AGRICULTURE GLOBAL PRACTICE TECHNICAL ASSISTANCE PAPER

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PARAGUAY AGRICULTURAL SECTOR RISK ASSESSMENT

IDENTIFICATION, PRIORITIZATION, STRATEGY, AND ACTION PLAN

Carlos Arce, Jorge Caballero, and Diego Arias

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Cover images from left to right: Andrea Pavanello, Milano; soy in drought-affected soil: CSIRO; drought-affected soil: Abriles; cow (from Paraguay).

EXECUTIVE SUMMARY

The present study was undertaken by the World Bank following a request by the Government[1] of Paraguay and has an objective to identify, quantify, and prioritize agriculture risks, proposing solutions for reducing the volatility of agriculture output and incomes of family farmers. The methodology includes a two-phase process. In the first phase, risks are identified, quantified, and prioritized from the point of view of the supply chains and from an analysis of the public and private sector capacity to manage those risks. The second phase objective is to define the details of the solutions to reduce the exposure to the prioritized risks, proposing a strategy and action plan.

Given that agriculture is a key sector of the Paraguayan economy (30 percent of gross domestic product [GDP] and 40 percent of exports), it is evident that agriculture risks have repercussions on economic growth (and its exports), public finances, and the development of agriculture supply chains and rural poverty. In particular, risks related to soy and livestock production have great importance in terms of growth and economic stability of the country. A significant drop in production and soy exports, as happened in 2011, has a significant impact in global economic activity, which has translated, during the first quarter of 2012, into a drop in agriculture GDP of 28 percent and in total GDP of 3 percent. But the study was not limited to the commodities of macroeconomic importance; it also analyzed the supply chains and agriculture commodities that are key from a social point of view in Paraguay, given that they involve a great number of family farms. A particular focus was placed in risks and crops that provide employment to the great majority of the rural population and that, to a great extent, ensure the national food security. Therefore, in addition to soy, maize, wheat, livestock, and rice, the following crops were included: sesame, cotton, sugar cane, cassava, and vegetables.

Paraguay losses approximately $237 million on average every year, or 5.4 percent of agriculture GDP, due to production risks that could be managed along the main agriculture supply chains. In the years in which

[1] Ministry of Finance (MOF) and Ministry of Agriculture and Livestock (MAG).

extreme events have occurred, losses have reached $1,000 million. This represents a negative shock that not only impacts the agriculture sector as a whole but also other economic sectors. The recent study on volatility in Paraguay (World Bank, 2014), shows that the activities most affected beyond agriculture are input provision, such as machinery, storage, and transport, but also other sectors like construction and financial services, which suffer with agriculture shocks. In 2011, $920 million were lost in soy alone. This drop in soy production produced a loss of several percentage points in national GDP. Also in 2011, due to drought, family farming incurred the following losses: cassava, $94 million or 38 percent of value of production (VOP); sesame, $13 million or 46 percent of VOP; and cotton, $3 million or 26 percent of VOP. Estimates of regional losses coincide with the supply chains with major production values (soy, maize, wheat) and with cassava. The departments with the largest losses in value have been Alto Parana and then Canindeyu, Itapua, Caaguazu, and San Pedro. The variability in the availability of basic staples, mainly cassava and beans, has represented a permanent threat for food security of rural households.

Given the nature of the impacts and dimension of losses in the agriculture sector, it is clear that there is ample room to undertake investments in risk management programs. Paraguay could reduce losses significantly and make an important contribution to poverty reduction, stabilizing rural household income.

Production risks are the most frequent and of greater impact in the agriculture sector of Paraguay. The most notable one, given global magnitude of losses, is drought. In commercial farming, summer drought accompanied by high temperatures has a significant impact on soy, whereas maize, which is also relevant for family farming, is mainly affected by winter drought and early frosts. The family farming crops, like sesame, cotton, sugar cane, and vegetables, also suffer from the impacts of recurrent droughts. Cassava, the main consumption staple of family farms, is relatively tolerant to water deficits and is only affected by severe droughts.

Pests and diseases also impact production, although in general, they do not represent the main risks. They manifest themselves every year, although their intensity varies as a function of climatic conditions and crop management (monocropping contributes to the development of diseases like rust and other fungus). These events are generally controlled by agrochemicals or resistant varieties, and therefore the main impact is due to the increases in production costs, which particularly affects family farming.

The animal health problems like the foot and mouth outbreaks have had catastrophic economic consequences. They have resulted in the almost total paralysis of meat exports, resulting in the losses of foreign currency and fiscal resources. Its effects reach all participants along the production chain. Paraguay suffered foot and mouth disease outbreaks twice in the past few years: The first outbreak happened in 2002 and the last one in 2011. Currently, there is periodic vaccination, and the Permanent Veterinary Committee of the Southern Cone and Panaftosa are monitoring the National Animal Health and Quality Service (SENACSA). Weather risks, like drought, floods, and frosts, also cause important losses to farmers, but unlike foot and mouth disease, which can be mitigated with vaccination, extreme weather events have limited mitigation possibilities.

Prices of agriculture products from family farms, like sesame and cotton, are subject to high volatility, which is directly transmitted to producers. In cotton, the significant domestic price fluctuation associated with low productivity results have been progressively discouraging farmers and causing the decline of production in this crop. In soy, on the other hand, prices received by producers are subject to international price volatility and a strong seasonal and interannual variation of price differentials (specific price discounts for Paraguay in relation to the prices in Chicago). But given the high level of current prices, the volatility has resulted in relatively low impact on production decisions, although it does impact significantly the family farming cooperatives and low-scale traders, who can lose significant resources due to changes in the differential between the selling and buying of the commodity.

Enabling environment risks are important for the agriculture sector of Paraguay, in part given its landlocked situation and for the past weaknesses

of public investments in basic infrastructure and technology. Both commercial and family agriculture are exposed to these risks. For example, the market oversupply due to extraordinary entry of commodities from neighboring countries motivated by exchange rate differentials (tomatoes) or the frequent regulatory changes in boarding ports in Argentina result in costs and business losses (soy). In rice, the erratic policies followed by Brazil regarding imports, and with frequent changes in sanitary and tariff barriers, impact exporters and the entire rice supply chain.

The distributional impact of risks throughout the supply chains varies. The stakeholders most affected tend to be the producers, and the final result is often an increased indebtedness and the reduction in investment capacity. At the level of family farming, drought situations, especially when extreme, cause severe losses to crops and can have significant impacts on the economy of farmers, making them reach unsustainable debt levels, to the point of leaving them out of the market and forcing them to sell assets. A portion of the production and loss variations faced by farmers and other supply chain actors, especially family farmers, is the result of unmitigated risks: in other words, risks that could be managed ex ante with adequate agricultural practices, with infrastructure investments, and with prices and timely information.

The rural poverty situation of Paraguay (almost half of the rural population is poor) is intrinsically connected to the vulnerability to agriculture risks. Family farmers and their households are the ones most at risk of continuing or falling into poverty, first due to their initial vulnerability situation and second due to their low capacity to efficiently manage agriculture risks. In order to change this situation, it would be necessary both to improve the conditions by which small farmers manage risks and to modify the causes of the initial vulnerability situation of those families.

The Government of Paraguay is implementing a series of programs and projects that address resilience problems and many of the identified risks. A special mention is warranted for the Agriculture Risk Management Unit of the Ministry of Agriculture and Livestock of Paraguay (MAG), which represents the most clear institutional response that recognizes the importance of agriculture risks in the context of sectoral public policies. For the moment, it is a project in development that does not reach the producers at a massive scale and that would be necessary to strengthen and integrate with other ongoing initiatives. Other relevant projects include the Pequeños Perimentros de Riego [PPR] (International Fund for Agriculture Development [IFAD]), Proyecto de Desarrollo Rural Sostenible [PRODERS] (World Bank), Agriculture Supports (Inter American Development Bank [IADB]), Proyecto de Manejo de Recursos Naturales (PMRN/2KR), Paraguay Inclusive Project (IFAD), the Family Farming Food Production Development Program (MAG), and others.

Given these current programs and projects, the proposed strategy intends to tackle risks in an integrated manner through better management and with the objective of reducing rural poverty and increasing the resilience of family farms. The priority solutions proposed include instruments for responding, transferring, and mitigating production and market risks, and for providing public services and agriculture innovation.

The best risk management for family farmers is proposed through the development of a more efficient and coordinated Agriculture Innovation System, and through a mechanism for compensating incomes in case of extreme weather contingencies. The objective is to respond to technological and market problems that produce the initial exposure of family farms to great production risks, and in the case of catastrophic events, to provide orderly and objective emergency support to those families.

With respect to animal health risks, the strategy includes measures for protection of export markets and for improving the country's sanitary conditions and safety of food products. The proposed measures have SENACSA at its center and are, to a great extent, directed toward the mitigation of foot and mouth disease risk and other diseases also important for meat exports and national production. However, the strategy does not stop at the external requirements but also goes into the consequences of the sanitary deficiencies related to human health.

TABLE ES.1. ESTIMATED COSTS FOR THE AGRICULTURE RISK MANAGEMENT ACTION PLAN (US$)

Estrategic Line	2014	2015	2016–19	Total
Solutions for sanitary and food safety risks of livestock supply chains	19,883,660	51,296,167	126,905,167	198,085,001*
Strengthening of the Agriculture Innovation System for the mitigation of family farming risks	3,105,000	6,726,500	13,541,500	23,373,000
Price risks and the development of an agriculture commodity exchange	70,000	58,000		128,000
Agriculture risk financing strategy	123,400	874,300	1,067,150	2,064,850
Total				**223,650,851**

* This cost includes all actions identified in the gap analysis undertaken by the World Animal Health Organization (OIE).

The strategy also proposes the development of an Agriculture Commodity Exchange to mitigate and eventually transfer market risks, among other objectives. Price volatility was assessed as a significant risk not easily mitigated, both for large- and medium-sized soy producers and other commercial commodities (maize, wheat, rice) as for family farmers, for whom price volatility (international prices and exchange rates) can be critical for survival (such as for cotton). This difficulty requires strong institutions to achieve more transparent markets and mechanisms for price coverage, which can be achieved by the development of an agriculture commodity exchange.

The financing of agriculture risks is done through a financial structure based in different simultaneous instruments, designed to cover in an efficient way the various risks, defined by their estimated impact as per their frequency and severity. This risk financing modality allows for integral coverage and for a maximum of financial efficiency, in addition to providing transparency to public management and very likely achieving a higher level of effectiveness in the ex post emergency assistance. Furthermore, it is considered that the optimization of agriculture insurance would have positive impacts on family farming and other agriculture segments.

