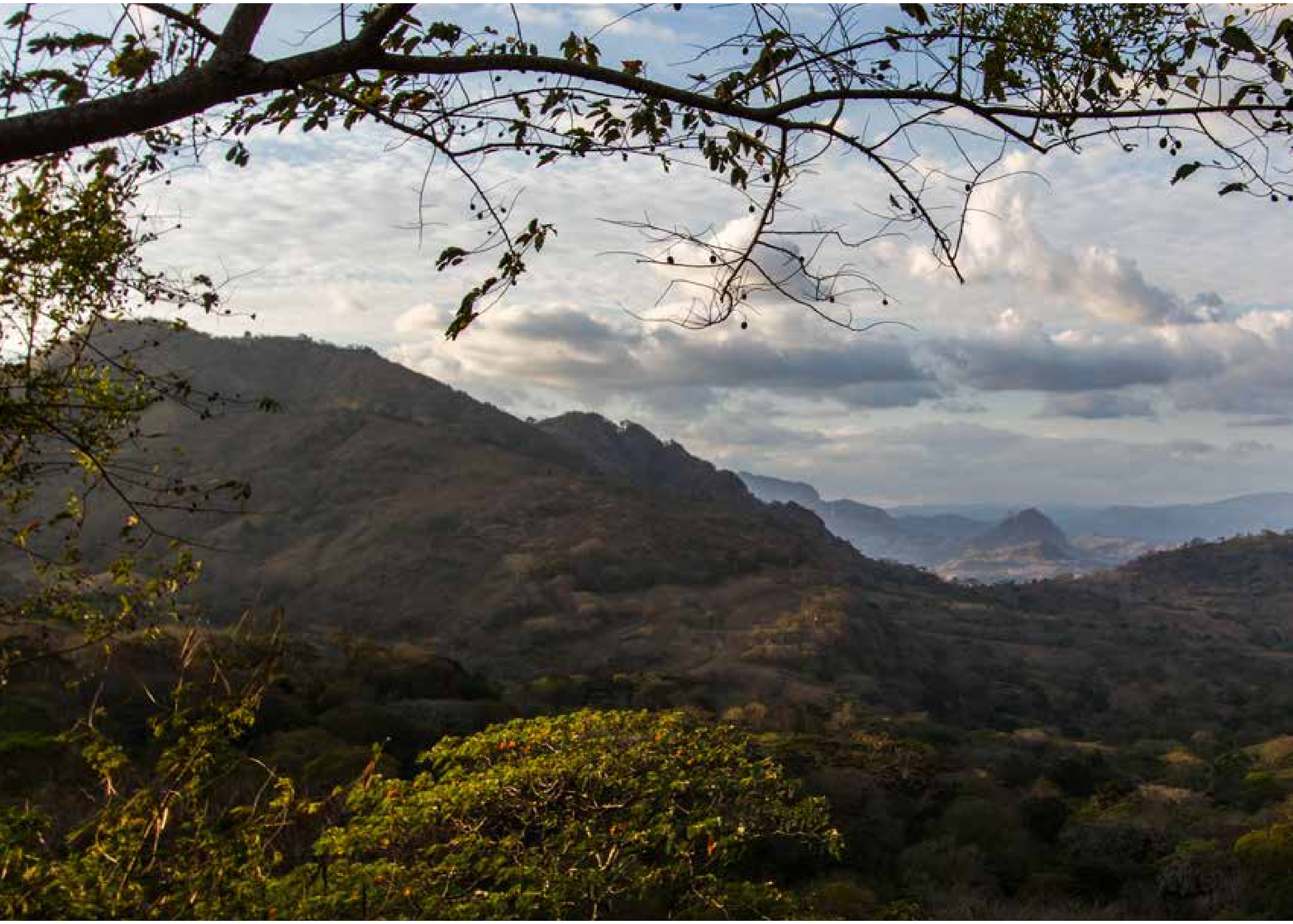
Family agriculture in Nicaragua is heterogeneous in production systems, sources of income, and livelihood strategies. Targeting differentiated policies and interventions for the various typologies that comprise family agriculture – subsistence, transitional, and commercial – can be achieved by:

(i) *Subsistence family farmers are more effectively targeted by assistance programs.* Income support and cash transfers are among these programs, complemented by food security programs and livelihood strategies not necessarily related to agriculture but that can include agriculture. In other countries, good programs for subsistence family farmers include Brasil Bolsa Escola and Bolivia Juancito Pinto. Other initiatives, like in Colombia, help subsistence farmers develop a "social safety net" or network of contacts to provide support if needed. In Nicaragua, Hambre Cero and Usura Cero are good assistance programs for these farmers. These programs can be oriented towards families trapped in extreme poverty in rural areas.

(ii) *Transition family farmers need support in implementing strategies to link them to markets.* Good strategies for those transition farmers able to/interested in moving towards commercial activities include: improving access to agriculture productivity by enhancing services, such as extension, financial services, titling, etc.; assisting farmers in acquiring other sources of income, such as facilitating access to funding for business startups, retraining, and other agriculture and non-agriculture programs to facilitate income diversification;[23] and, promoting productive partnerships, associations, and alliances between producers and buyers, to boost competitiveness. Successful programs for transition family farmers incorporating productive rural livelihood strategies are: India Andra Pradesh, Himachal and Uttarakhand Watershed programs, and Afghanistan AREDP. In Nicaragua GAFSP is a good example of these programs.

(iii) *Commercial family farmers need policies and interventions that enhance competitiveness and encourage entry into foreign markets.* Public support must focus on providing an adequate framework of incentives and essential rural infrastructure services. Commercial family farmers require less direct state intervention, as they are self-motivated to increase productivity and less likely to fall into poverty traps. Nevertheless, public interventions that target this group may have a multiplier effect in both rural and urban areas, benefiting many landless farmers. The public sector can play an important role in dealing with markets failures such as credit, technology, logistics services, and the overall incentive framework as already discussed. In addition, the state can support national branding and tourism related to specific products. Programs for commercial family farmers are geared towards supporting their competitiveness capacity by helping establish productive alliances between associated producers and buyers. In the most sophisticated alliances, there is also participation of financial and service providers. Successful programs in other countries are: Honduras COMRURAL, Panamá PRORURAL, Bolivia PAR, and Colombia Alianzas Productivas. In Nicaragua, the Ministry of Agriculture is designing a similar productive alliances program for the coffee subsector.

23 Foster et al. (2011).



Nicaragua Mountains at Dusk by Adam Cohn / CC BY-NC-ND 2.0

WEATHER RISKS AND CLIMATE CHANGE

CHAPTER 6

Given that agriculture is a key sector of the Nicaraguan economy, as described in earlier chapters, the occurrence of risk events has repercussions on the growth of the economy, public finances, the performance of value chains, and the food security of the most vulnerable sectors.

This chapter presents the findings of the technical analyses of production risks in Nicaragua's agriculture sector, and advances some measures for better managing production risks.[24]

Nicaraguan agriculture is subject to frequent climatic shocks produced by excessive precipitation (hurricanes and tropical depressions) and droughts of varying intensities, sometime associated with the El Niño Southern Oscillation (ENSO).

Table 6.1 shows a record of the events reported by the Nicaraguan Institute of Territorial Studies (INETER) and The Economic Commission for Latin America (ECLA) of the United Nations system. It shows that the Nicaraguan economy is exposed to some type of extreme weather event every year and a half on average. Events that were declared natural disasters occurred in 1982, 1988, 1996, 1998, 2001, and 2014, primarily hurricanes and tropical storms that caused damage to infrastructure, displaced people from their homes, and produced losses to the agriculture sector.[25]

In spite of the high incidence of recent weather phenomena, Nicaragua has made significant progress with regard to food security. The main issue has not been availability of food, but rather reliable access to it.

The aggregate balance of cereals displayed in Figure 6.1 shows that over the past 11 years, the availability of cereals (inventories + production), excluding imports, has been sufficient with respect to utilization (food consumption + animal food + agro-industrial use). Nicaragua has not had to resort to high levels of cereal imports to alleviate the situation, but rather has gradually reduced its reliance on imported food aid, finally eliminating it completely in 2010 (Table 6.2).

Table 6.1: Record of Recent Weather Events in Nicaragua, 1972-2014

Year	Event
1972	ENSO
1976	ENSO
1977	ENSO
1982	ENSO
1983	ENSO
1986	ENSO
1987	ENSO
1988	Hurricane
1991	ENSO
1992	ENSO
1993	ENSO
1994	ENSO
1996	Hurricane
1997	ENSO
1998	Hurricane
2001	Severe
2002	ENSO
2004	ENSO
2006	ENSO
2006	Tropical
2007	Hurricane
2009	Severe
2011	Tropical
2014	ENSO

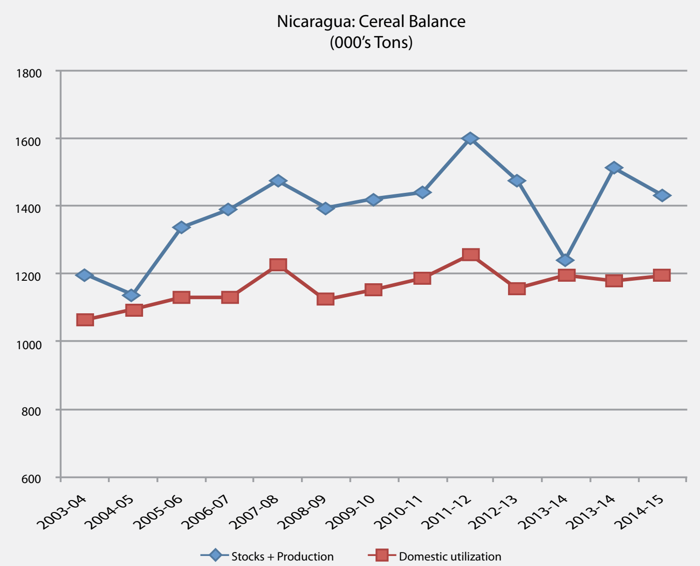
Source: Authors based on data from INETER and ECLA.

Table 6.2: Food Assistance Imports, 2003-2015

Year	TM (thousands)
2003-04	32.4
2004-05	40.6
2005-06	39.4
2006-07	26.9
2007-08	43.9
2008-09	20.3
2009-10	0.3
2010-11	0
2011-12	0
2012-13	0
2013-14	0
2013-14	0
2014-15	0

Source: Authors.

Figure 6.1: Cereal Balance, 2003-2015



Source: Authors, based on FAO data

24 Based on Background Paper prepared by Carlos E. Arce (2015).

25 The methodology of agricultural risk assessment developed by the World Bank was applied covering production risks only, and did not include market and enabling environment risks.

Table 6.3: Average Annual Agricultural Production Losses in Nicaragua, 1994-2013

Item	US$ millions	% of Ag.GDP
Basic Grains	82.8	4.7
Losses in area planted	74.4	
Losses due to drops in yield	8.4	
Export Crops	24.2	1.4
Losses due to drops in yield	24.2	
Total	107.1	6.1

Source: Authors' calculations based on data from BCN, MAG, and MIFIC.

Table 6.4: Average Annual Monetary Value of Losses by Crop and Department (thousand US$)

Department (Region)	Maize	Rice	Beans	Sorghum	Total
Nueva Segovia	2,454.7	165.0	3,031.1	80.9	5,731.6
Madríz	1,890.2	-	3,158.7	344.1	5,393.1
Estelí	2,440.2	-	4,531.0	401.3	7,372.5
Chinandega	2,977.5	536.1	730.5	571.9	4,815.9
Leon	3,564.9	99.9	1,611.5	1,319.9	6,596.2
Managua	1,553.0	50.0	1,137.0	883.5	3,623.5
Masaya	421.8	31.0	421.9	60.7	935.4
Granada	279.4	136.7	488.3	115.1	1,019.5
Carazo	744.6	89.5	1,214.3	324.7	2,373.2
Rivas	670.9	1,086.0	932.5	375.9	3,065.2
Zelaya Central Oeste	1,576.2	168.7	924.0	-	2,668.9
Boaco	2,008.4	56.5	1,764.8	480.1	4,309.7
Chontales	588.7	226.8	497.6	42.9	1,356.0
Jinotega	3,036.7	48.4	4,221.8	96.2	7,403.2
Matagalpa	5,927.9	259.9	7,701.7	539.7	14,429.2
Siuna	890.7	358.5	486.6	-	1,735.9
Rio San Juan	626.7	235.9	750.6	-	1,613.2
Total	31,652.6	3,548.9	33,603.8	5,636.9	74,442.2

Source: Authors' calculations based on data from BCN, MAG, and MIFIC.