The proposed measures are not easily implemented and require a concerted effort between public and private sectors. It is worth highlighting, however, that the annual cost for this strategy is significantly lower ($223 million over five years) when compared with the actual annual losses of non-mitigated risks, which average $237 million. In the table above, the short-, medium-, and long-term costs are presented.

In parallel, a series of policy measures were identified as essential to achieving an appropriate agriculture risk management framework and to put into practice the preceding mentioned actions. They are the following:

- » Expansion of the control and inspection of slaughter houses for local consumption
- » Establishment of a coordinating body for family farming risks that facilitates the creation of an agriculture innovation system
- » Budget approval of the Integrated System for Agriculture and Rural Development's institutions in a coordinated fashion and with the participation of MAG
- » Strengthening of the regional coordination of actions related to family farming risks
- » Approval of a new regulatory framework for agriculture commodity exchanges, differentiating between the physical and financial markets
- » Approval of incentives for the agriculture sector actors to trade/register physical goods at the exchange
- » Establishment of weather contingency financing mechanisms for family farmers (such as drought)
- » Guarantee that agroclimatic information is permanently shared among data producers and user institutions

VOLUME ONE

IDENTIFICATION AND PRIORITIZATION OF AGRICULTURE RISKS

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ACKNOWLEDGMENTS

This report was prepared by the Agricultural Risk Management Team of the Agriculture Global Practice of the World Bank. The World Bank team was led by Carlos Arce and Diego Arias (Agriculture Global Practice [GFADR]) and composed of Pablo Valdivia (GFADR) and Sophie Storm (Sustainable Development Department of Latin America and the Caribbean [LCSSD]). The following consultants contributed to the work: Jorge Caballero (Lead Consultant), Marcelo Regunaga (Agroindustrial Supply Chains), Carlos Peixoto (Agrifood Supply Chains), Gustavo Picolla (Agriculture Commodity Exchanges), Luis Zarza (Agriculture Innovation Systems), Ricardo Avalos (Price Risk Management), Jaime Estupiñan (Animal Health Specialist), and Guilherme Cunha (Livestock Supply Chain).

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ACRONYMS AND ABBREVIATIONS

AF	Family farming
BCP	Central Bank of Paraguay
BNF	National Development Bank
CAH	Credito Agricola de Habilitacion
CAN	National Agriculture Census
CDA	Agriculture Development Centers
DAMA	Asunción's Central Market
DCEA	Agriculture Census and Statistics Directorate of MAG
DEAg	Agriculture Extension Directorate of MAG
DGEEC	General Directorate of Survey and Census Statistics (MAG)
FAS	Free alongside (price)
FECOPROD	Federacion de Cooperativas de Produccion Ltda
FMD	Foot and mouth disease
GDP	Gross domestic product
IADB	Inter-American Development Bank
IFAD	International Fund for Agriculture Development
IMF	International Monetary Fund
IPTA	Agriculture Technology Institute of Paraguay
LAC	Latin America and Caribbean Region
MAG	Ministry of Agriculture and Livestock of Paraguay
MOF	Ministry of Finance
OIE	World Animal Health Organization
PMRN/2KR	Sustainable Natural Resource Management Project/Agriculture Development Program for the Eastern Region of Paraguay
PPA	Family Farming Food Production Development Program
PPR	Rural Poverty Institutional Empowerment and Investment Coordination Project
PRODERS	Sustainable Rural Development Project
R&D	Research and development
SENACSA	National Animal Health and Quality Service
SENAVE	National Plant and Seed Health and Quality Service
SIMA	Farmer Market Information System (MAG)
SPI	Standardized precipitation index
STP	Technical Planning Secretariat
USAID	United States Agency for International Development
VAB	Gross added value
VBP	Gross value of production
VOP	Value of production

CHAPTER ONE
INTRODUCTION

This report is the result of a World Bank mission that visited Paraguay in June 2013 at the request of the Government of Paraguay. The mission's objective was to identify, quantify, and prioritize agriculture risks that determine the volatility of agriculture gross domestic product (GDP), based on a methodology to assess sector risks developed by the World Bank (see figure 1.1).

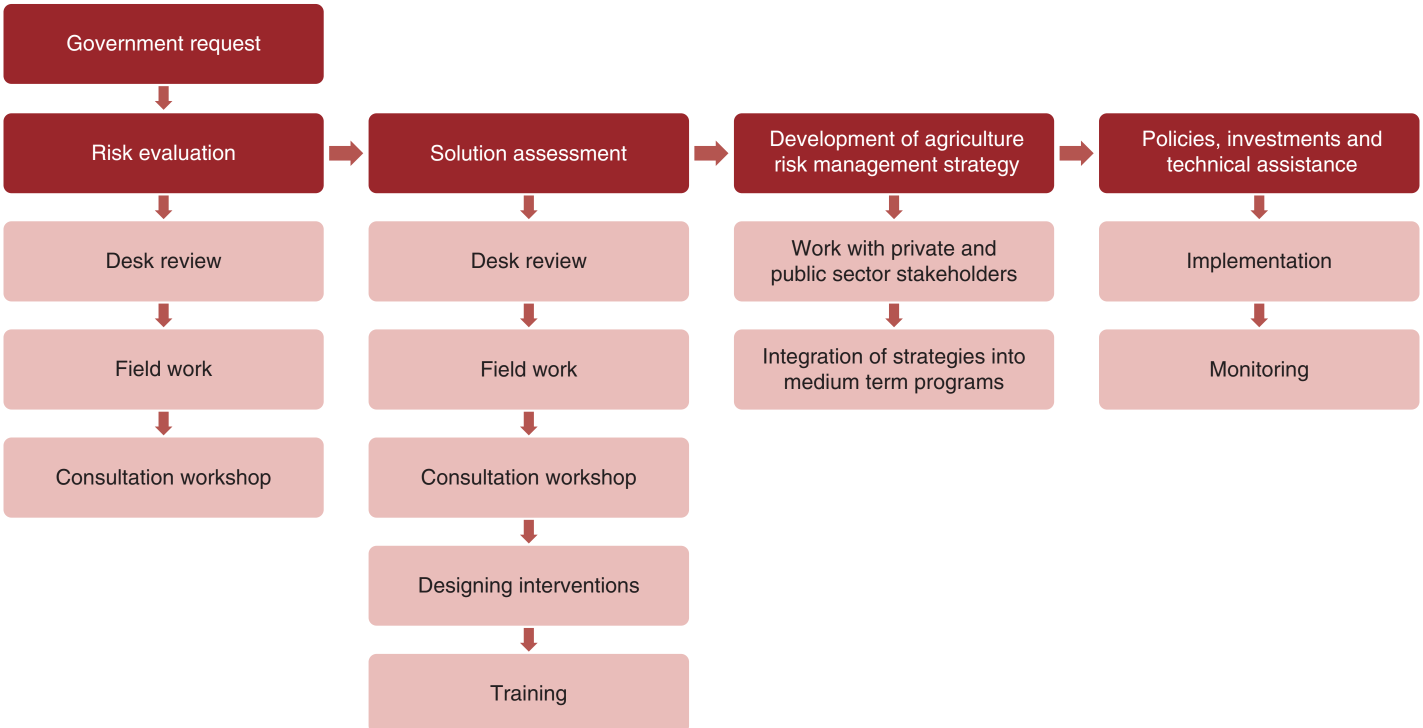
The methodology stipulates a two-phase process. The first phase (risk evaluation), which is in volume 1 of this report, was reviewed by the government and evaluates the current situation and perspective of agriculture sector risks, starting from the standpoint of supply chains. From here, and based on the identification of the most important risks, given their frequency and severity, a list of possible solutions was produced in addition to the existing public and private programs and policies.

This process is completed with a second phase, where an action plan was prepared (volume 2 of the current report) that could be executed in the medium term to reduce sector risks and to contribute to the sustainability of agriculture investments. This second phase includes the assessment of solutions, the design of a risk management strategy, and the planning of its implementation (action plan).

During the entire process, continued consultations with public and private sector stakeholders were held, especially with the selected supply chain actors. In order to capture the different implications of risks to the various participants, the different realities of the commercial and family farming were considered, taking into account the most important commodities relevant for the different regional realities. The significant efforts undertaken by the government to maintain support programs in critical production and trade areas of the sector are recognized, as well as the institutional development to strengthen the response capacity to agriculture risks.

In chapter 2 of this report, information about the agriculture sector and its recent performance is included, allowing to determine the most important supply chains for

FIGURE 1.1. WORKFLOW FOR THE DESIGN OF A STRATEGY



Source: World Bank data.

this risk assessment and to place the relative economic and social importance of the various commodities and production methods in the appropriate context. In chapter 3, a comprehensive assessment of production, market, and enabling environment risks is undertaken for the main commercial and family farming supply chains, in addition to livestock. Chapter 4 shows the repercussions that risks have had in the past, in particular aggregated losses incurred by supply chain actors. Chapter 5 assesses the impacts of these losses throughout the supply chains and explores the relative vulnerability of the different actors. Finally, chapter 6 presents the results and ranking of risks, a list of possible solutions jointly with different public initiatives where some identified risks are addressed. As a result, a short list of actions is presented as a starting point for a detailed solutions assessment to be done in phase 2 and included in volume 2.

CHAPTER TWO

THE AGRICULTURE SYSTEM OF PARAGUAY

DEMOGRAPHIC, GEOGRAPHIC, AND CLIMATIC CHARACTERISTICS

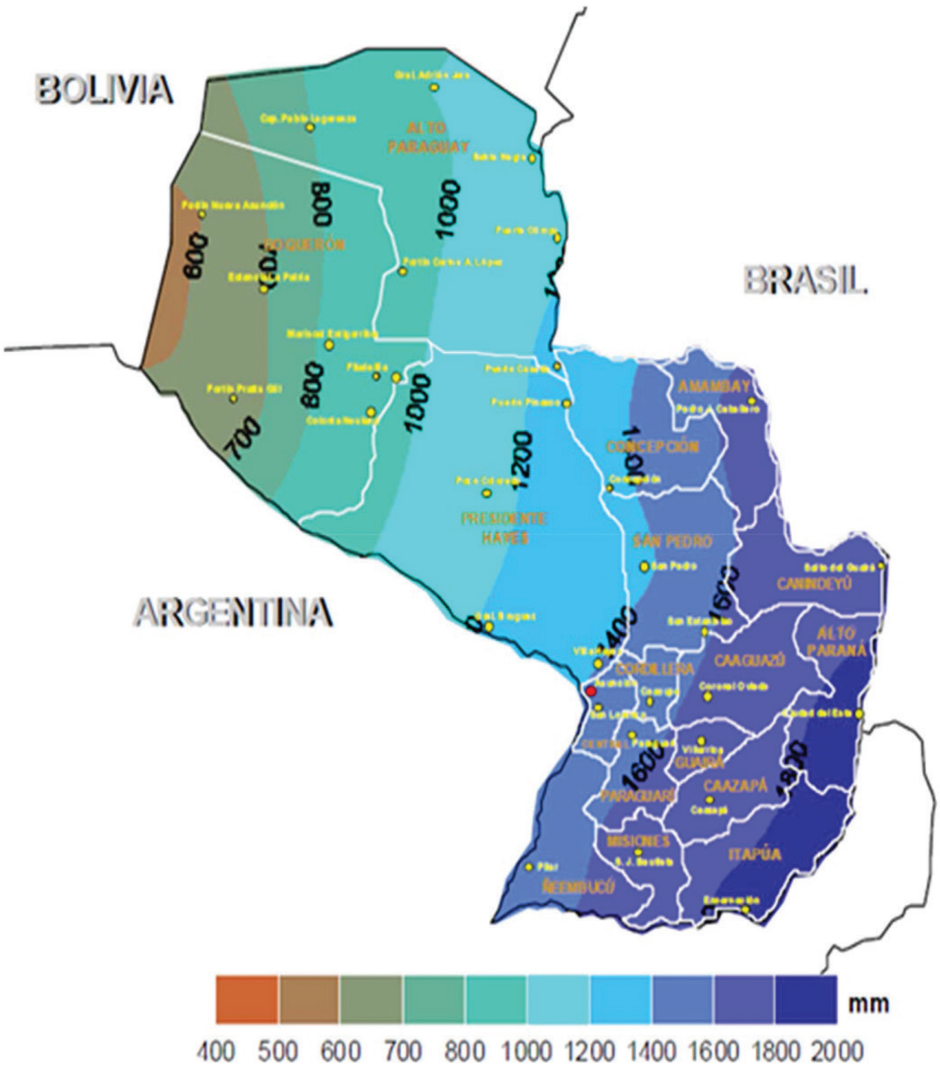
Paraguay has an area of 406,752 km^2 and is administratively divided in 17 departments, which are at the same time divided into 218 districts. Population is 6,672,633 as of 2012,[2] with an annual growth rate of 2.2 percent and with 43 percent of the population living in rural areas. It is a country with a high poverty rate—32.4 percent of the population in 2011, although falling since 2007, when it was 41.2 percent. Paraguay has a high level of income inequality and land tenure inequality. The richest 10 percent of the population earns 40 percent of total income, and the bottom 40 percent only 10 percent.[3] Furthermore, 1.1 percent of the rural establishments own 80 percent of the land, and 82 percent of farmers (255,578), who have less than 20 hectares each, occupy only 6 percent of the total area.

The country has a landscape that combines plains with slight hills, with the highest elevation not reaching the 780 meters over sea level. The country is comprised of very well differentiated regions, Eastern and Western. The Eastern Region occupies 39 percent of the land, hosts 97 percent of the population, and comprises the largest part of agriculture and economic activity of the country. The Western Region (Chaco) has the largest reserve of ecological resources of Paraguay, and the dominant activity is livestock. The Paraguay River divides both natural regions, where two types of different climates exist: the template in the east and southeast of the

[2] According to estimations by Technical Planning Services (STP)/the General Directorate of Survey and Census Statistics (MAG) (DGEEC) from the last population census data of 2002.

[3] Presidential Secretariat of Social Action, 2002, quoted in SEAM, "Estrategia Nacional y Plan de Accion para la conservacion de la Biodiversidad de Paraguay."

FIGURE 2.1. CLIMATOLOGICAL AVERAGES OF PARAGUAY, 1971–2000



Source: Meteorology and Hydrology Directorate.

Eastern Region and the semiarid to semi-humid in all of the Western Region and the rest of the Eastern Region.

Average temperatures vary between 21°C in the southeastern extreme of the country to 25°C in the northern extreme of Chaco, with absolute maximum and minimums that vary between 40 and −2°C.[4] Rainfall presents a bimodal behavior of high rainfall values during the months between October and March, and of low precipitation between April and September. In spatial terms, there is a clear differentiation between the different zones of the country: The average annual values tend to decrease from the southeast to the northeast, going from an average of 1,900 mm to over 600 mm per year (see figure 2.1).

THE STRUCTURE OF THE AGRICULTURE SECTOR

The economy of Paraguay is highly dependent on the agriculture sector, which provides 30.4 percent of the GDP (22.2 percent agriculture, 6.6 percent livestock,

[4] Environmental Secretariat. "Estrategia Nacional y Plan de Accion para la conservacion de la Biodiversidad de Paraguay." Asunción, November 2003.

1.5 percent forest, and 0.1 percent fisheries) and 35 percent if one adds agroindustry (2010). This generates around 40 percent of national exports, only with primary products, with 23 percent only from the oil complex (2012),[5] and employs 40 percent of the working population.

According to the data from the Agriculture Census and Statistics Directorate (DCEA) of MAG, most of agriculture production is concentrated in three crops—soy, maize, and wheat—which occupy 56 percent, 18 percent, and 12 percent, respectively, of planted area with seasonal crops on average between 2009–10 through 2011–12. The three crops are generally produced in rotation in large and medium farms, therefore being part of the same productive logistics of commercial vocation. The gross value of production (VOP) of these three crops represents around 76 percent of the total agriculture production value of Paraguay, with soy reaching 46 percent.[6] At the commercial level, low-irrigation rice is also notable, as the production area has tripled in the past eight years. Occupying the least amount of surface, but no less important from the socioeconomic point of view for family farming, is cassava, beans, white maize, cotton, sesame, fruits, and vegetables.

The largest part of commercial agriculture in Paraguay has incorporated sustainable production systems, which includes direct planting, fertilization, and improved seeds resistant to pests and diseases. Soy productivity in good years is high and comparable with the other major soy-producing countries in South America, around 3,000 kg/hectare in the Departments of Canindeyu, Alto Parana e Itapua (2010–11), which are those where the crop started and where the largest part of national production is concentrated.

Meat production has a long tradition in Paraguay, with 480 years of history. Currently it has 123,000 producers with a stock of 13.2 heads of cattle, or almost two cows per habitant. The distribution of the stock is as follows: The Eastern Region has 63 percent and the Western Region only 37 percent. A century had to go by in order for an important livestock improvement process to happen in Paraguay, allowing access to ever more demanding international markets. A technological jump happened in relation to the genetic improvement, the care of animals during the production chain, and a constant effort for improving. Today, livestock is a key sector of the economy of Paraguay, especially given its contribution to exports (meat), which have increased significantly, going from 27,000 tons in 1994 to 211,000 tons in 2010. In terms of monetary value, this represented going from $55 million to $290 million in annual exports.

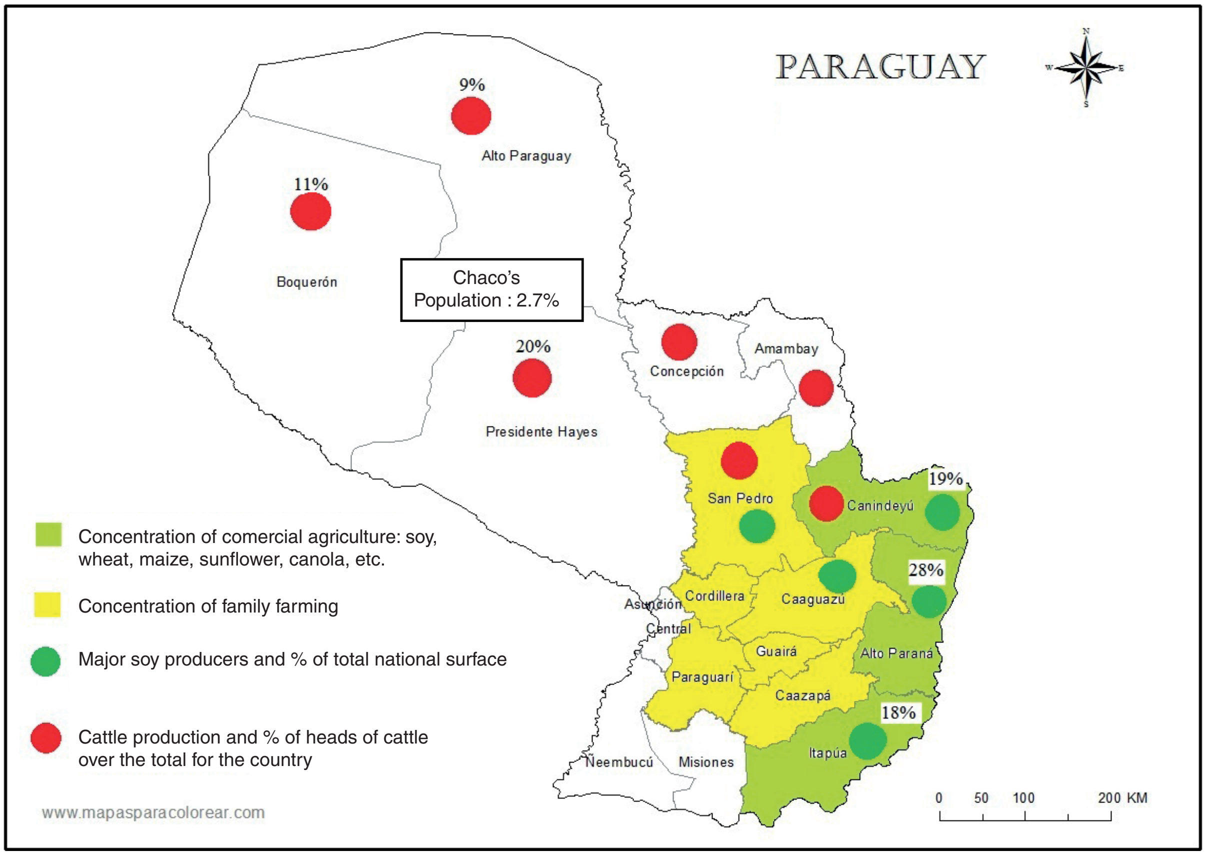
Family agriculture in Paraguay differs from commercial agriculture given its lower technological level, low capitalization, partial dedication for autoconsumption, and a less favorable relationship with the market. The family farms are more than 90 percent of total farms as per the census of 2008, but only occupy 6 percent of the land. Traditionally, the main family farming crops are white maize, beans, and cassava for auto consumption, and cotton, sesame, sugar cane, soy, and cassava (industrial) for selling in the market. On the other hand, banana and pineapple are the main permanent crops. As per livestock, animals are kept as a savings strategy and from the productive standpoint, for milk production. Recently, vegetables (tomatoes, locoto, and so forth) are increasing in importance as commercial products among family farmers.