Estimates of agricultural production losses show that Nicaragua loses on average about US$107 million annually due to unmanaged production risks. This is the equivalent of 6.1 percent of agricultural GDP (Table 6.3).

One of the most severe weather events occurred in 1982, when economic losses (damages plus losses) were estimated at US$795 million, of which US$244.8 million was in the agriculture sector. These losses were caused by a combination of ENSO and the effects of Tropical Storm Alleta (CEPAL 2012). Losses in the agriculture sector due to weather events do not always have similar impacts on overall national economic losses, however. For example, in 1988 Hurricane Joan caused losses in Nicaragua of approximately US$1,412.7 million, of which only US$141 million was in the agriculture sector (ECLA 2012). Similarly, in 1998 Hurricane Mitch caused losses of US$1,303.7 million, of which US$244.6 was in the agriculture sector. In contrast, in 2001, one of the most severe droughts on record caused losses of US$49.1 million, of which US$41.4 was in agriculture (ECLAC 2012).

The bulk of the estimated annual average losses occur from the reduced area planted in basic grains, incurring average annual losses of US$74.4 million (Table 6.3).

The most significant factor is the erratic distribution of precipitation during the planting period, which directly impacts the area planted.[26] The values of the estimated losses reflect the difference between area planted and area harvested for the group of basic grains. In other words, these values represent the opportunity cost in the hypothetical case that the entire area planted is harvested with average yields every year. The highest losses

26 The losses are estimates based on the average difference between the area planted and the area harvested historically (1995-2013) for basic grains, using the average price and exchange rate for the past three years.

are concentrated in maize and red beans, the most widely planted crops during the annual cycles.

Additionally, the volatility in performance of the area harvested has resulted in average annual losses estimated at US$8.4 million.

This volatility is caused by risk events that happen during crop development (Table 6.5), and is in large part due to the loss of optimal sowing seed (either improved, native, or domesticated foreign seed) in years when the rainy season arrives late or is erratic, which forces producers, now under increased economic constraints, to replant using poorer quality seeds with consequent reductions in yield.

Table 6.6 shows another dimension of loss estimates, expressed as a percentage of area lost by crop in each region (Average 1994-2014). The regions that lost the most area were Madriz, Estelí, Boaco, and Managua, areas generally considered part of the dry corridor. Unfortunately, weather statistics are not available at the municipal level, precluding greater granularity in the identification of weather impacts on area losses.

The impact of weather on basic grain yield is heterogeneous.

This volatility is caused by risk events that happen during crop development (Table 6.5), and is in large part due to the loss of optimal sowing seed (either improved, native, or domesticated foreign seed) in years when the rainy season arrives late or is erratic, which forces producers, now under increased economic constraints, to replant using poorer quality seeds with consequent reductions in yield.

Table 6.6 shows another dimension of loss estimates, expressed as a percentage

Table 6.5: Average Annual Losses Due to Volatility in Basic Grain Yield

	Pérdidas anuales promedio (1994-2014	
Cultivo	Volumen (QQ)	Valor (US$)
Arroz secano	54,662	2,907,062.84
Frijol negro	3,810	127,293.37
Frijol rojo	31,569	1,317,219.10
Maíz	182,550	3,087,680.97
Sorgo blanco	16,002	180,217.19
Sorgo millón	38,615	437,758.93
Sorgo rojo	32,582	369,362.55
Total		8,426,594.95

Note: Estimates using average prices and exchange rates from 2011-2013.

Source: Authors' calculations,based on data from BCN, MAG, and MIFIC.

Table 6.6: Percentage of Area Lost by Region and Crop

Region	Maize	Rice	Red Beans	Black Beans	Red Sorghum	White Sorghum	Plain Sorghum
Nueva Segovia	14	3	20	10	9	12	23
Madriz	40	0	36	37	64	23	19
Estelí	37	92	34	21	9	19	23
Chinandega	28	4	30	41	5	20	14
León	32	6	36	15	9	21	23
Managua	37	36	40	41	11	22	26
Masaya	17	17	20	5	3	5	7
Granada	25	14	27	4	3	11	8
Carazo	39	20	37	25	17	25	20
Rivas	29	17	28	8	15	19	21
Zelaya Ctral O.	19	18	18	4	0	0	0
Boaco	35	3	36	54	44	30	25
Chontales	19	29	25	9	1	8	9
Jinotega	10	9	18	17	56	29	48
Matagalpa	20	15	22	12	19	23	24
Siuna	15	13	10	7	0	0	0
Rio San Juan	17	10	18	11	0	0	0
National Total (Average)	22	11	26	17	7	21	20

Note: Yellow cells indicate losses between 25-35% of area planted; red cells indicate losses greater than 35% of area planted.

Source: Authors' calculations based on data from BCN.

of area lost by crop in each region (Average 1994-2014). The regions that lost the most area were Madriz, Estelí, Boaco, and Managua, areas generally considered part of the dry corridor.

The effect of weather on basic grain yield is heterogeneous.

Of 13 weather events recorded between the agricultural cycles of 1996-97 and 2012-13, only 5 events were associated with losses greater than 25 percent of yields (Figure 6.2). This is because agriculture in Nicaragua is carried out in three distinct annual cycles (primera, postrera, and apante); the extent of the impact of the weather event depends on the moment and the cycle when the event takes place, as well as the capacity of agriculture to recover during subsequent cycles.

Losses in the agriculture sector, particularly those associated with hurricanes, tend to be relatively concentrated in a short window within one of the three agricultural cycles. The periods of heavy precipitation associated with tropical storms generally occur between August 20 and November 15, mainly affecting basic grain output during the second cycle (postrera). Further, with the exception of Hurricane Mitch, hurricanes usually affect the Caribbean coast, not the Pacific coast where most agriculture is concentrated.

Episodes of the ENSO phenomenon occur with varying degrees of severity about once every 2.6 years, intensifying during the period of March - August, as demonstrated in the recent ENSO events of 2002/03, 2004/05, 2009/10, and 2014/15. During severe el Nino events, significant precipitation reduction are recorded in Aug-Oct of the first year of the event. These episodes tend to mainly affect the second cycle (postrera) of basic grain production.

6.1.2 Losses in yields of export crops in area harvested

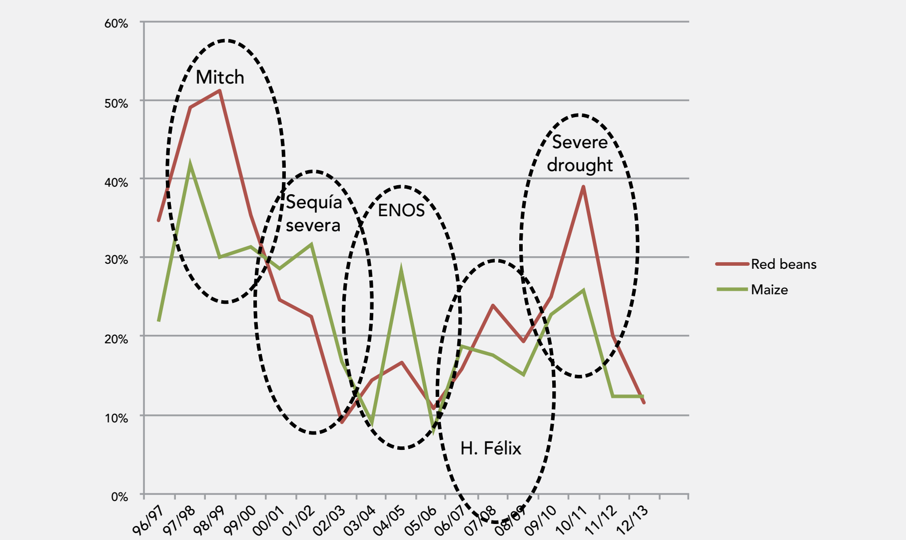
Yield volatility of export crops has historically resulted in average annual losses of around US$23.8 million, equivalent to about 1.4 percent of agricultural GDP (Table 6.7).

The agro-export crops, mainly the annual crops (peanuts, soybeans, sesame seed) harvested during the first crop cycle (May–August) in the west of the country, generally tend to avoid the strongest impacts of hurricanes and tropical storms, which occur mostly from August –November. Severe droughts and to a lesser extent pests and diseases are the main causes of yield variability for export crops.

The effects of production risks for export crops are heterogeneous,

which suggests either that production risks have differential impacts on crops and/or that substantial differences exist

Figure 6.2: Basic Grain Yield Losses Due to Extreme Weather Events in Nicaragua, 1996-2013



Source: Authors, based on data from BCN and INETER

Table 6.7: Annual Average Losses Due to Yield Volatility in Nicaragua, 1994-2014

Export crop	Volume (quintals)	Value (US$)
Coffee	44,277	8,882,973.50
Bananas	159,837	4,280,663.47
Sugarcane	81,167	5,100,499.92
Peanuts	52,600	5,023,639.02
Sesame	4,176	220,094.37
Soy	13,341	342,420.52
Total		23,850,290.80
Percentage of agricultural GDP	1.4%	

Source: Authors's calculations

in the capacity to manage the risks. Figure 6.3 shows that the only clearly identifiable event affecting all crops during the period 1994-2014 was Hurricane Mitch, which remained stationary over the border with Honduras. The nearby El Picacho meteorological station in Chinandega recorded 1,597 mm of precipitation during the month of October 1998. This was an exceptional phenomenon, as precipitation amounts for most hurricanes and tropical storms are much lower at this station; for example, Hurricane Irene, September 1971 (98 mm), Hurricane Edith, September 1971 (111 mm), Hurricane Joan, October 1988 (87 mm), Hurricane Brett, August 1993 (14 mm), Hurricane Gordon, November 1994 (40 mm), and Hurricane César, July 1996 (169 mm).

The presence of ENSO does not have a homogeneous pattern of impact on export crops, nor does the historical record reveal any clear correlation between ENSO years and the yields of export crops.

Analysis of the perception of risk by actors who deal with export crops revealed that drought is considered the most significant risk for annual oilseed crops, but is considered less of a threat to coffee and bananas (Table 6.8).

Because oilseed production is primarily carried out by agribusiness using highly technical methods, the risks of pests and diseases are managed quite effectively. Hence, virtually the only significant risk to the oilseed crop is drought, as the technical capacity to manage this risk is more limited.