The geographic distribution of family farming is very heterogeneous, but it is mainly concentrated in the departments of San Pedro, Caaguazu, Caazapa, Paraguari, Guaiara, and Cordillera, in the Western Region of the country. In general, they coexist in the same areas with medium and large commercial farms. Figure 2.2 shows the distribution in the territory of the main agriculture activities of the country overlapped with the departments where the largest concentration of family farms and commercial farms and livestock production is found.

[5] Data from the Central Bank of Paraguay.

[6] Calculated based on 2011 production data and average prices of 2010–12.

FIGURE 2.2. SPATIAL DISTRIBUTION OF THE MAIN AGRICULTURE ACTIVITIES



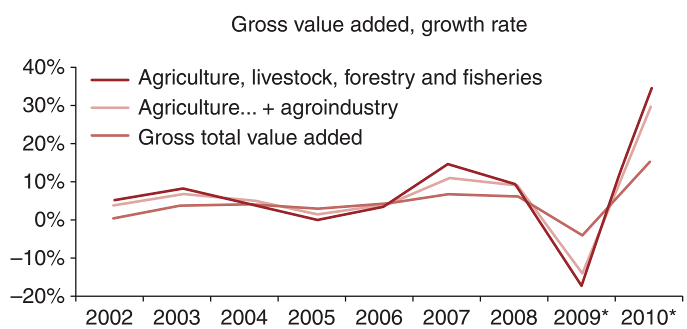
Source: World Bank data based on data from MAG.

MAIN RECENT TRENDS

The overall economy and the agriculture sector have grown consistently since 2006, both for primary production and agroindustrial chains, with the exception of 2009, coinciding with the international financial crisis (see graph 2.1). The annual average growth rate of the agriculture sector between 2002 and 2010 was 6.2 percent (6.7 percent if one considers only primary agriculture) against 4.4 percent of the overall economy.

The large value of production increase in 2010 reflects the quick recovery of agricultural exports after the 2009 contraction following the financial crisis and the drop in international demand. The same occurred in the first quarter of 2013 with the recovery of soy and meat exports, and consequently with total GDP (47.4 percent, 10.8, percent and 14.8 percent, percent respectively), after the sharp drop in production and exports in 2012 as a result of the drought in the 2011–12 crop season and the comeback of the foot and mouth disease outbreak of 2012.

GRAPH 2.1. PERFORMANCE OF THE ECONOMY AND THE AGRICULTURE SECTOR



Source: BCP.

The main engine of growth experienced by the agriculture sector in Paraguay has been the sustained growth in production and exports of soy, wheat, and maize, as well as livestock and other commercial activities.

The growth in soy, maize, and wheat production, and to a less extent for sunflower, has been notable during the last decades, especially in soy and maize (which for the most part corresponds to a second maize crop, “maiz zafriña”). The planted area with the four crops grew from 1.05 million average hectares for the years 1991–92 to 4.44 million in 2010–11, and production grew from 2.29 million tons to 11.15 million in the same period. The soy expansion was done mainly at the expense of forested areas and pasture land. Today it is expanding into areas traditionally occupied by family farmers, given through rental contracts or sold by family farmers, mainly in the departments of Caaguazu, San Pedro, and Caazapa.

Soy production for the 2012–13 season has been estimated at 9.4 million tons, maize at 3.9 million, and wheat at 1.4 million, so overall grain production will be 14.7 million tons (more than 30 percent above at the average of the previous two years). A significant portion of the production is destined for exports; in 2011, according to data from CAPECO, 5.14 million tons of soy; 1.94 million of maize; and 1.86 million of wheat (these three grains amounted to 8.94 million tons).

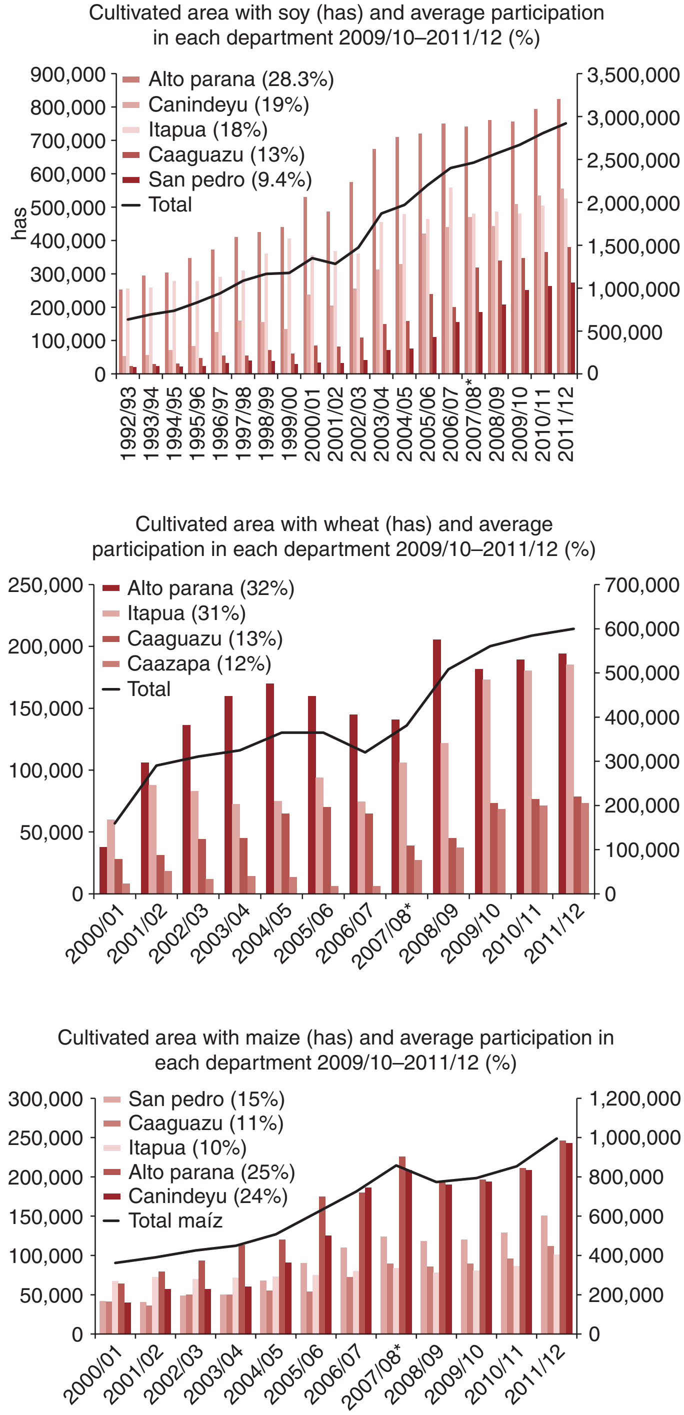
The largest increase in soy was in a few departments of the Eastern Region: Alto Parana, Itapua, Canindeyu, San Pedro, and Caaguazu, which make up for 88 percent of total planted area on average during the years 2009–10 to 2011–12. Soy production occupies today half of the total agriculture area in Paraguay. The areas destined for wheat and maize more than doubled since 2000–01. See graph 2.2.

Livestock is another raising star in the agriculture sector of Paraguay. The cattle stock increased from a level of 9.6 million heads, which had been stable for many years, to 13.3 million heads in 2012. The expansion has been occurring from the commercial sector, mainly in Chaco (departments of Presidente Hayes, Alto Paraguay, and Boqueron). Graph 2.3 shows the global trend and by department.

Chaco has less than 3 percent of the national population but concentrates 40 percent of the total cattle stock in 2012, against 30 percent in 2000.

Conversely to soy and other commercial crops, area planted by family farming has remained constant or has decreased in relation to some products in the past decade.

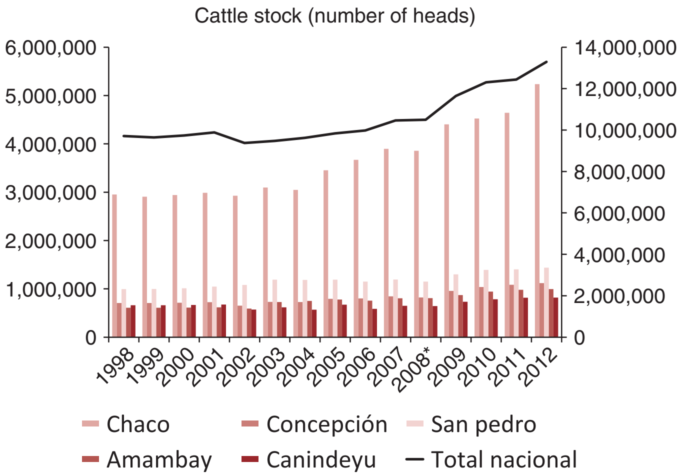
GRAPH 2.2. PLANTED AREA



Source: MAG.

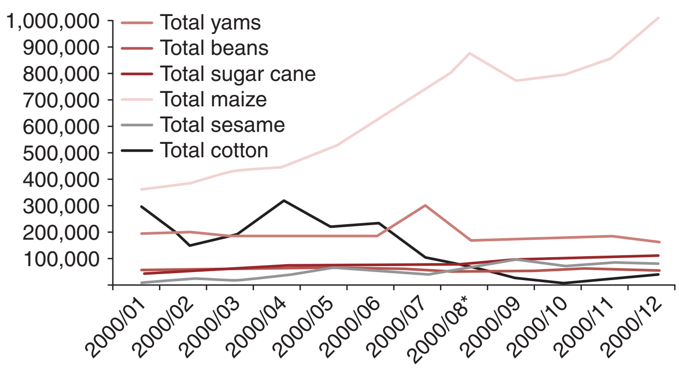
In general terms, the area dedicated to cassava and beans has remained relatively stable, while cotton, a crop that in the past had been key for the cash economy of family farming households, has seen its area reduced from 215,000 hectares on average in 2000–01 to 2002–03 to 29,000 hectares on average in 2009–10 to 2011–12. The area with sesame, on the other hand, has seen a constant

GRAPH 2.3. CATTLE STOCK



Source: MAG.