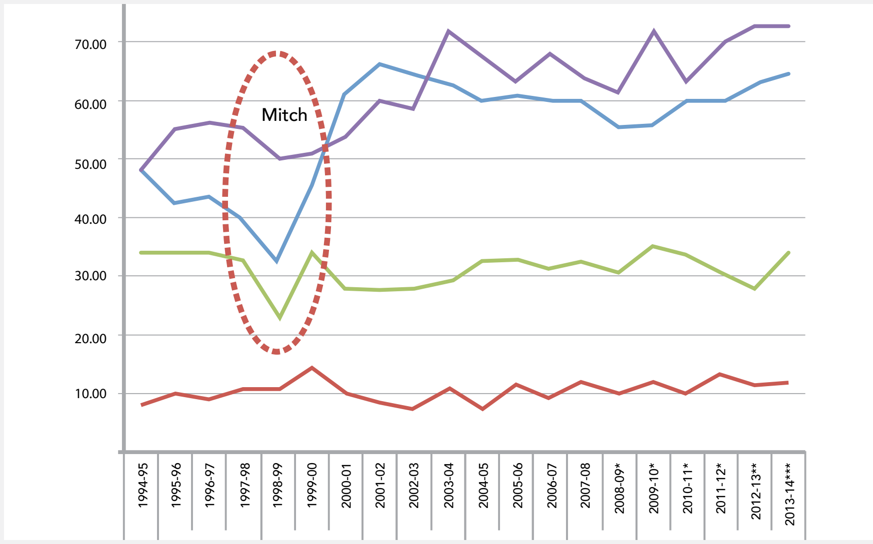
Coffee presents a variety of production risks, with pests and diseases the most threatening, as revealed in the latest rust outbreak in 2013-14. However, inadequate rainfall during the critical seasonal windows (i.e., blooming) during the phenological stages of development of the coffee bean can produce yield losses beyond the biannual harvest cycle characteristic of coffee.

6.1.3 Towards a risk management strategy

Nicaragua needs to move from its current reactive (ex-post) strategy to a proactive (ex-ante) strategy of agricultural risk management.

In an agriculture sector where the future is expected to bring increasing volatility in production and market risks, implementation of a more holistic strategy is indispensable. Instead of reacting to extreme weather events, it is necessary to adopt short- to medium-term strategies that will complement long-term efforts to adapt to climate change. Figure 6.4 illustrates how such a strategy might look. For those events that occur with relatively high frequency, risk mitigation (farming practices that reduce the effects of risks) is the optimal strategy since it does not only mitigate the effects of adverse events but incorporates resilience in agricultural systems, particularly suitable for small farmers. The second layer refers to risk transfer strategies (particularly agriculture insurance) for

Figure 6.3: Yields of Export Crops (quintals/mz), 1994-2014



Source: Authors' calculations

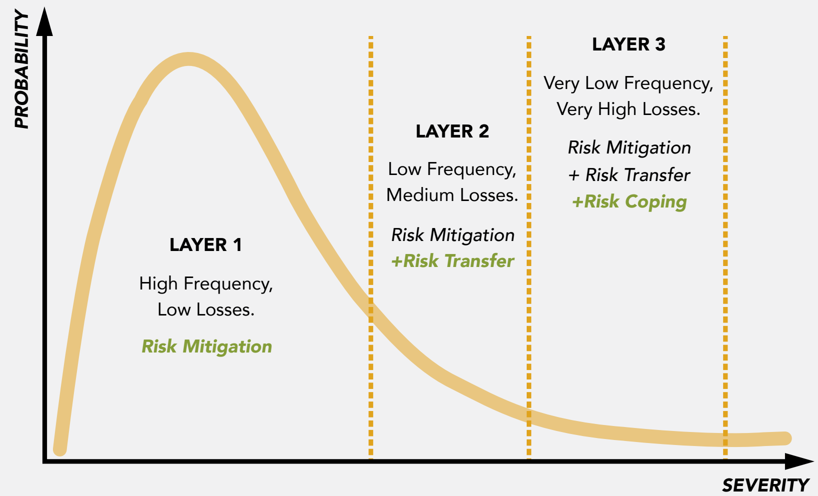
Table 6.8: Perception of Production Risks for Export Crops[27]

Export crop	Risk 1	Risk 2	Risk 3	Risk 4
Bananas	Volcanic ash	Drought	Moko disease	Black Sigatoka disease
Coffee	Rust	Rain distribution	Price	Nematodes
Soy	Drought			
Peanuts	Drought			

Source: Authors, based on stakeholder's interviews

27 The perception of risks among producers of export crops focuses on the volatility of international prices. Market risks are outside the scope of this analysis, but they present important issues that deserve more in-depth analysis.

Figure 6.4: Diagram of a Holistic Risk Management Strategy



Source: Authors.

those adverse events that occur with less frequency but cause moderate losses to agriculture. This is the layer that insurance companies try to serve, as risk transfer of this type of risk is insurable. However, not all farmers can or are willing to pay for insurance, inevitably relying on risk coping mechanisms (selling of assets, indebtedness, selling labor, migration, or ultimately reducing consumption).

The strategy of risk transfer (agricultural insurance) is relevant only under certain conditions and would be difficult for small-scale producers to obtain individually.

Recent experience in Nicaragua with agricultural insurance closely resembles the international experience. The index-based insurance programs are more complex than initially thought, particularly due to the inherent basis risk.[28] It is also quite technically complex to accurately model the losses that might occur in areas with microclimates and multiple crops. However, the literature suggests that designs of collective insurance related to an "aggregator" of risk have potential for success (World Bank 2011a). The aggregator could be a financial institution, a fertilizer credit association, or simply the local municipal government, which would provide protection from fiscal risk in case of catastrophic events. This is an option that insurers in Nicaragua might like to explore with more chances of success, particularly for linking farmers to financial credit markets.

Due to the frequency and intensity of the shocks experienced by Nicaragua, the large number of small producers, and fiscal constraints, risk mitigation needs to be a strategic priority.

Investments in prevention strategies can save high recovery costs in risk coping. An investment package of risk mitigation that represented only a fraction of the US$107 million in average annual losses could have far-reaching impacts in terms of reducing the effects of the production risks. Prevention strategies are intimately related to the goal of improving the resilience of agricultural production systems.

6.1.4 Suggestions for reducing production risks

According to the data on the estimated losses presented in this document and the capacity of agricultural producers, it is small-scale agricultural producers and their families who are the most vulnerable to the production risks identified here. To reduce this vulnerability and strengthen the resilience of production systems, it is necessary to focus on risk prevention strategies and place a priority on family agriculture, as described in this analysis.

This section presents a series of proposals to reduce unmitigated risks. It should be pointed out that many of the gaps identified here are already being addressed, at least partially, through public initiatives, and that the suggestions about investments and ways to close the gaps presented below take these initiatives into account.

28 When losses occur but insurance does not pay because the meteorological reference station did not record the weather event.

The agricultural research system should be integrated with an agenda focused on climatic risks and productivity.

The system of agricultural innovation has passed through several stages, in which the responsibilities for research, transference, and training have been shared to varying degrees and among various actors from both the public and private sectors. INTA (the Nicaraguan Institute of Agricultural Technology) recognizes the need to share and coordinate research agendas in the agriculture sector. To this end, at the beginning of 2015, INTA, with the participation of all actors in agriculture, created the National System of Agricultural Research and Innovation (SNIA). SNIA is charged with taking up the challenge of reconciling a strategy of agricultural innovation to cope with the challenges of climate change now faced by the agriculture sector, especially with regard to enabling small-scale family agriculture to adapt to climate changes. The incorporation of CSA with much more vigor is becoming a priority option. Agencies such as CGIAR (Consultative Group for International Agricultural Research), CIAT, FAO, IICA (Instituto Interamericano de Cooperación para la Agricultura), and other actors, which can serve as guides for their implementation, have already developed the conceptual frameworks. A recent study by MARENA-PNUD-COSUDE (2014) presented the region of Las Segovias with an interesting range of practices and technologies for adapting to climate change.

The principal challenge of the system of technological innovation will continue to be the transfer of technology. The III CENAGRO of 2001 reported that 30,136 farms received technical assistance and training. The IV CENAGRO of 2011 reported that 46,063 farms received the same, a 52.8 percent increase between the two censuses. Overall 17.5 percent of EAs received technical assistance and training in 2011, according to CENAGRO, representing an important advance. However, an effective link is needed between the recently created SNIA and the providers of technical assistance, given the fragmentation of the latter.[29]

Attention to the traditional system of basic grain seeds needs to be a priority,

including the production, storage, and distribution of native and domesticated foreign seeds. These systems should play a more strategic role in reducing short-term interannual losses and adapting to long-term climate change. The production of basic grains by family agriculture, particularly the segments classified as self-subsistence (which account for more than 70 percent of EAs) is mainly directed at satisfying food security needs. The agricultural surveys of basic grains report that between 50-72 percent of EAs are adversely affected by weather events, being systems that rely on rainfall and where the introduction of improved seeds tends to rapidly encounter financing and coverage constraints, in spite of the efforts of INTA to provide improved seeds.

Unión Nacional de Agricultores y Ganaderos (UNAG), through the Campesino to Campesino (CaC) program, conducted a national survey of native seeds in 2011, resulting in an inventory with 114 varieties of maize (Zea mays), 121 of common beans (Phaseolus vulgaris), 18 of other food legumes (various species of Phaseolus and Vigna), 24 of sorghum and bicolor sorghum, and 8 of rice (Oryza sativa), including native and domesticated foreign varieties (Bendaña 2012). Research revealed that these domesticated foreign varieties are improved conventional seeds that arrived in communities 25-30 years ago and that have been able to adapt to the conditions of the countryside by means of natural selection or directed selection by spontaneously crossing with other local varieties. Examples include pinolero maize, "Rocamel," H5, NBS, NB6, and NB100, which have cross-pollinated with native varieties such as the pujagua, white olotillo, red olote, and the yellow egg yolk, giving rise to a diversity of varieties. Foreign domesticated beans include blackened beans, descendants of DOR 364, Revolution 84, and the Estelí 90, which have adapted to environmental conditions, satisfy local taste, and are easily sold in the market.

The recently created SNIA could prioritize its agenda to ensure that small-scale family agriculture has timely access to genetic materials such as clean, healthy, affordable seeds. This has implications for public policy, which should take advantage of existing regional and local structures that have already made significant progress in this regard. It is important for local organizations to safeguard native genetic materials and preserve local biodiversity. They should develop a network of community seed banks, which would create the possibility of building a decentralized national genetic bank with seed reserves. These seed reserves would aid the process of adapting to climate change by providing materials that are suitable to changing local conditions. In addition, they would contribute to national food security and strengthen the foundation for a national productive strategy to cope with climate change by means of genetic variability (Bendaña 2012).

29 The public sector and forestry institutions provided technical assistance and training to 60.4 percent of the overall 17.5 percent who received assistance. Several different institutions provided training to the rest, often using a variety of approaches confined to particular regions. For the SNIA to be effective, regional and local SNIA representatives will have to play a proactive role not only in coordinating agendas and sharing technical knowledge, but also, and even more importantly, in establishing effective links with the providers of training and technical assistance.

INETER is capable of playing a more strategic role in reducing losses in the agriculture sector and improving decision making with regard to climate change.

Agricultural exports and basic grains face increasing climatic variability that translates into greater volatility in sector performance. INETER realizes that by 2030 appreciable changes will occur in crop suitability distribution; that planting windows will be smaller; and that rainfall distribution will become more erratic. The long-term structural solution is to take a systemic approach to environmental preservation and integrated water resource management. The services of INETER will be key to supporting the long-term strategies of adapting to climate change and the short-term reduction of interannual losses in the agriculture sector.

INETER has the technical capacity and know-how to improve the accuracy, timeliness, and resolution of its agro-meteorological services.

This will provide valuable input to the decision-making process with regard to risk prevention in the agriculture sector. The main bottleneck is the lack of financing to modernize the hardware and software needed to provide the specialized services required for agricultural risk management. Fortunately, existing databases contain the variables needed to improve the management services of climate risks, so the investment needed to apply them would be minimal. Currently, more than 80 percent of INETER's annual budget is allocated towards maintenance of the network (a total of 320 stations: 120 radio telemetric, 10 hydrological, 90 meteorological, 220 rain gauge locations, and 16 main stations) that operates with minimal funding to focus on the urgent task of providing services to agriculture. Data volumes in excess of 20 million mega bytes are being processed with obsolete hardware on slow Microsoft XP operating systems. This is a real bottleneck that can easily be overcome by applying more effective established meteorological services and by drawing on the accumulated experience and lessons learned in several countries in Latin America, Asia, and Africa.

The priority actions for agro-meteorological technical services are, among others, to:

- Design risk maps based on homogeneous climatic areas. This is a basic step to define the geographical boundaries and gradients where areas experience the same impacts during climatic events. However, Nicaragua is a small country and already has soil use maps that use a scale of 1:50,000. These maps would be fairly accurate with regard to the effects of climatic events on Nicaraguan territory.

- Use agro-meteorological indices instead of relying solely on meteorological indices. INETER needs to incorporate indices of water requirements by crop and by homogeneous climatic area into its climate monitoring systems for agriculture. These indices already exist at the Ministry of Agriculture, along with a database and valid methodology. The ministry designed them at the end of the 1990s by crop and by region. They just need to be updated with more recent data.

- Create a working alliance with Ministry of Agriculture (MAG) to publish calendars for planting. The planting timetables are a basic service and a high priority that would provide support to producers as they decide when to plant and would help reduce losses in areas already planted (estimated to be around US$74 million annually on average). This investment by INETER would result in high social and economic returns by helping to reduce losses.

- Transfer information about the climate to producers via cell phones. INETER professionals can design new applications at minimal cost. Once again, the alliance with MAG is very important, as MAG is the entity that manages agricultural information by territory and by crop. Moreover, this platform could be used to provide other services related to price risks. By taking advantage of this platform for cell phones, INETER could offer price information to producers that would facilitate market transparency and improve the decision-making process regarding the commercialization of its products. The high penetration of cell phones in Nicaragua's rural areas could be exploited to install a practical and low-cost system of agricultural information that would potentially provide a high return on investment.

If INETER has sufficient resources to upgrade its hardware and software equipment, the institution can take a giant leap forward in improving its support for Nicaraguan agriculture as it adapts to the new climate norm. This urgent priority can no longer be postponed.

6.2 ADAPTATION TO CLIMATE CHANGE

The CSA concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove GHGs, and require planning to address tradeoffs and synergies between the three pillars of productivity, adaptation, and mitigation (FAO 2010).

CSA practices are not new in Nicaragua, but there is renewed interest in implementing them to adapt Nicaraguan agriculture to climate change. Although the integrative approach of CSA is still a work in progress, many CSA practices are already being used by Nicaraguan farmers to deal with various kinds of production risks (FAO 2013). To more thoroughly integrate the CSA approach into Nicaraguan agriculture, a critical inventory is needed of current practices, options for the future, and potential financial and institutional collaborators. This section presents an overview of current conditions to identify a working baseline for implementing CSA on a larger scale.[30]

The bulk (80 percent) of total GHG emissions in Nicaragua come from land-use change and forestry activities, principally the loss of forestlands dedicated to other uses.

It is estimated that the rate of deforestation is 70,000 ha/year; when added to other processes degrading forest ecosystems, this poses a serious threat to the destruction of forests (Figure 6.5). Only 25 percent of the total land area is covered by forests, while about 40 percent is dedicated to crop cultivation or livestock raising. Approximately 2 million hectares are protected, but only a million of them (50 percent) are forested (INAFOR-FAO 2009).

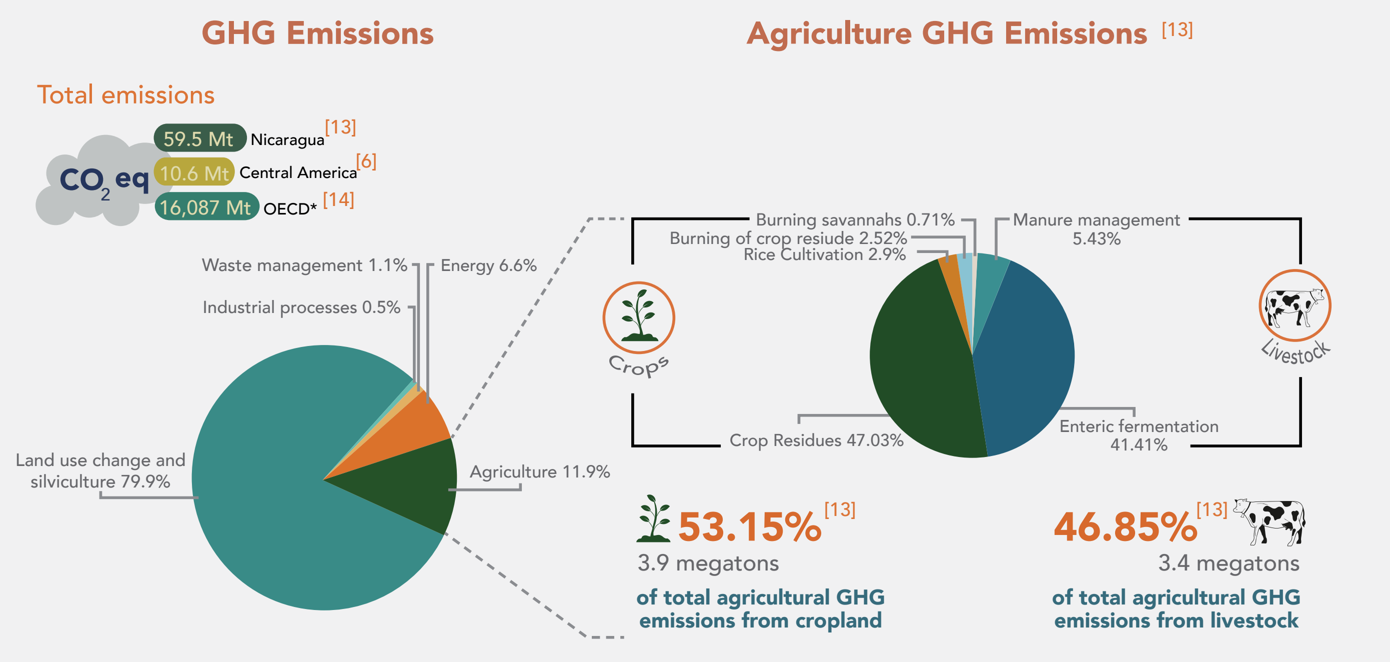
The agriculture sector accounts for 12 percent of total GHG emissions.

N2O emissions coming from nitrification and denitrification processes[31] on agricultural soils represent 47 percent of the agriculture sector's emissions; methane gas emissions from enteric fermentation constitute another 41 percent. Other sources of GHG emissions from agricultural activities include manure management (5 percent), rice cultivation (3 percent), and the burning of agricultural waste in the countryside (3 percent) (MARENA 2008).

Droughts, floods, and rising temperatures represent a daunting challenge for the productive systems of Nicaragua.

Deforestation exacerbates the effect of temperature and precipitation changes in the microclimates (Gourdji et al. 2015). This could have a strong impact on several crops, especially those managed with traditional methods and those using commercial grains instead of improved seed varieties. Figure 6.6 shows changes projected to the year 2030.

Figure 6.5: Agricultural GHG Emissions in Nicaragua

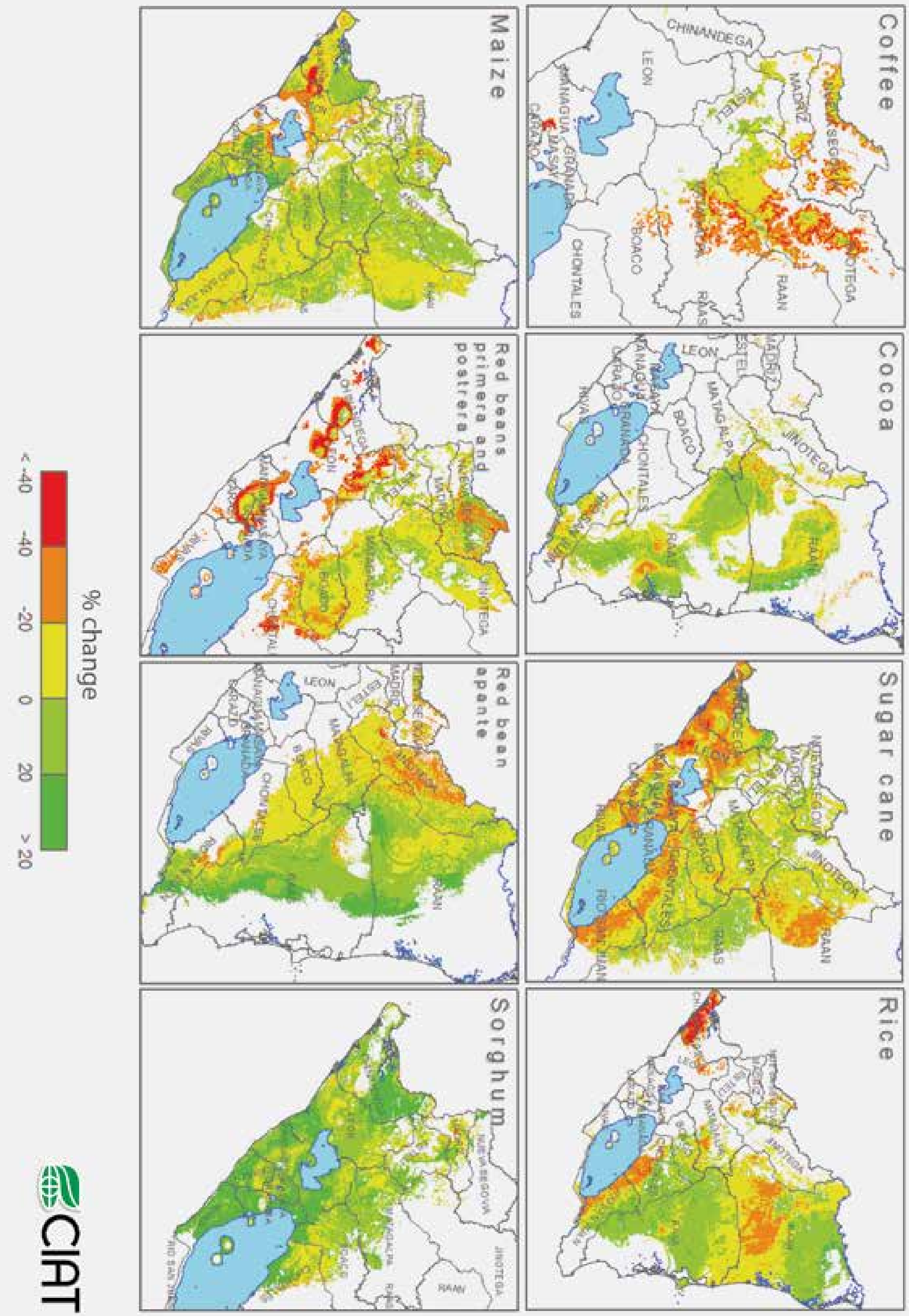


Source: CIAT 2015.

30 Based on Martínez (2015) in a Background Paper commissioned by the World Bank.

31 Nitrification and denitrification are processes that entail the loss of N2O from the soil into the atmosphere, largely coming from the mineralization of animal excrement or organic materials in the soil.

Figure 6.6: Change in Climate Suitability for Nicaraguan Crops, Projected to 2030



Studies have been conducted regarding the impact of climate change on coffee production and on the livelihoods of family producers (Baca et al. 2011). Cacao is classified under the agroforestry system because of its tolerance for warm weather, which makes it less likely to be affected by expected increases in temperatures (Läderach, Martinez Valle, and Castro 2012). IFAD's "Adapting to Markets and Climate Change Project" (NICADAPTA) focuses on these two crops.

Sugarcane and rainfed rice may become less suitable for cultivation in the west of Nicaragua. Red beans grown in the first and second growing cycles will have to be located in cooler areas (unless varieties more resistant to high temperatures are used) and red beans grown in the apante season will have to be located closer to the Caribbean coast, generating even more pressure on land use in this area. The efficient use of water, catchment facilities, and improved varieties are key for crops considered basic grains.