GRAPH 2.4. AREAS WITH SEASONAL CROPS OF FAMILY FARMING

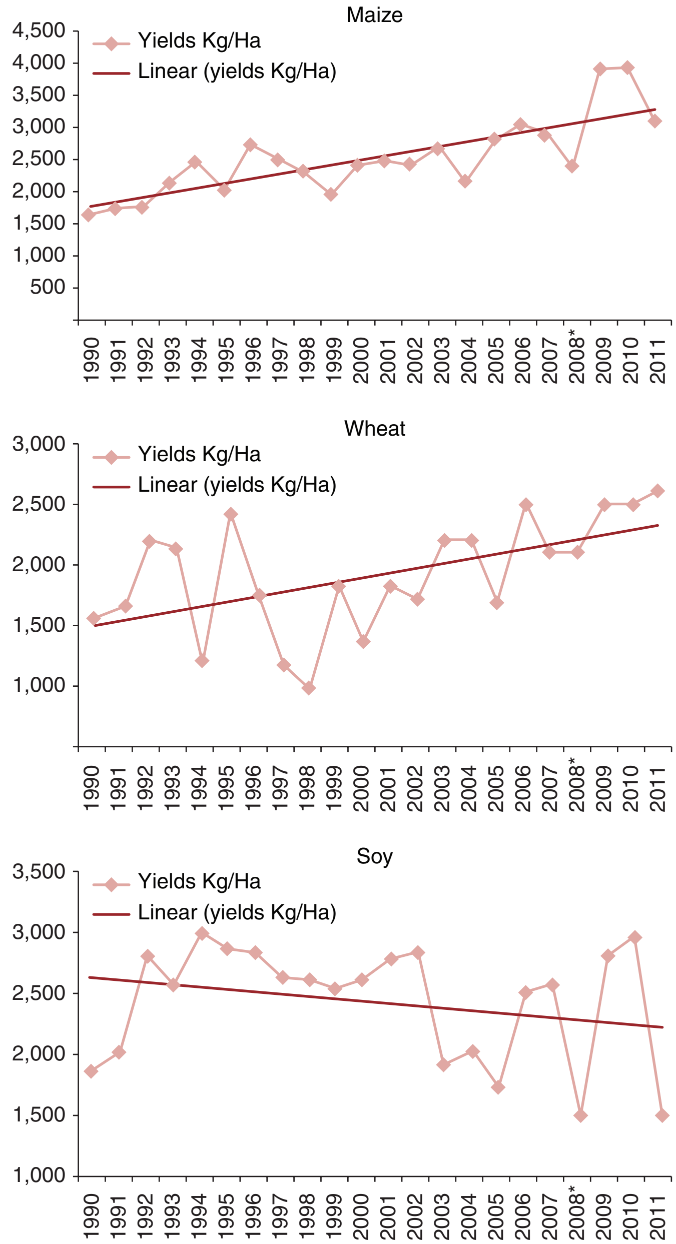


Source: MAG.

increase, taking over land that had been planted with cotton in the past. Furthermore, soy has been incorporated gradually into the family farming crop mix.

Maize, another important crop for family farms, has evolved positively due to high international prices. See graph 2.4. Although the behavior shown in the graph likely reflects more the portion of commercial maize (yellow) production that has been traditionally consumed by rural families (white).[7] The land planted in cassava, the most traditional of auto consumption crops, has varied between 170,000 to less than 240,000 hectares, with an average of 192,000 hectares since the 1990s.

GRAPH 2.5. COMMERCIAL AGRICULTURE YIELDS



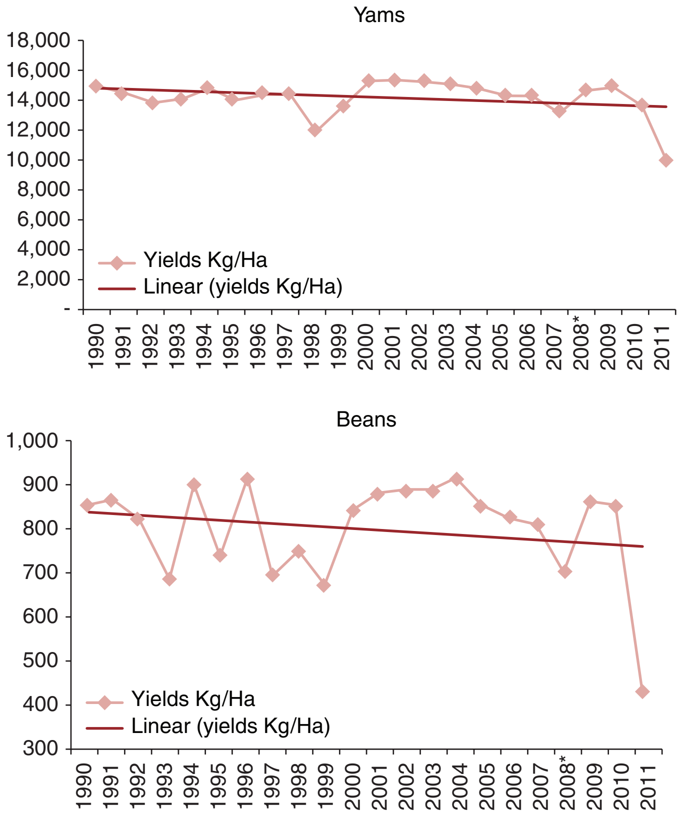
Source: MAG.

Yields of the main crops show great variation throughout the years (which is assessed in the next chapter) and different medium-term trends among them. In commercial farming, maize and wheat yields have tended to increase, while soy seems to be stable and subject to excess variation since the start of the decade, maybe due to the decreasing yields resulting from planting in lands with less productive potential (see graph 2.5).

Yields of the main domestic consumption crops, cassava and beans, do not represent a clear medium-term trend

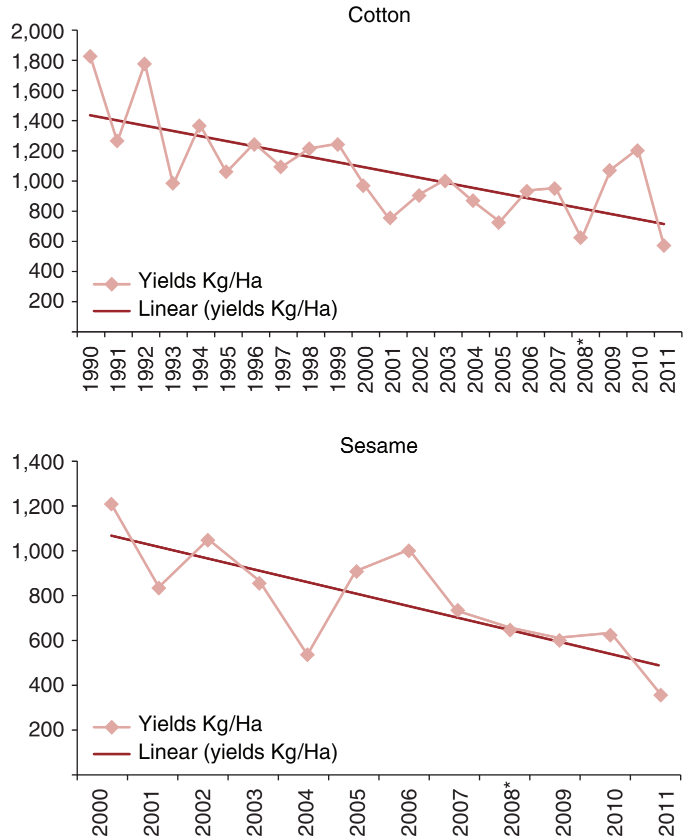
[7] According to the 2008 census, producers with less than 50 hectares represented 26.3 percent of the land and 16.7 percent of maize production.

GRAPH 2.6. YIELDS OF THE MAIN CONSUMPTION PRODUCTS



Source: MAG.

GRAPH 2.7. COTTON AND SESAME YIELDS



Source: MAG.

(see graph 2.6). The analysis of the yield evolution of cassava shows a slightly decreasing trend during the entire period, except for the last year, where a historical minimum of 9.8 tons/ha was reached. The overall average is 14.1 tons/ha.

Cotton and sesame, both cash products for family farmers, show very varied national average yields in the short term and a clear decreasing trend in the long term (see graph 2.7).

With respect to sesame, the average during 2000–01 to 2002–03 was 1,025 kg/ha and in 2008–09 to 2010–11 was 613 kg/ha. The large expansion of cultivated area, the appearance of pests and diseases, the lack of good agricultural practices, and the decrease in soil fertility have been stated as the main reasons for the drop in yields. It is estimated that current yields in years without weather problems are situated in the 400–600 kg/ha range. In cotton, the entry of the *picudo* has been an important factor.

The public research and extension services have not been able to combat the low performance of family farming. The Agriculture Extension Directorate (DEAg) has suffered a continued institutional deterioration, and the Agriculture Technology Institute of Paraguay (IPTA) has not met its expectations since its creation in 2010. Partially, some public institutional services have been replaced by specific projects by MAG, which have limited coverage and reach.

In summary, commercial agriculture and livestock have tended to expand in surface, while family farming has been stagnated or decreasing, both in area and in yields, and there is a lack of public goods at the service of agriculture, impacting small-scale as well as large-scale and export-oriented agriculture. As can been seen further in this document, this situation is critical for the design of institutional strategies for mitigating agriculture risks, reducing non-mitigated risks, and reducing losses from farmers and agriculture supply chains in general.

CHAPTER THREE
AGRICULTURE SECTOR RISKS

The assessment of agriculture risks focused on those supply chains that are most important from the economic and social points of view in Paraguay. For that, the macroeconomic importance of the supply chains was considered, in particular in relation with exports, and here the importance of the soy cluster (soy, maize, and wheat) and livestock was evident (see chapter 2).

Furthermore, the supply chains that are predominantly for family farmers have great importance given their contribution to employment and revenues for farming households that make up the majority of the rural population. The supply chains of the most important cash products of family farming are sesame, cotton, soy, sugar cane, cassava, and vegetables. The crops for autoconsumption such as beans occupy a relatively smaller portion of their land and are exposed to similar risks as those cash crops.

In summary, the supply chains selected for this assessment were soy, maize, wheat, rice, cassava, sesame, cotton, sugar cane, and vegetables, in addition to livestock. As a group, these products represent 98 percent of the gross value of agriculture production, and they occupy more than 90 percent of the cultivated area each year, as well as with the great majority of farmers. It is assumed that the identified risks for these supply chains are representative of the agriculture sector as a whole (see table 3.1 on commercial farming risks). The statistical appendix presents detailed information about cultivated area and gross value of production.