The greatest impacts are caused by droughts, flooding, and erratic climatic variations,

which result in reduced productivity due to the partial or total loss of crops. The impacts are exacerbated by poor soil quality in marginal areas, the presence of pests and diseases, the scarcity of water in the dry corridor, and bad agricultural practices, such as the open burning of waste (CCAFS 2013). Long-term climate projections indicate that the impacts of these climatic events will become more severe in the future as global warming continues.

A study analyzing historical climate data found that a strong warming pattern exists throughout Nicaragua, especially in diurnal temperature increases (~0.40° C/decade) in deforested areas, which are experiencing twice the average temperature rise of tropical areas (Gourdji et al. 2015).

Climate change does not impact all regions of the country and all production systems equally.

For example, the dry zone of Nicaragua is the most vulnerable to drought. Other examples of how climate change impacts Nicaragua's most important export crops and dietary staples include:

- In Las Segovias, municipalities in north-central Nicaragua, the dry season now lasts up to 6–7 months, threatening water supplies and food production for subsistence agriculture crops such as maize, sorghum, and beans (PNUD-COSUDE-INETER-MARENA 2013)
- Rising temperatures and more frequent droughts and floods will present a major challenge for the country's production systems by 2030. Deforestation aggravates the temperature and precipitation changes in microclimates, with potentially strong implications for crops cultivated using traditional practices and commercial, instead of adapted, seed varieties (Gourdji et al. 2015).
- As temperatures increase above the current suitability range (18–28 °C) for coffee production, cocoa may become an important alternative crop. Heat tolerance can be further improved with agroforestry, which may become an important practice in hot areas, such as Waslala, Jinotega, and Río Blanco in the central region (Läderach, Martinez Valle, and Castro 2012).
- For cocoa producers in the southeastern corridor, changing precipitation increases their crops' vulnerability to cryptogrammic illnesses such as Monilia and Black pod. This is especially true on the Atlantic coast in Bluefields, El Castillo, Laguna de Perlas, and El Rama (Läderach, Martinez Valle, and Castro 2012).
- As much as 68 percent of the total area under bean production (148,836 ha) could be susceptible to heat stress of 25°C or more by 2030. Introducing common varieties to cooler, more climatically suitable regions could improve smallholder adaptation (FAO-USAID 2012).
- Rainfed sugarcane and rice crops along the Pacific coast face future suitability challenges. The efficient use of rainwater harvesting and/or catchment facilities, plus the adoption of drought-resistant varieties, will be key to sustained productivity increases.

Nicaragua has made significant advances in developing an effective CSA strategy, including the following:

(i) A coherent regulatory framework designed to promote CSA practices is now in place;

(ii) Producers have been made aware of climatic impacts on various systems of production; and

(iii) Scattered efforts are now being consolidated, with the identification and validation of practices, technologies, and strategies designed to promote and create small businesses as suppliers of technological products and services at various scales.

The National Plan of Human Development (NPHD) contains a productive sector strategy that prioritizes the family, community, and cooperative economy, as well as sovereignty and food security in a scenario of climate change. The productive strategy recognizes the need to coordinate with the generation and incorporation of science, technology, and innovation to propel a qualitative leap towards greater productivity (Government of Nicaragua 2012).

Small-scale producers have adopted a series of measures of adaptation that vary according to the system of production and level of organization.

For example, small-scale coffee producers are already implementing initiatives such as reforestation with different timber species, shade management, soil and water conservation, pest and disease management (use of mineral stocks and monitoring), reduced use of agrochemicals, waste management (e.g., mucilage), the use of new varieties, and diversification.

INTA in conjunction with other institutions has carried out projects aimed at producing and delivering drought-resistant seeds, mostly maize and bean seeds. Similarly, MARENA and MEFCCA (Ministry of the Economy for Families, Communities, Cooperatives, and Associations) are implementing programs and promulgating practices to help the agriculture sector adapt to climate change.

Several nongovernmental agencies (including CATIE, CRS, Christian Aid, and COSUDE) and producer organizations (including CECOCAFEN, Cafenica–Soppexcca, UNAG, and UPANIC) are currently promoting a series of climate-smart practices, such as rainwater harvesting, water and soil conservation projects, diversification of farm crops, restricted burning, agroforestry systems, the use of high-quality, nutritional, drought-resistant forage crops, and the use of improved varieties of cacao. Box 6.1 outlines the main directions that practices should take for the various actors to adapt their activities to climate change.

Sustainable environmental practices need to be identified and incorporated into the national system of technological innovation.

Figure 6.7 offers a selection of practices that are essential for the agriculture sector to adapt to climate change.[32] They are compatible with Nicaragua's agricultural production systems and appropriate for the country's socioeconomic conditions. They should be adopted and included in the transfer of technology.

Box 6.1: Considerations Regarding CSA

A,P,M. Cattle feeding in the summer is crucial and often problematic; hence, practices are being promulgated with regard to conservation of forage and creation of protein banks of leguminous shrubs and leguminous hay varieties, along with energy banks of sugarcane.

A,P. With respect to the production of basic grains, the following are being promoted: elimination of open burning of waste and use of green fertilizers, Rhizobium, and improved seed varieties. Leasing and sharecropping contracts must contain clauses ensuring the protection of natural resources in keeping with national legislation.

A,M. Silvopastoral and agroforestry systems have proven themselves to be key with regard to environmental restoration and food security, and will contribute significantly in adapting to and mitigating the impacts of climate change.

A,P. With regard to coffee production, in addition to management of the coffee bean tissue, agroecological practices that should be adopted include the integral management of the coffee berry borer (CBB) with entomopathogenic fungi and the use of lime sulfur sprays to combat rust.

I. The transfer system must be strengthened to address market failures. Existing mechanisms must be adapted to the production conditions in marginal areas (food security) and areas with high productive potential.

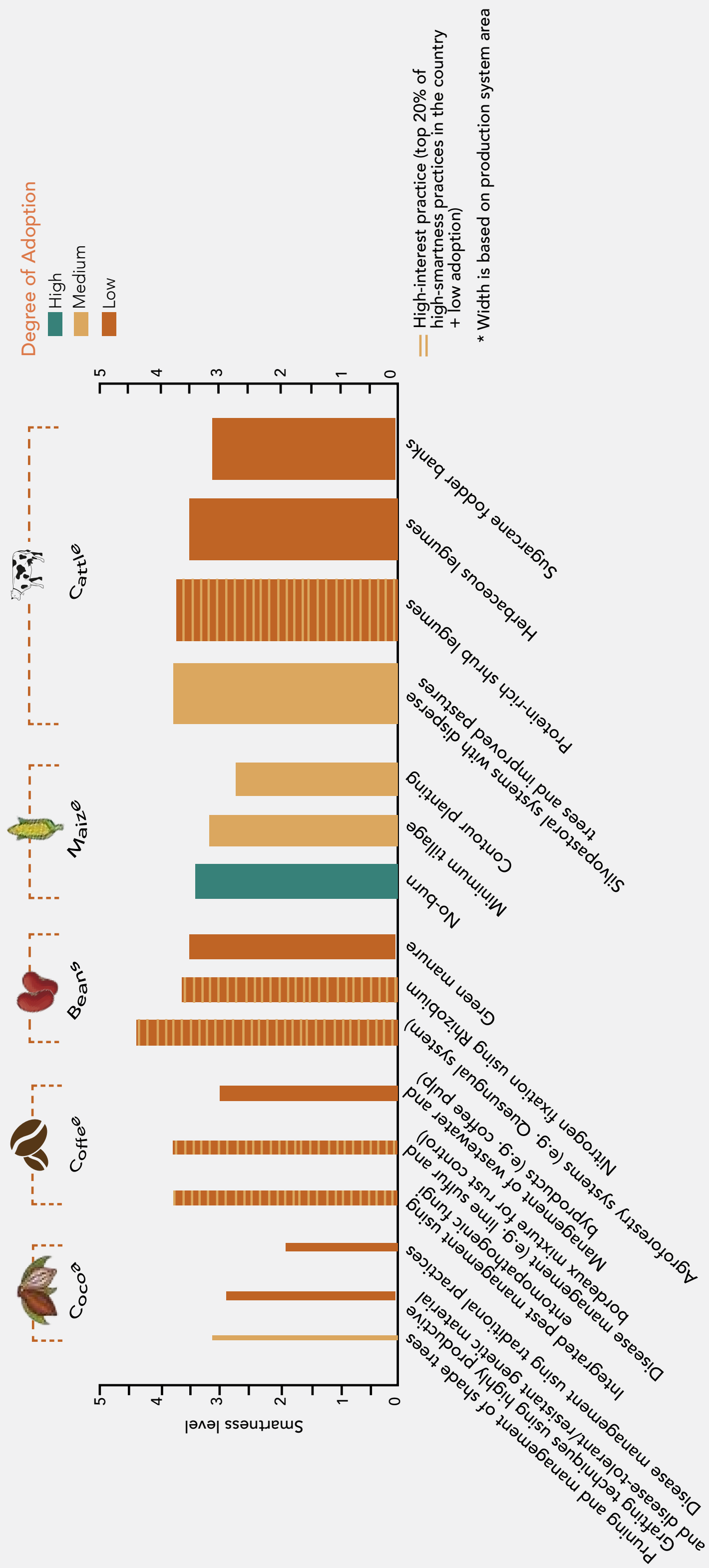
I. An action plan with defined roles and goals for the agriculture sector to adapt to climate change should be developed and promulgated. The objective is to ensure operational collaboration among public institutions and to align their activities with the various initiatives carried out by NGOs.

F. At the organizational level, facilitating transfer of technology and financial assistance to producers is vital. Particularly striking is the case of the coffee and cacao producers, whose cooperation in the use of agroforestry systems (for environmental restoration) is critical, especially given their current and future importance to the Nicaraguan economy.

Key: A= Adaptation, **M**= Mitigation, **P**= Productivity, **I**= Institutions, **F**= Finances.

32 This graph displays the smartest CSA practices for each of the key production systems in Nicaragua. Both ongoing and potentially applicable practices are displayed, and practices of high interest for further investigation or scaling up are visualized. Climate smartness is ranked from 1 (very low positive impact) to 5 (very high positive impact).

Figure 6.7: Select CSA Practices for Production Systems with High "Climate-smartness" for Nicaragua



Source: CIAT 2015

Box 6.2: Dynamic Information Frameworks for Decision Support to Policy Makers

Introduction

Globally, as population increases, urban areas expand, agriculture intensifies, and climate changes, natural and human dominated landscapes are under increasing pressure. For example, land use actions at a discrete spatial location can have hydrological flow impacts hundreds to thousands of miles away. Floods and droughts are increasingly impacting rural and urban settlements, biodiversity, freshwater availability, agriculture and livelihoods. Climate variability and change is forcing changes in temperature and rainfall regimes, reduction of mountain glaciers, rising sea levels, and the frequency and intensity of extreme events.

Definition of a landscape:

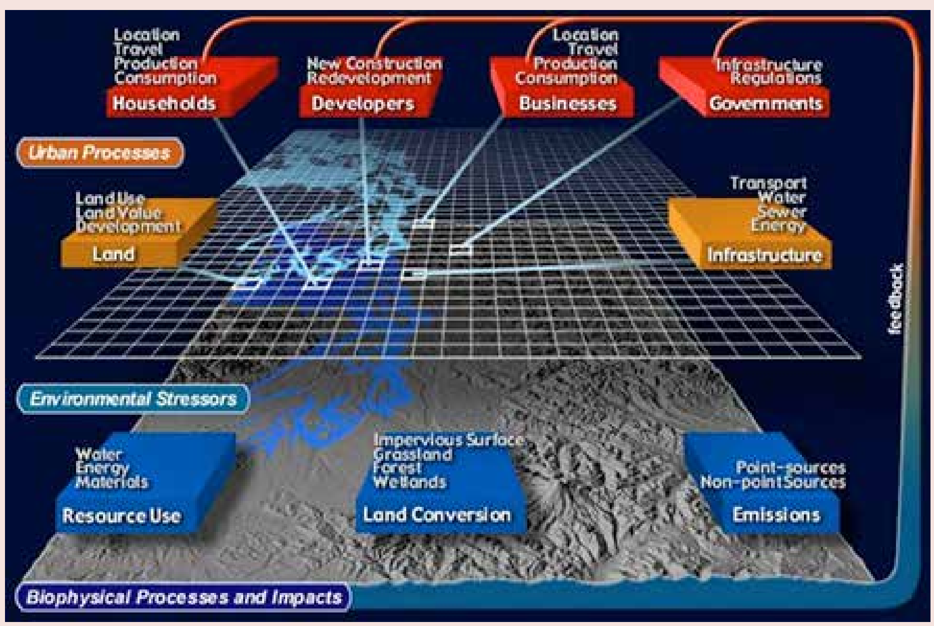
"A 'landscape' is a socio-ecological arrangement that consists of a mosaic of natural and/or human-modified ecosystems, with a characteristic configuration of topography, vegetation, land use, and settlements that is influenced by the ecological, historical, economic and cultural processes and activities of the area. The mix of land cover and use types (landscape composition) usually includes agricultural lands, native vegetation, and human dwellings, villages and/or urban areas. The spatial arrangement of different land uses and cover types (landscape structure) and the norms and modalities of its governance contribute to the character of a landscape.

Depending on the management objectives of the stakeholders, landscape boundaries may be discrete or fuzzy, and may correspond to watershed boundaries, distinct land features, and/or jurisdictional boundaries, or cross-cut such demarcations. Because of this broad range of factors a landscape may encompass areas from hundreds to tens of thousands of square kilometers." (EcoAgriculture, Policy Note 10, 2013)

Resource managers and policy makers are grappling with decisions and the prioritization of urgently needed investments for sustainable development across multiple sectors in the face of dynamic and interacting impacts of population growth, food, energy, and water demands changing climate from local to landscape scales. Both mitigating the drivers of negative impacts and enhancing resilience to unavoidable shocks requires geospatial data *(Figure 1)*, linked multisector data systems *(Figure 2)*, and simulation platforms to facilitate critical and timely decision-making in the absence of adequate information and scenarios of projected change.

Examples of some the questions faced by resource managers and policy makers include:

- What effects would changing climate (temperature, rainfall) have on agriculture, water resources and biodiversity?
- How would changes in land use practices affect water supply, water quality, and biodiversity? What are the impacts of changes in agriculture and forestry practices on local to regional water balances?
- How does biodiversity respond to altitude, soil, and climate gradients?
- What are the linkages between biodiversity and agricultural productivity?
- Can climate data over a growing season be used to improve crop selection (and fire management)?
- Can floods or droughts be anticipated and likely impacts simulated one or two months in advance?



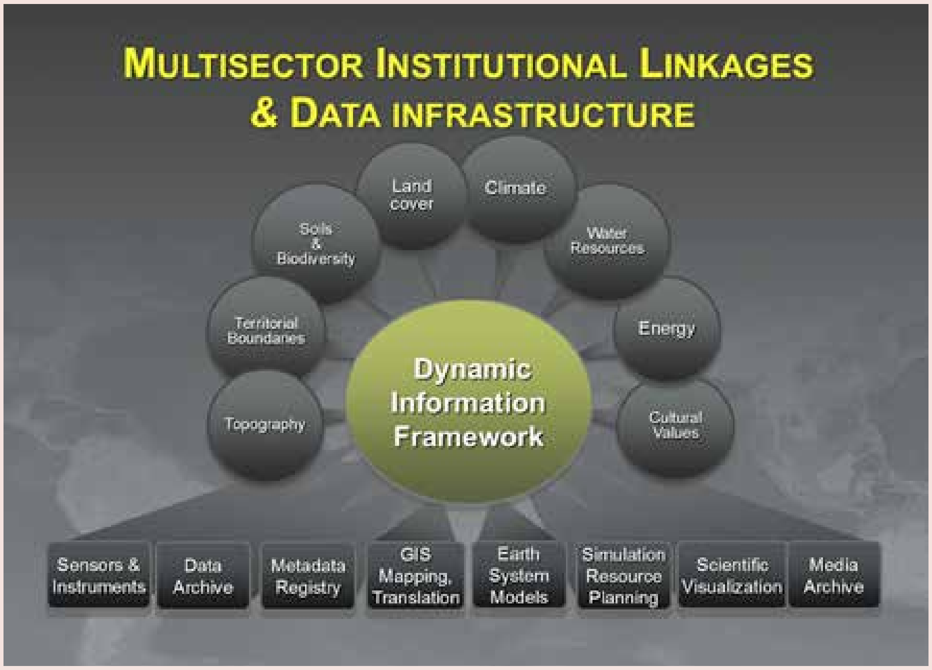


Figure 2: Multisector data infrastructure and institutional linkages

What is a Dynamic Information Framework (DIF) and why is it needed?

To respond objectively and quantitatively to the questions posed above, it is essential to have (a) actionable information, (b) synthesis of the information, and (c) "bringing to life" (simulation) of the key information to provide integrated and local to landscape scale impact and outcome scenarios that can be compared and assessed by decision makers.

The objective of the Dynamic Information Framework (DIF) is to provide a geospatial gateway for (i) multisector data repository and data organization, (ii) coupling the data to new generation Earth System Science models, and (iii) using the models to produce dynamic simulations and integrated, nested local to landscape scale impact scenarios. The scenarios can be modified to suit a variety and levels of natural resource (topography, soils, vegetation, biodiversity) and other change drivers in both space and time so that decision makers can evaluate best case-worst case outcomes as a basis for assigning priorities, timing, and levels of needed investments. The DIF can also serve as an efficient Monitoring, Reporting, and Verification (MRV) tool for governments and donors.

Methodology & Components

A central component in the DIF-based, local to landscape approach of resource planning and management is based on how water and the landscape converge, in space and time. Water provides spatial, time-based, and operational connectivity among the multitude of DIF layers and everyone understands water (one has it or not, it is of adequate quality or not, it is available in the right place at the right time or not). Most important, water is observable, measureable, and subject to being modeled, as a function of known drivers and spatial-temporal relationships.

To meet these challenging criteria, the DIF approach uses a new class of open and publically accessible hydrology models, which also serve as overall landscape models, because of the processes (and data layers) they represent. The requirements of the model dictate what data modules must be assembled and the output variables for the Decision Support System (DSS).

The Earth System model *(Figure 3)*, the core of the computation engine, is a geospatial hydrology model that explicitly represents the effects of vegetation, topography, and soils on the exchange of moisture and solar energy between land and atmosphere. The core model can then be coupled to other models, and compared to independent data sources, to ultimately provide the basis for management-focused applications in the DSS. The results of model runs are complex, multi-layer, 4-dimensional (including space, time) analyses of landscapes and their resources that require visualization (graphs and short movies) to make complex technical outputs understandable by policy makers *(Figure 4)*.

The information required to support modeling and decision support is derived from multiple sources. Even in very remote, data-sparse regions, global coverages can provide at least first-order estimates (e.g. Google Earth). There are three types of data that are needed:

1. Static data such as the basic structure of the river basin (topography, river networks), soil properties (how deep are the soils, what is their texture), vegetation properties (rooting depth, height, leaf area index).

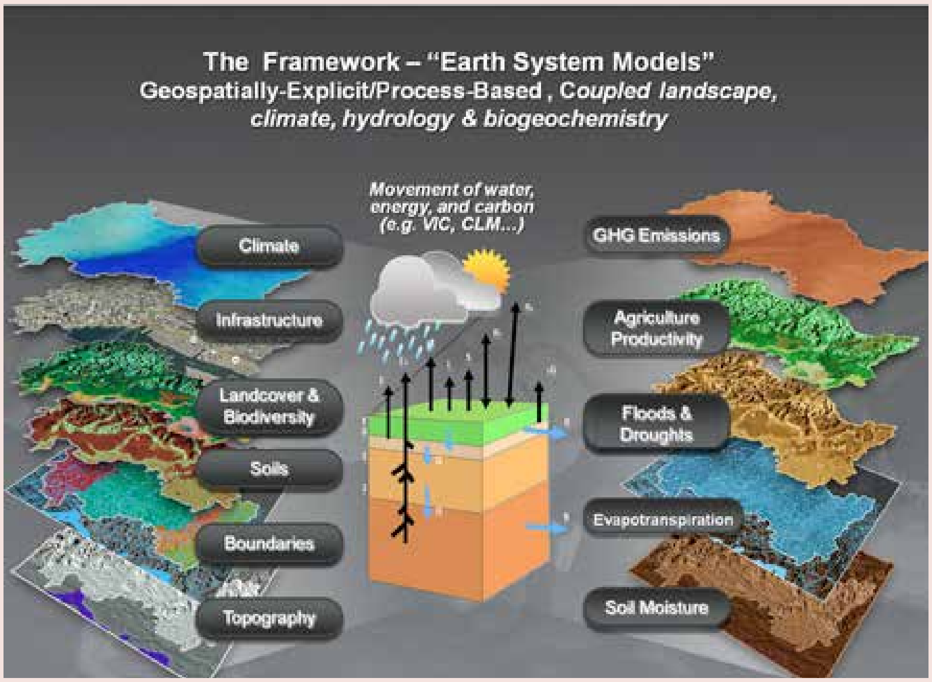


Figure 3: Earth system model with data layers

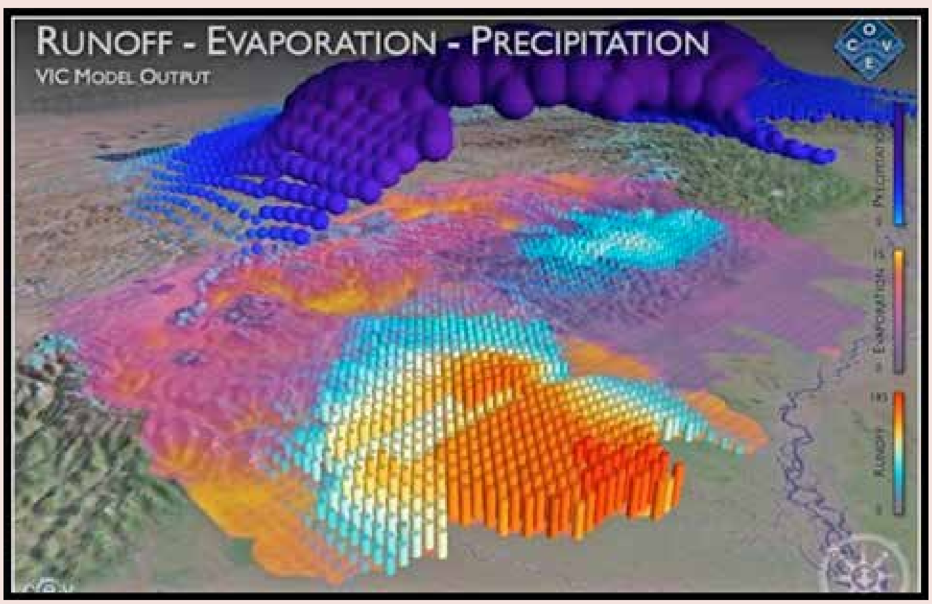


Figure 4: Complex data to Easy 4-D Visualization

2. Climate forcing data, which includes the daily average precipitation, minimum and maximum temperature, and winds. These dynamic data "drive" the model and can be derived from meteorological observation networks, climate weather models, or directly from satellite observations. Changing the climate forcing data, allows testing of different climate change scenarios at scales that are much more relevant for policy makers than the scale of global or regional climate models.

3. Model calibration and validation data e.g. river/stream flow as measured by gauges. These data are used for model calibration and to test the calibrated model, against observed data from a different time period than used for calibration.