SOY CLUSTER (SOY, MAIZE, WHEAT, AND SUNFLOWER)

According to the Agriculture Census of 2008, 88 percent of the cultivated area with soy corresponded to business above 100 hectares and 62 percent was concentrated in those above 500 hectares. Therefore, the commercial grain production in Paraguay belongs to businesses that for international standards are relatively big, with

TABLE 3.1. SUMMARY OF COMMERCIAL FARMING RISKS

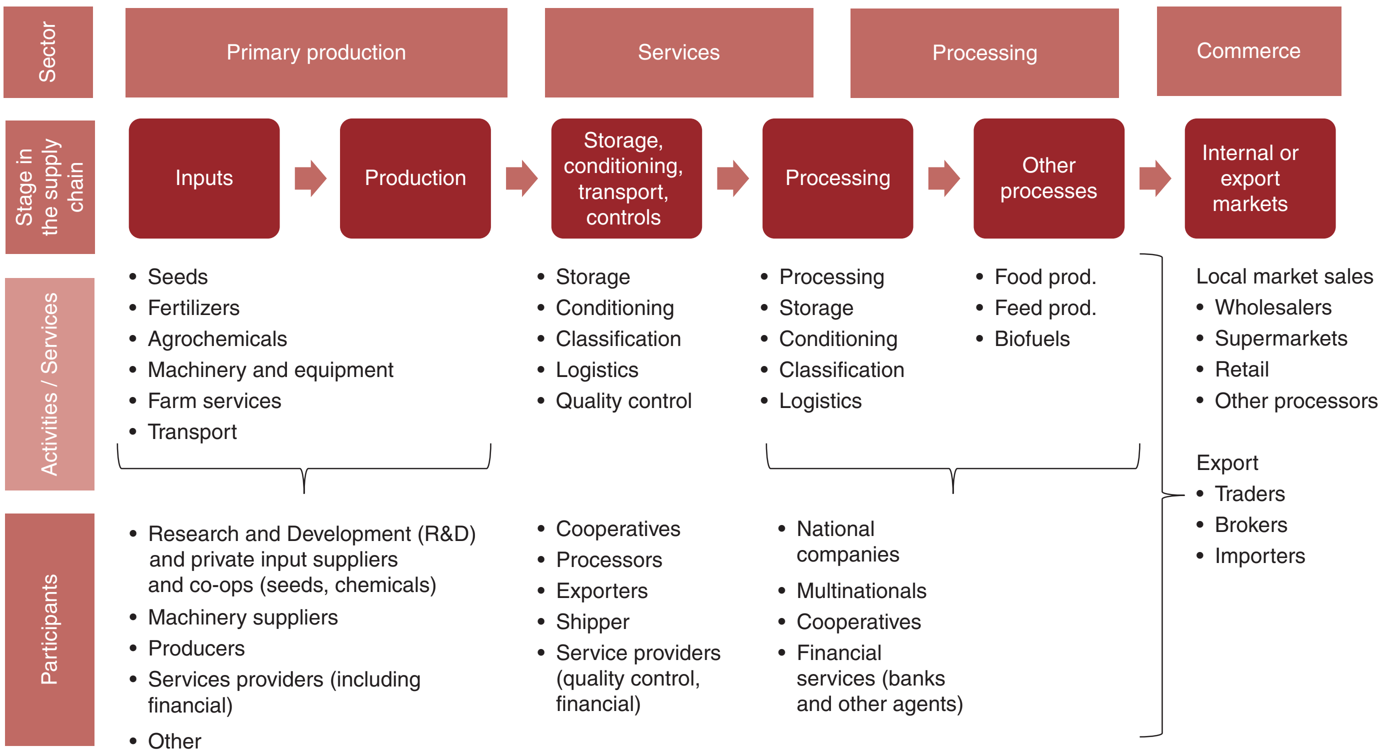
Supply Chains/ Risks	Production	Market	Enabling Environment	Mitigation/ Absorption
Soy	The main risk factor for soy is drought in the summer months, mainly January.	The seasonal and interannual variability in differentials and the discounts in relation to Chicago prices represent a risk for soy.	Various enabling environment risks related to exports, like availability of barges, and variable transport costs. Eventual lack of availability, in the required time, from planting and harvest equipment and for storage and transport infrastructure.	
Maize	Zafriña maize, early frosts, and summer drought are the main causes of yield variation.	There is a very high volatility of maize prices linked to interannual changes in the level of production and seasonal variations.		
Wheat	Excess rains in the pre-harvest and harvest periods are a relatively important risk in wheat, as they reduce yields and quality.			Genetic improvement and the best practices have contributed to mitigate weather risks.
Soy, maize, and wheat	Grain production is systematically impacted by weeds and other pests and diseases.	Export price volatility is a risk for the soy cluster as well as exchange rate variation.		Pests and diseases are controlled by chemicals and resistant varieties so that the main impact is in relation with the increase in production costs.
Rice	Drought can only be a problem when it is severe and when the hydraulic system is affected. Pests and diseases only have an impact when they are not controlled.	The price variability in Brazil is transmitted directly to Paraguayan farmers and is a relatively important source of risk.	Erratic trade policy by Brazil for rice imports, with frequent changes in sanitary regulations and tariffs. Regulatory framework is ambiguous for water use.	Pests and diseases are controlled with chemicals.

the corresponding economies of scale and high level of competitiveness.[8] In Paraguay, as it happens in the United States and Brazil, the large majority of farmers above 500 hectares have their own planting and harvesting equipment. Almost all of the commercial grain producers develop integrated production systems that involve rotation of soy (main crop), maize, and wheat, and to a lesser extent rotation of other crops like sunflower,[9] canola, and other cereals. The use of rotations that include maize and other cereals are a very important part of this way of

[8] If production from rented farms by larger producers is added, the concentration in production is even higher.

[9] Sunflower production has been limited due to large losses arising from pigeons and other birds.

FIGURE 3.1. SUPPLY CHAIN FOR GRAINS PRODUCED BY COMMERCIAL FARMS



Source: World Bank Data.

production, contributing to the sustainability of soils and pest control.

The important growth in production and in grain exports has allowed development and gradual consolidation of the complex supply chain that has been characterized by its great dynamism. Figure 3.1 describes the main links in the supply chain, the functions that each actor has, and the type of enterprise or entity involved. The supply chains of the four grains—soy, maize, wheat, and sunflower—involve almost the same actors in each link, with the exception of specific stages like the milling industry for wheat or the oil and biodiesel industry for soy and sunflower, or the animal feed and bioethanol industry for maize. It can be seen that in each stage of the chain there is a significant number of different actors.

A characteristic factor of the supply chain is that the main actors often participate in more than one stage, showing an important degree of vertical integration: Exporters operate as industries, intermediaries, and land and river transport agents, owning ports and providing port services and inputs and financing; cooperatives participate in R&D centers and provide inputs, technical assistance, and financial services, involving producers, functioning as intermediaries for storage, processing, and export; farmers are input providers; and so forth.

Recently, the installed capacity for the processing of oilseeds has increased with new private sector investments, in large part from traditional businesses, due to which the processing capacity is estimated to reach 4 million tons per year approximately. This increase in the internal demand for soy as raw material for the industry (for export as oil and pellets) will contribute to define a more homogeneous demand during the year.

Nevertheless, the rapid expansion of commercial agriculture supply chains, the consolidation of the growth, and development process face important challenges. Among them are the weakness of the R&D system and the low coordination among many of the participants of the supply chain, leading to high transaction costs and low competitiveness.

Production risks. Grain production in Paraguay is exposed mainly to agroclimatic risks and to a less extent to pest and diseases.

BOX 3.1. CORRELATIONS BETWEEN RAINFALL AND YIELDS

Correlations between yields of the main crops and accumulated rainfall measured by weather stations were established. Appendix A presents the details of the study.

The values found for correlations from accumulated rainfall during the production cycle are not significant. Soy was the only crop where a correlation coefficient was found above 50 percent (Estacion Capitán Miranda). However, negative correlation values were registered in one of the stations (−24.15 percent in Estacion Misiones) for the same crop. With respect to the correlations obtained for each of the phonological stages of soy, these show a slight improvement, in particular for stage 3, where values of 62 percent and 74 percent for the values of the coefficient of correlation in the Encarnación and Capitán Miranda stations, respectively. Although these values are significant, such patter does not repeat itself in the rest of the meteorological stations assessed. This shows that both accumulated rainfall by productive cycle and by phonological state (such as soy) do not explain clearly yield behavior of the crops in the stations mentioned.

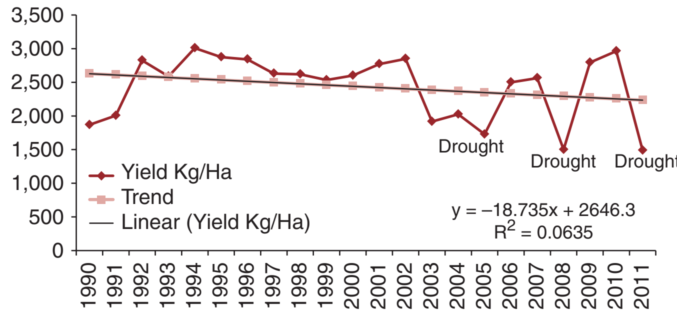
However, the results obtained do not contradict the hypothesis that the variable rainfall is one of the productive factors that is most relevant to determine crop behavior. Among the factors that can explain the reasons why higher correlations could not be obtained are: (i) the excessive aggregation of days could be hiding the partial or total losses registered in the non-irrigated production systems; (ii) when assuming unique dates for planting per meteorological station and per department, the study could not consider the amplitude of the planting windows for many of the crops;[a] (iii) the plant growth characteristics of some crops allow them to recover quickly after water stress (excess or deficit of humidity), as is the case of cotton, which makes the period of analysis differ with the actual effective period of production; and (iv) as rainfall is an heterogeneous variable from the spatial and time point of view, the registered data at the selected meteorological stations are only valid for a specific area of influence and the yield data that was used was at the department level.[b]

[a] MAG registers annual average yields for the different planting windows.

[b] This is the lowest level of aggregation of the production data captured by MAG.

The main risk factor for **soy** (the crop with the highest economic importance in commercial farming) is *drought* during summer months (mainly January), whose impact is worsened by high temperatures and made more severe

GRAPH 3.1. EVOLUTION OF SOY YIELDS AND MAIN CAUSES FOR LOSSES (KILOS PER HECTARE)



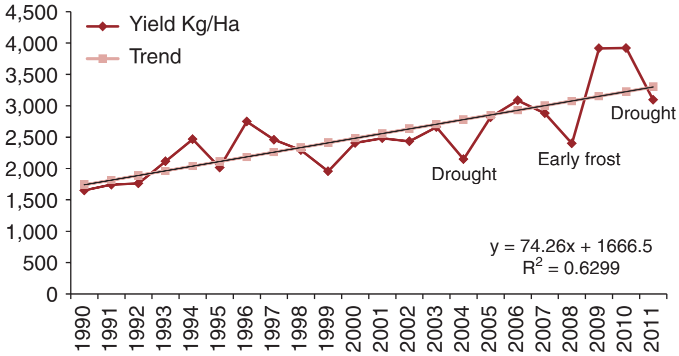
Source: World Bank data based on data from MAG and field information.

in production areas with soils with less water retention capacity (sandier soils in San Pedro and Canindeyu). (See box 3.1.) The impact of drought has been very significant for soy in the years 2005, 2008, and 2011, with very important average yield reductions for the country (see graph 3.1) and in the main soy-producing departments. Complementary irrigation is not always an option to mitigate drought risk due to the frequent shortfalls in the supply of energy and changes in tension for distribution.

In the case of **zafriña maize,** the *early frosts and summer droughts* are the main causes of yield variation. The occurrence of early frosts is sporadic, but they constitute a permanent threat and also limit the planting of the second maize harvest if soy harvest is delayed. Moreover, as it can be seen in graph 3.2, in the last decade only one high-impact frost was registered in 2008, in which losses were between 30–40 percent of the production in some departments,[10] beyond losses in grain quality. In that same period, maize production was impacted by two droughts: one of high impact in 2004 where almost 25 percent of expected average production was lost; and a second one with less impact in 2011, where less than 10 percent of expected average production was lost. Finally, *excess rainfall* during harvest of the second maize harvest (June) is quite frequent, but the hybrids developed in Brazil have spines that limit flowering, in contrast with the main hybrids from Argentina.

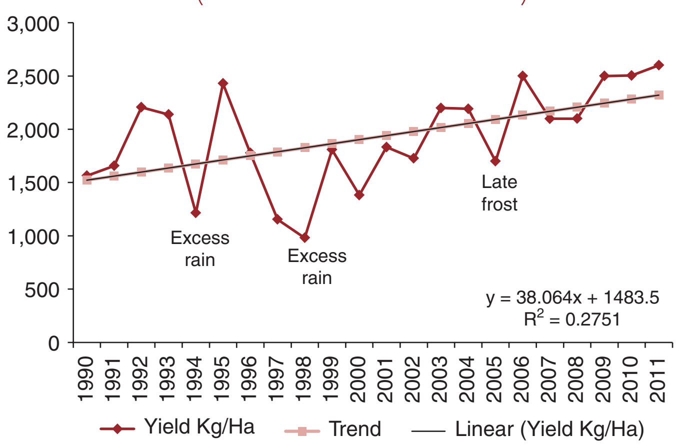
[10] Based on information provided by producers and field agents.

GRAPH 3.2. MAIZE YIELD EVOLUTION AND THE MAIN CAUSES OF LOSSES (KILOS PER HECTARE)



Source: World Bank data based on data from MAG and field information.

GRAPH 3.3. WHEAT YIELD EVOLUTION AND THE MAIN CAUSES OF LOSSES (KILOS PER HECTARE)



Source: World Bank data based on data from MAG and field information.

Excess rainfall over the pre-harvest and harvest period had significant impacts in years 1994, 1997, and 1998 for **wheat**, reducing yields and quality (see graph 3.3). However, in recent years, this phenomenon has not had a significant impact in yields. The early and late frosts are also production risks, but have not had any importance in recent years. Only losses were registered in one year with significant yield decrease (about 20 percent) as a result of a late frost. At a global level, hail does not constitute a significant threat. It is interesting to note that even though agroclimatic events have had a significant impact for soy in recent years, this has not happened for wheat, as genetic improvement and best practices have contributed to mitigate those risks.

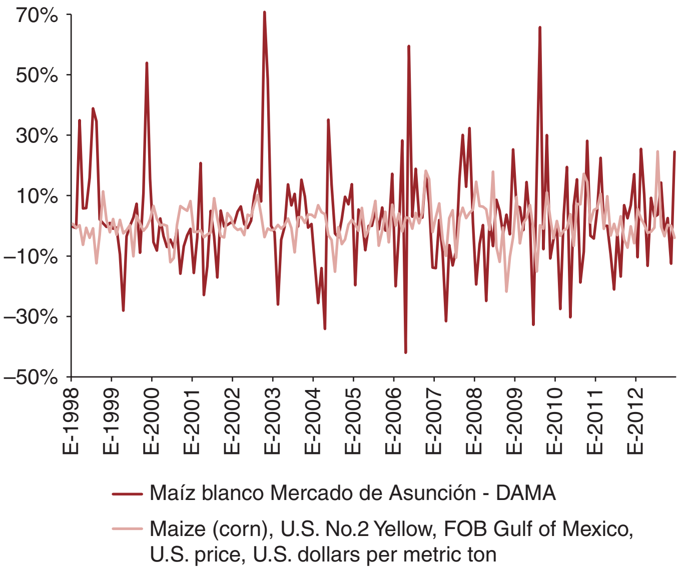
Grain production in Paraguay has been systematically affected by *weeds and other pests and diseases* that appear every year, although their intensity varies according to weather conditions and crop management (monocropping contributes to the development of diseases such as rust and other fungus). These events are generally controlled with chemicals or resistant varieties, and the main impact is the increase in production costs. The biotic factors did not appear during field visits as having great relevance in yield variation. But it is to be noted that in the case of soy, the effects of drought are amplified by the presence of *macrophomina phaseolina*, a fungus that is present in the soil of certain areas and attacks the soy roots with great impact (total destruction) in drought years.

Market risks. *Export price volatility* is another relevant risk for the soy cluster. In the case of soy, domestic prices are mostly defined by differentials (price discounts) based on the Chicago futures market. In the case of maize and wheat, in general, transactions do not use differentials with respect to Chicago as a basis for calculating prices as they may be influenced by export opportunities from the Brazilian market, which has other differentials. In both cases, however, exchange rate variations have tended to deepen price risks due to the price differences between the payment of costs and the receipt of revenues for the sale of the product.

Beyond the international price volatility (basically Chicago), prices received by producers are subject to *an important seasonal and interannual volatility in differentials*, in other words, the discounts with respect to Chicago. These variations are quite large in the case of Paraguay. They are associated with local demand and supply conditions, and are directly linked with the level of stocks during harvest, as well as with a series of other factors that have an impact on the evolution of internal and transport cost rates to open ocean ports (see enabling environment risks, below).

Domestic prices are also very volatile. Of the soy cluster products, maize is likely the most particular of all, as it is cultivated by commercial and family farmers alike, and is an export (yellow) and autoconsumption (white) crop. The domestic price of maize according to data for the Asunción Market (DAMA), assumed to be representative of the price behavior in other domestic markets, shows a high volatility in the medium term, linked to interannual

GRAPH 3.4. MONTHLY VARIATION OF THE PRICE OF WHITE MAIZE



Source: World Bank data based on data from MAG.

changes in the production level and seasonal variations, and which is greater than the volatility of international prices (see graph 3.4). In the short run, the main cause of interannual price changes is found in the yield variations due to weather events, but there could be other factors impacting like fires and contraband.

However, there are differences in price behavior between yellow and white maize, detrimental to the latter. The series of monthly percentage variations in the wholesale domestic price of white and yellow maize have a standard deviation of 17 percent and 12 percent, respectively, against 6 percent exhibited by the international price of yellow maize during the period 1998–2012. The family farmers (white maize) suffer a greater price volatility and benefit less from the increases in international prices compared to commercial farmers who produce yellow maize for export for agroindustries.

In appendix A the full discussion on maize price volatility is presented.

Enabling environment risks. Several *enabling environment risks linked to exports* were identified as they impact in greater marketing costs. The main ones are:

- Insecurity in the supply of river barges for transport to the ocean ports (especially for actors that do not own barges and for specific periods of the year when exports are concentrated)
- Variations in the cost of transport through barges during different parts of the year caused by two limitations:
  - Lack of dredging and signaling, in particular in the Paraguay River, through where most exports circulate
  - Lack of a barge transfer station to ocean liners from Paraguay to Argentinean or Uruguayan ports, which results in unknown delays at different periods of the year and to a decrease in efficiency in the use of barges
- Internal transport cost variations and logistic insecurity due to the bad conditions of roads and lack of paving in some of the most important production areas

Another enabling environment risk factor linked to harvest and marketing, but that has been very difficult to quantify during field visits, is associated with the *eventual lack of availability, in the needed time period, of planting and harvesting equipment and of storage and transport infrastructure*, both for soy and maize. These deficiencies can have an impact on the harvests in optimal periods with short windows (few days for planting, for example, for zafriña maize in the recommended dates), facing weather risks and availability of additional transport. The lack of machinery and harvesting services is a limitation for several farmers that have limited machinery of their own and that at times cannot plant all of the area with zafriña maize as they potentially can. Regardless, this was not a risk that seemed very important for most producers.

RICE

Rice has grown and continues to grow at a great pace, the estimated area planted at 105,000 hectares in 2012. This number contrasts with 30,000 hectares 10 years ago (according to data from MAG). The main production areas are in Itapua and Misiones, but the crop has been expanding northward in the direction of Asunción and also Caazapa. According to data from the Agriculture Census of 2008, the production is very concentrated in medium to large farmers, with approximately 80 percent of the area in the hands of 8 percent of the producers with more than 500 hectares each. The family farmers are the majority (62 percent), but only have 2.3 percent of the cultivated area with rice. Among small producers interviewed, the average size of rice farms is 7–8 hectares, and all of them have a quarter of their land for autoconsumption crops. The yields are varied, from 1,500 kg/ha for more inefficient producers to 8,000 kg/ha for farmers with modern technologies; the national average is 5,000 kg/ha approximately.

In the country, there are 20 rice mills, most of them in the business of vertical integration. The largest producers have their own mill and sell directly to one of them. However, the smaller farmers sell to intermediaries who also provide inputs and credit for working capital, with interest rates that reach 36 percent. National production is estimated at 620,000 tons in 2013, of which 125,000 only are consumed domestically. The rest is exported, Brazil being the main market (82 percent of what was exported last year). Other markets are Chile, Peru, and Russia. Only 165 of the total exported volume was traded with HULL, representing a great advance since 2007 when it was 57 percent.[11]

With the exception of extreme droughts and hail at a local level, rice does not face great natural risks. The main risks are related to the context in which the production and exports develop.

Enabling environment risks. *Access to the Brazilian market*. The rice producers and industry face great uncertainty with respect to the Brazilian market due to the erratic trade policy by Brazil for imports, with frequent changes in sanitary regulations and tariffs. Even recently the government of Brazil has threatened to impose import quotas. Brazil justifies this policy with the argument that Paraguayan imports, although small in quantity with respect to Brazil's domestic supply, has an impact on prices to Brazilian farmers because it arrives at a time of the Brazilian Harvest. The reality is that the trade policy represents an important risk for prices and for market access, especially for farmers with little storage capacity to sell the product out of season.