Examples of Prototype DIFs in Central Asia, South Asia, East Asia, and Latin America

http://test4.ocean.washington.edu/

http://www.drukdif.ocean.washington.edu/

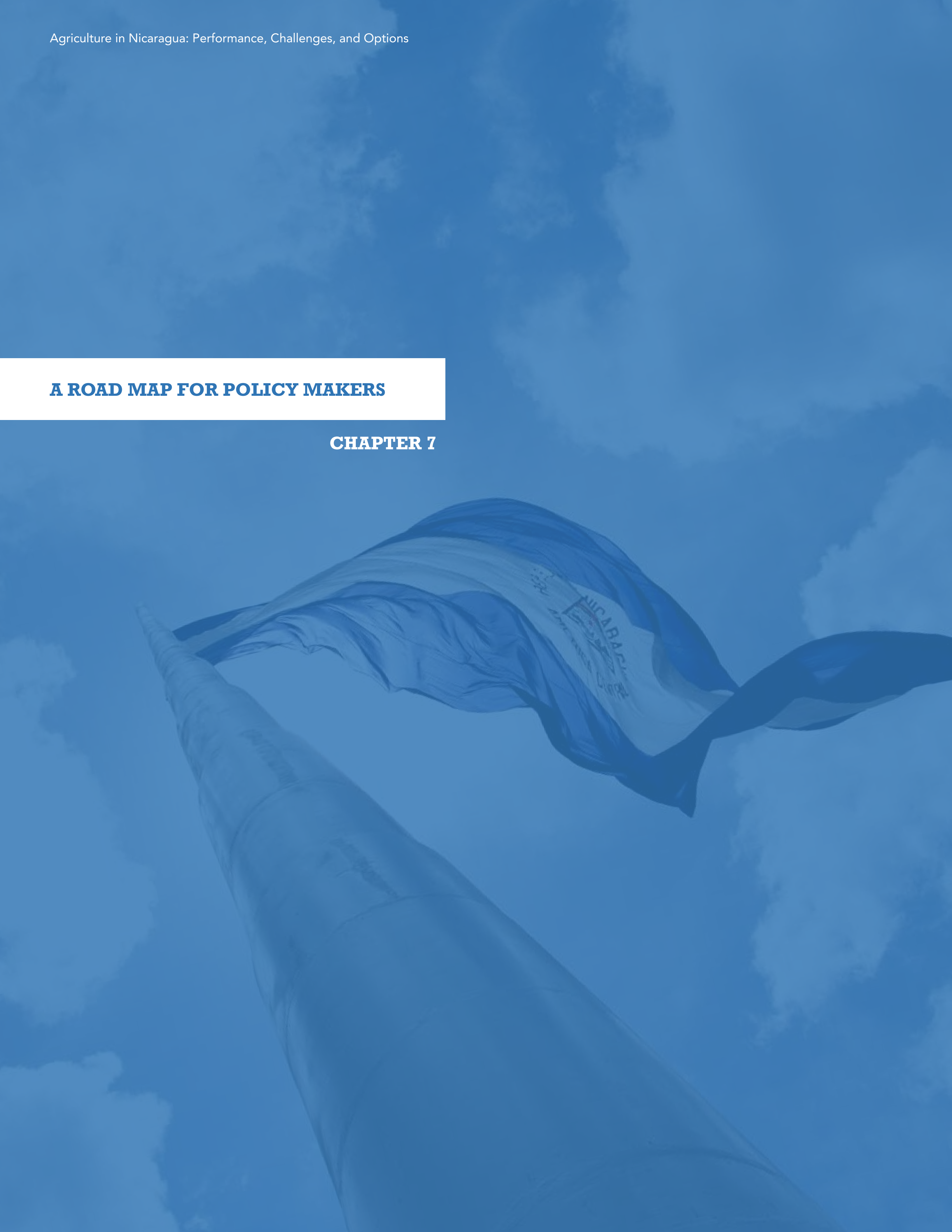
http://vmb.ocean.washington.edu/

http://pangaea.ocean.washington.edu/

Nicaragua flag by Jorge Mejía peralta / CC BY 2.0

A ROAD MAP FOR POLICY MAKERS

CHAPTER 7



This document contains several assessments, all of which support the argument that betting on agriculture in Nicaragua makes sense. A number of reasons explain how activities in the agriculture sector positively impact national development:

(i) The multiplier effects of this sector extend well beyond the farm and have strong forward and backward linkages. A 1.0 percent increase in agricultural GDP generates a 0.6 percent increase in non-agricultural GDP, a figure that is quite high relative to other Latin American countries;

(ii) As long as the manufacturing and construction sectors do not absorb the rural labor force, agriculture will continue to be the highest source of employment in Nicaragua, especially for nonskilled workers, employing more than half of the poor and nearly a fifth of the non-poor. Furthermore, agriculture provides a safety net for smallholders and those living in poverty, as 65 percent of all poor and 80 percent of all poor living in extreme poverty live in rural areas and their livelihoods come mainly from agricultural activities;

(iii) Agriculture, the sustainability of natural resources (including soil, water, and biodiversity), and the impact of agriculture on the climate and vice versa are inextricably interconnected. Given that agriculture is a key sector of the Nicaraguan economy, the occurrence of risk events has repercussions on the growth of the economy, public finances, the performance of value chains, and the food security of the most vulnerable sectors, and

(iv) Agriculture, especially smallholder agriculture, plays a crucial role in preventing food and nutritional insecurity. food and nutrition security, a "business as usual" approach to agriculture will not utomatically translate into improved nutritional outcomes for vulnerable groups of the population, nor will it necessarily be sustainable. In agriculture, specific nutrition-sensitive actions such as investing in female smallholder farmers, biofortified crops, and improving nutrition knowledge to enhance dietary diversity must continue to be pursued to achieve full food security, including nutrition security.

Based on the key findings of this paper,this chapter highlights areas that need attention to improve the agriculture sector's international competitiveness, provide opportunities for broader-based growth in agriculture, and manage climatic risks. The recommendations are grouped in order of priority, on four main fronts: (i) development of an incentive framework; (ii) achievement of greater inclusiveness; (iii) effectiveness of public spending; and (iv) management of climatic risks.

7.1 DEVELOPMENT OF AN INCENTIVE FRAMEWORK

Key recommendation:

Invest in rural road infrastructure to reduce transport costs. Nicaragua's road infrastructure is one of the less developed in the region. According to the Ministry of Transport (MTI), less than 40 percent of the road network was in good or very good condition in 2011, and more than 30 percent of roads become unusable during the rainy season (May to October) for the primera and postrera agricultural cycles. The great majority of roads have been well maintained in recent years, but they represent less than one-third of the total road network. Reducing transaction costs in agriculture, including high post-harvest losses, could be improved by:

(i) Increasing farmers' access to processing centers and markets by adopting a more aggressive strategy to build, update, and maintain rural roads that serve productive zones in priority areas. Strategically linking rural roads to secondary and trunk roads would increase connectivity, boosting productivity in the agriculture sector;

(ii) Emphasizing rural road maintenance through the programs of the Fondo de Mantenimiento Vial (FOMAV) and funding arrangements to ensure that rehabilitated roads do not deteriorate prematurely and to protect recent investments in the rural road network.[33] Well-designed public-private partnerships could reduce the financial burden on the public sector and increase overall efficiency;

(iii) Shortening the distance between farms and refrigerated storage facilities, distribution, and processing centers by facilitating the establishment of such facilities near rural production zones. The facilities could be built by cooperatives and producers' associations with government support or guarantees; and

(iv) Considering disaster risk in road planning and designing and constructing infrastructure likely to withstand the area's extreme weather conditions. MTI may consider emphasizing properly reinforced infrastructure rather than simply expanding the size of the transport network, given the frequency of damage by natural disasters, as well as the difficulty of maintaining a growing road network.

33 Road maintenance is cost efficient given that the cost of maintaining a road regularly is an order of magnitude less than rehabilitating it once every 10 years.

Other recommendations:

Improve logistic services' efficiency. Border crossings and weigh stations are often a source of delays and corruption, increasing logistics costs and reducing reliability. Low-cost measures to increase efficiency could be achieved by:

(i) Implementing a Weigh Station Review and Strategy to identify specific reasons for long delays by station and to monetize and ferret out corruption practices at weigh stations; and implementing changes according to findings and best practices in the region. Some examples include installing scanners and closed circuit television (CCTV), centralizing and recording the data, and providing public access to inspection site websites. Some of these methods have been successfully implemented in El Salvador in recent years. In addition, to ensure efficiency of equipment, El Salvador outsourced the maintenance of scanners and cameras;

(ii) In the short term, synchronizing border agencies' schedules and improving their coordination. For instance, reduce double inspections by having border agencies conduct inspections together when possible. In addition, coordinate with neighboring countries to ensure that their schedules are in sync with those of Nicaraguan border agencies.[34] Consider installing non-intrusive equipment to facilitate inspections.[35] In the medium term, establish a single window system, whereby all primary controls are carried out by customs;

(iii) Improving customs' risk management system, which is only partly implemented, as demonstrated by low detection rates and a high percentage of physical and documentary inspections, often causing considerable delays in clearing imports. Thus the need to complement the risk profile system with additional information to help assure fair selection of inspections, minimize opportunities for corruption, and reduce the need for the high percentage of inspections;

(iv) Continuing with carrying out improvements suggested in the Custom Assessment Toolkit (CAT); and

(v) Learning from best practices in the region on ways to facilitate and improve customs processes.[36]

Improve border efficiency and regulations. Sanitary and phytosanitary (SPS) procedures are often burdensome for importers and exporters. They have become increasingly stringent due to a combination of factors including genuine intent for protection following growing concerns over food-borne diseases, inefficient sampling and procedures, and disguised protectionism. Additionally, border-crossing times in Central America are often long and unpredictable, raising transport time and costs. Waiting times vary widely among Nicaragua's border crossings and even within a border crossing. For example, truckers reported spending anywhere between 2-24 hours at the Peñas Blancas border crossing with Costa Rica. Efficiency could be achieved by: (i) proactively addressing the use of SPS measures as non-tariff barriers to trade as part of regional initiatives to improve trade, integration, and competitiveness,; (ii) collaborating with other countries in the region in an attempt to reduce duplicate inspections and sampling by sharing resources and quality services;[37] (iii) facilitating the inspection process by implementing preclearance of low-risk perishable products prior to completion of laboratory testing; and (iv) coordinating inspections with other border agencies to reduce the number of inspections.

Improve efficiency by reducing empty backhauls. The relatively high rate of empty backhauls throughout the region results in inefficiencies and higher prices for importers and exporters, which can be improved by: (i) working with neighboring countries to develop an explicit agreement for the reciprocity of backhaul for cross-border trucking, including to and from free trade zones; and (ii) promoting coordination mechanisms that match supply and demand for trucking services, such as through the use of specialized websites that help find loads for trucks.

Promote greater regional integration. Nicaragua relies heavily on port gateways in Honduras and Costa Rica, and on the transit system - road and procedures - in connecting Nicaraguan importers and exporters. Around 70 percent of Nicaraguan trade is hauled along the Pan-American Highway through Honduran and Costa Rican border crossings and ports. More efficiency could be gained if Nicaragua took a greater regional perspective into account when developing its infrastructure and logistics services. Given its dependence on neighboring countries, especially in the medium term, Nicaragua may find it more efficient to prioritize investments on integrating systems, procedures, and regulations in an attempt to facilitate trade in the region. For instance, improving border procedures through standardization of SPS requirements and a single bill of lading would likely reduce delays at border crossings, with limited investment required.

34 For instance, the South American integration market (MERCOSUR) and Chile arranged for a border crossing coordinator at each station, setting common schedules (schedules should be included in international agreements). In addition, some of the SPS functions in Chile are delegated to customs, and at small crossings border control includes representatives of the immigration, agriculture, and health authorities. In Guatemala's Puerto Quetzal, for example, coordination goes beyond local agencies, with El Salvadorian customs representatives present there as well.

35 The introduction of scanners should include ports and all border agencies. The World Bank has offered to provide assistance to facilitate the process of selecting an appropriate business model and locations, technical specifications, and other considerations. The bank has experience in non-intrusive projects in El Salvador and Costa Rica.

36 For instance, El Salvador's risk management system applies selectivity based on automated compliance measurement and risk profiling systems to target suspect consignments, minimizing the physical inspections.

37 For countries that are partners in trade agreements, the duplication of SPS inspections can be avoided through a common set of testing procedures, saving considerable time and costs, particularly for perishable goods.

7.2 ACHIEVEMENT OF GREATER INCLUSIVENESS

The heterogeneity of family agriculture poses the challenge of formulating policies and implementing programs that will provide appropriate support to generate positive externalities associated with inclusiveness, food security, and the environment. Policy design and effective program interventions can be complex, thus the need to better target interventions to support the livelihoods of family farming households, aiming at improving the effectiveness of poverty reduction strategies.

Key recommendation:

Promote differentiated policies and interventions that take into account a typology of producers. Family farming in Nicaragua is heterogeneous in production systems, sources of income, and livelihood strategies. This stresses the need to adopt differentiated policies and interventions to promote economic and social welfare. Targeting differentiated policies and interventions for the various typologies that compose family agriculture (subsistence, transitional, and commercial) can be achieved by:

(i) Targeting subsistence farmers with assistance programs such as income support and cash transfers, comp lemented by food security programs and livelihood strategies not necessarily related to agriculture but that can include agriculture. In Nicaragua, Hambre Cero and Usura Cero are good assistance programs for these farmers. Other initiatives help subsistence farmers develop a "social safety net" or network of contacts to provide support if needed. These can be oriented towards families trapped in extreme poverty in rural areas;

(ii) Identifying and designing productivity programs and market linkages strategies for transitional family-based farming; improving access to agriculture productivity by enhancing services such as extension, financial services, titling, etc., and by assisting farmers in acquiring other sources of income, such as facilitating access to funding for business startups, retraining, and other agricultural and non-agricultural programs to facilitate diversification of livelihoods; and promoting partnerships, associations, and alliances between associated producers and buyers - this allows transitional farmers to enter new markets, build their capacity, create social capital, and take advantage of economies of scale; and

(iii) Adopting strategies to support the competitiveness of commercial family-based farming. The public sector can play an important role in dealing with market failures such as access to credit, technology, logistics services, information, and the overall incentive framework, as already discussed.

Other recommendations:

Incorporate crosscutting strategies into interventions. The determining factors with regard to productive efficiency examined in this paper cover aspects related to economies of scale, levels of technological adoption, and the organization of producers. Incorporating measures to boost competitiveness could be achieved by:

(i) Introducing strategies for fostering the creation of associations and cooperatives as a way to boost competitiveness, since they provide small-scale producers with access to new markets, improve their overall capacities, boost social capital, and permit greater economies of scale;

(ii) Complementing productive strategies with other subsector initiatives. Productive improvements associated directly with production (technological adoption and scale) are relevant in beans; while for dairy and coffee production chains, there is a higher need to complement productive improvements with those supporting collective action among farmers (particularly small-scale farmers) and vertical links with markets to drive productive and quality improvements; and

(iii) Establishing a strong link with private sector supply chains. Platforms for the coordination of public and private efforts in the implementation of these strategies/plans are gradually being established; their future consolidation is critical to ensure gains at the sector and producer levels.

Address productivity gap across subsectors (dairy, beans, coffee). Higher aggregate rates of growth and productivity at the subsector level can be achieved by:

(i) Targeting dairy producers displaying low to medium efficiency levels (particularly those productive units above 10.5 mz);

(ii) Targeting efficiency improvements among bean producers along the three efficiency levels, particularly those with capacity to scale up/ expand production, as identified in Chapter 4; and

(iii) Fostering efficiency among coffee producers displaying low and medium efficiency levels.

(iv) Improving the efficiency of family farmers in the three productive sub-sectors could have less impacts in growth and productivity at the aggregate sector level (with the exception of coffee), yet, it will be crucial to support objectives of inclusive growth, food security, and poverty reduction.

Adopt a geographic focus. Focusing efforts geographically, and under several other considerations including environmental and future climate impacts, is needed to materialize gains in productivity and/or support diversification of livelihood strategies. Key sub-sectoral considerations are:

(i) Beans: most of the low efficiency production units are concentrated in the southern Caribbean and Las Segovias dry corridor, where several areas are low and not suitable for bean production and are highly vulnerable, given persistent drought. These areas demand strategies to increase resilience to climate variability, for example, through water harvesting. In some cases, diversification of production and of livelihood strategies, rather than productivity improvements, might be priority considerations.

(ii) Dairy: targeting the sustainable intensification of dairy production in municipalities concentrating productive units displaying low to medium efficiency levels via productivity improvements could significantly contribute to environmental sustainability by reducing the pressure to replace forestland with pastures.

(iii) Coffee: climate projections forecast a significant reduction in production viability for coffee production – in the 365 to 1000 masl (meters over sea level) range production will be severely affected by expected increases in temperature, involving several areas in the departments of Jinotega and Matagalpa (which contain about 58 percent of the coffee-producing units countrywide). Therefore, conversion to other types of crop production and livelihood strategies are needed.

7.3 IMPROVING THE EFFECTIVENESS OF PUBLIC SPENDING

Nicaragua has experienced a decade of economic growth, positive trade expansion, and public expenditure increases to reduce poverty levels. Whereas the progress in poverty reduction is considerable, it is still not enough to lift massive numbers of rural households out of poverty. As public spending in agriculture is a key component in the mix of interventions aiming at a more equitable distributional impact of growth, more effort is needed for more effective public spending.

Key recommendation:

Increase the share of agricultural expenditures going to public goods. Nicaragua has comparatively and historically low public spending on agriculture, but spending on rural development is higher and has been rising. The policy shift toward food security during the last six years is fully reflected in spending patterns, which also indicate a strong, albeit more tacit, policy shift toward public spending on private goods. This has also been mirrored by the rise of official development assistance (ODA) directly to the agricultural private sector. On the other hand, Nicaragua has seen a smaller share of agricultural expenditures going to public goods like R&D, natural resource management, and animal and plant health. Renewed attention to the delivery of these and other public goods would generally benefit a broader swathe of producers and could help to reverse the declining productivity in some agricultural products.

Other recommendations:

Improve targeting of development assistance programs. Ideally, a well-targeted agricultural spending program should be biased in favor of those regions that have agricultural benefit potential, but are lagging in efficiency and productivity. The territorial approach of the former PRORURAL, for example, was focused at a variety of different geographic levels, but outcomes and outputs were not tracked in a systematic way across geographic divisions.

Adapt agricultural public spending to match differentiated policies and interventions. Family agriculture in Nicaragua is heterogeneous in production systems, sources of income, and livelihood strategies, as mentioned earlier. This stresses the need to adapt public expenditure policies to support differentiated strategies for the various segments of family-based farming typologies. In this way, it will be easier to: evaluate the intended results, particularly those regarding distributive impacts of the increasing poverty focus of agricultural programs over time; and avoid large leakages to wealthier households.

Build consistency on strategic programs over time. Many program lines have shown large volatility from one period to the next, with some programs disappearing and reappearing over time. For areas such as crop management, seed production, and product development, which are likely to see their structural impact only in the medium to long term, maintaining consistency of public spending in available resources would enhance their impact. Building a national consensus on the direction of some of the smaller but crucial programs may help to maintain the strategic focus across time and ensure a steady flow of resources over longer periods of time.

7.4 MANAGEMENT OF CLIMATIC RISKS

Practices aimed at building the resilience of agricultural and forestry systems are not new in Nicaragua. However, due to the urgency to manage interannual weather shocks and the need to adapt to climate change, large-scale implementation of these practices must take place. The following are among the measures identified as being most effective:

Key recommendation:

Strengthen the resilience of agricultural systems. This could be achieved by reinforcing activities related to CSA. Reinforcing the development of the following CSA practices could go a long way to start the process of strengthening resilience in agriculture:

(i) Promulgating practices in cattle raising with regard to conservation of forage and creation of protein banks of leguminous shrubs and leguminous hay varieties, along with energy banks of sugarcane;

(ii) Promoting elimination of open burning of waste in basic grain production and the use of green fertilizers, Rhizobium, and improved seed varieties. Leasing and sharecropping contracts must contain clauses ensuring the protection of natural resources in keeping with national legislation;

(iii) Introducing programs incorporating silvopastoral and agroforestry systems. Silvopastoral and agroforestry systems have proven themselves to be key with regard to environmental restoration and food security, and will contribute significantly in adapting to and mitigating the impacts of climate change;

(iv) Developing and promulgating an action plan with defined roles and goals for the agriculture sector to adapt to climate change. The objective is to ensure operational collaboration among public institutions and to align their activities with the various initiatives carried out by NGOs; and

(v) Facilitating transfer of technology and financial assistance to producers is vital, particularly in hard-hit areas of the dry corridor of Nicaragua, where a vigorous plan to introduce CSA is much needed.

Other recommendations:

Adopt risk prevention strategies as a priority for risk management. Nicaragua needs to start making the transition to adopt a more effective ex-ante risk prevention strategy against weather risks, rather than relying on over-costly ex-post reactionary policy. This could be achieved by:

(i) Integrating the agricultural research system with an agenda focused on climatic risks and productivity. SNIA is charged with reconciling a strategy of agricultural innovation to cope with the challenges of climate change now facing the agriculture sector, especially to enable small-scale family agriculture to adapt to changes in climate;

(ii) Developing the capacity to effectively transfer technology. Nicaragua needs to incorporate cutting-edge technology into the transfer of technology and deliver it more efficiently and economically. The use of cell phones provides a solid platform that could be greatly exploited at low cost;

(iii) Prioritizing attention to the traditional system of basic grain seeds, which includes the production, storage, and distribution of native and domesticated foreign seeds; plus support the efforts to more efficiently and thoroughly integrate the seed supply chains in a more market driven manner; and

(iv) Prioritizing the agenda of the newly created SNIA to ensure that family-based agriculture has timely access to genetic materials, such as clean, healthy, and affordable drought-tolerant seeds.

Strengthen INETER's capacity to play a strategic role in risk management. INETER has sufficient technical capacity to play a more strategic role in reducing losses and increasing productivity in the agriculture sector. Investing in INETER is key to enhancing decision making and managing risks associated with climate change, especially those related to drought. The following measures are priority areas for the technical services INETER could provide to agriculture:

(i) Designing agricultural risk maps based on agro-meteorologically homogenous zones. INETER needs to incorporate indices of water requirements by crop and by homogeneous climatic area into its climate monitoring systems for agriculture. The information exists at the Ministry of Agriculture, and INETER technical staff can design the applications;

(ii) Designing and using agro-meteorological indices instead of relying solely on meteorological indices. This would be a giant step forward and at minimal cost, since databases with good resolution already exist;

(iii) Developing a working alliance between INETER and with MAG to publish yearly and seasonal (primera, postrera, and apante cycles) sowing windows per crop and per region. Sowing calendars are a basic service and a high priority that would provide support to producers as they decide when to plant and would help reduce losses in areas already planted; and

(iv) Transferring drought monitoring and early warning information to producers via cell phones, a platform that could also be used to provide other services related to price risks. The high penetration of cell phones in Nicaragua's rural areas could be exploited to install a practical and low-cost system of agricultural information, with a potentially high return on investment.

Build dynamic decision making systems. Nicaragua has adequate information data bases for various sectors of the economy, which can be transferred into a dynamic decision making platform. A dynamic model would allow the government and other stakeholders to integrate biophysical and socio economic data into a single decision support system to allow for the efficient design of climate smart landscapes.

Blue Sky From Hillside, Jinotega, Nicaragua by Adam Cohn / CC BY-NC-ND 2.0

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