[11] Data provided by Trociuk Industries.

Another issue, more of a threat than a risk, is the *everyday rice seed used in Paraguay*. The seeds that are regularly used in Paraguay are varied, but in general they are the ones of the rice compatible with the preference of the Brazilian market. The adoption of these seeds was done without following the established international procedures on the right of use of seeds. They do not have legal rights for their use, and it is feared that at some point in time there can be legal action by the Brazilian farmers if they feel threatened by the competition from Paraguay, which is growing in the volume imported in Brazil.

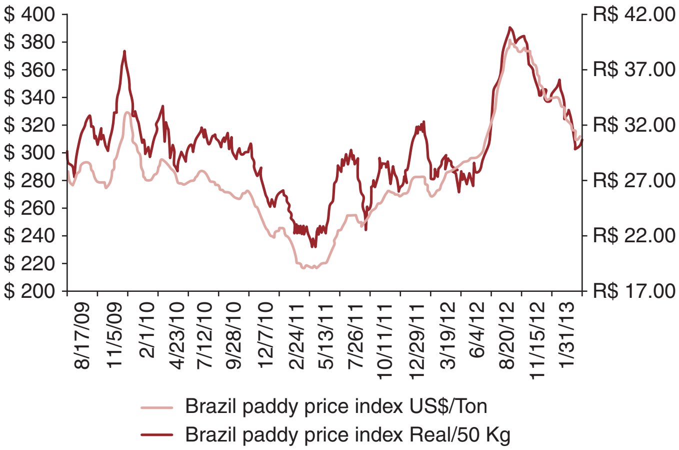
Ambiguous regulatory framework for water use. The lack of clarity in the regulatory framework[12] for water use leads to situations of conflict between rice producers and other rural populations, which in the most extreme circumstances have produced problems in the production and led to economic losses. Furthermore, the legislation does not include practical mechanisms for conflict resolution, which in the bureaucratic instances of the judicial administration have tended to perpetuate long-term conflicts. All of this would be resolved, and the risk for farmers reduced, if the norms on water use were clear and would be enforced in an effective fashion.

Production risks. Production risks are relatively low for rice. *Drought* could be a significant problem only when it is severe and when the hydrological system is affected. The impact tends to be greater among smaller farmers with a lower capital level, with no appropriate reservoirs to store water. The mitigation strategy disseminated is to plant ahead of time, in September, in order to harvest earlier, in January. On the other hand, yields tend to be lower when planting is delayed. The last years when a drought was recorded was 2009 and 2011. Another natural hazard that worries rice producers is *hail*. It is not a frequent event and it is not systemic, but when it happens, it can cause up to 100 percent of losses in the most affected areas. The last year recorded was 2010–11.

Finally, *pests and diseases* are a risk of a certain importance among small farmers. Those who have resources,

[12] Water Resources Law and other legal norms.

GRAPH 3.5. BRAZILIAN PADDY RICE INDEX



Source: World Bank data based on data from MAG.

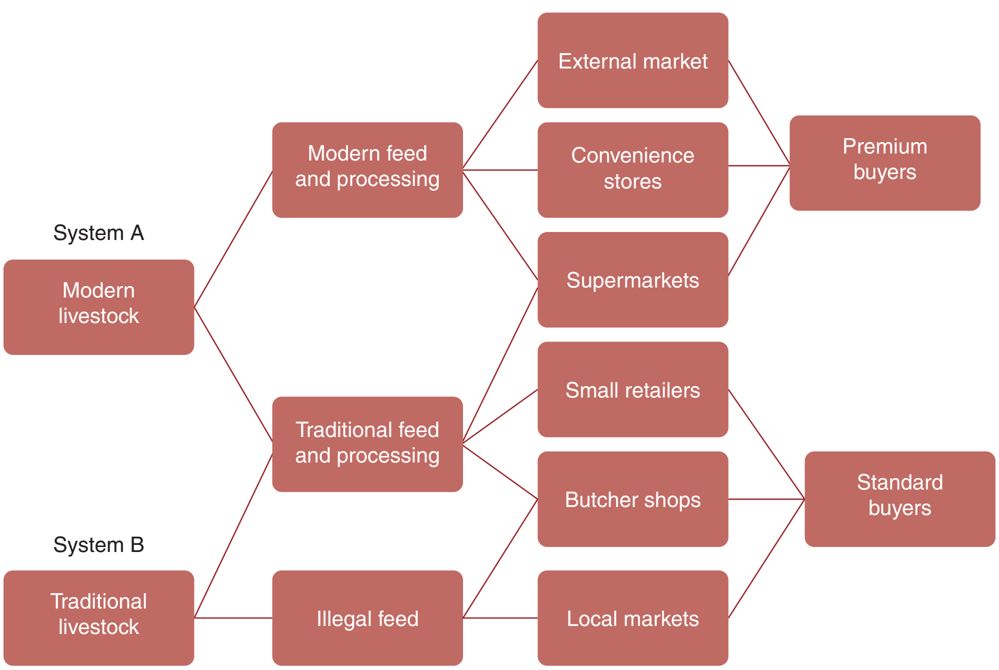
have technical knowledge, and are organized effectively even use fumigation by area. However, the impact is high in small farms that do not have the technology nor the resources to efficiently control it. Among small producers, it was observed that only those that are organized in committees have relatively efficient controls compared to the medium and larger farmers.

Market risk. Producer prices are set in relation to the prices paid by processors in San Pablo for rice in the hull, making the corresponding discounts for transport and other costs (see graph 3.5). Price variability in Brazil is transmitted directly to Paraguayan farmers and is a relatively important risk source, mainly at the level of the small farmers who do not have much negotiating power with the intermediaries.

LIVESTOCK

The meat supply chain can be divided in two systems (see figure 3.2). In system A we have modern businesses with important investments in physical infrastructure, livestock genetic improvement, and animal health. For the most part, the cattle has adequate international market quality standards. Meat is produced in modern packinghouses that in their majority comply with the norms and controls of the official veterinary services and are authorized by international and national markets. The packinghouses supply mainly external demand, and what cannot be exported is sold in the domestic market. The meat products of this system are destined for premium market niches. In system B

FIGURE 3.2. STRUCTURE OF THE MEAT SUPPLY CHAIN IN PARAGUAY



Source: World Bank data.

BOX 3.2. TYPOLOGY OF LIVESTOCK PRODUCERS

Small livestock producers (family farmers) represent 83 percent and provide 13 percent of production. They are characterized by their low productivity, empiric knowledge, no or little contact with the other links in the commercial supply chain, and weak participation in the sanitary campaigns to reduce disease outbreaks. These producers are dedicated mainly to milk production and eventually sell their cows that are no longer productive, and if they do trade meat, they are considered small with less than 100 heads. Livestock for small producers is considered an integral part of family farming, playing an important role in the capitalization process of the farm. The medium-size farmers however, are 14 percent of the total and produce 25 percent of total production. They are concentrated in farms with 100 to 500 heads of cattle. The indicators are better than the previous category as they access some technical assistance and formal credit. The level of production is higher, and they are more integrated to the agro-industrial supply chain although they supply local and regional slaughterhouses. The largest producers are only 3 percent of the total but supply 61 percent of total production. They have farms of more than 500 heads of cattle and possess high levels of capital, participate in the sanitary campaigns, and are totally integrated to the agro-industrial supply chain. However, there is great diversity within the large producers with respect to the level of technological development. The traditional producers are farms with extensive production and low productivity. The large and modern farms are managed based on business concepts and are the most dynamic segment of the livestock sector of Paraguay, responsible for the great improvements in the modernization of production. Its production targets the best international markets in a competitive way.

are the medium and small producers, with medium and low technological levels, that sell their product to authorized and non-authorized packinghouses that only supply the domestic market. It is estimated that packinghouses produce 60 percent of total production, while slaughterhouses 40 percent.

With this supply chain logic three different type of producers are considered (see box 3.2): small, medium and large producers. According to their level of capital, their technological development and their relationship with the market, they suffer the effects of risks in a differentiated manner.

Production risks. *Drought*. Drought occurs in every region of Paraguay, impacting severely the Western Region (Chaco) during the months of June to September. This is the time of the year when rainfall is lowest and when the probability of drought is highest. Droughts occur frequently in periods of four to five years, with extreme periods every 10 years approximately. The last drought periods were in 2008 and 2009. Production losses were estimated in the following percentage over technical indicators: pregnancy rate, 30 percent; birth rate, 25 percent; weight loss, 20 percent; and reduction in meat output, 20 percent. Drought impacts all type of producers, although those with better water conservation infrastructure can better mitigate its effects.

Floods. Floods occur frequently between the months of December and March and can affect millions of hectares of the Western Region of the country. These are clay soils that have a very slow water absorption rate, to which a slow incline is added, inhibiting good drainage. The last extreme flooding periods were in the years 2010, 2011, and 2012. In 2012, rainfall left large extensions of land under water in three departments of the northwest, and that were declared in emergency situation. According to the National Animal Health Service (SENACSA), 180,000 heads of cattle were affected by floods. Between 5 percent and 10 percent of animals died, especially calves. Furthermore, other production losses were registered, like animal weight loss by having to walk long distances to other areas, pasture loss, increase in production costs to rent pastures and transport animals, and so forth. Losses have long-term impacts, so this risk can be catastrophic for small farmers.

Frosts. Severe frosts are not very frequent but can cause important damage to all producers. In July 2010, 2,000 to 3,000 animals in Cencepcion and Amambay died due to frost. After the field visit, information was provided that a severe frost in August 2013 was responsible for the deaths of between 4,000 and 5,000 animals.

Foot and mouth disease (FMD). FMD is a disease that affects cattle, sheep, and goats, and whose economic consequences are catastrophic. It results in the almost total paralysis of meat exports, for which foreign currency is lost, fiscal deficits are produced, and producers and other actors along the supply chain are seriously impacted. Paraguay suffered FMD twice in the last few years: the first outbreak in 2002 and the last one in 2011 in the area of Sargento Loma, department of San Pedro. The outbreak in late 2011 impacted external trade and the livestock sector in the middle of a growth period. It caused Paraguay to lose the status of Free of FMD without vaccination.

Although the large shock caused by the FMD outbreak of 2011 on the national economy and the livestock sector—after the closing of the Chilean market, which was the largest meat export market for Paraguay—other markets became available, in particular the Russian market, which became the main meat export market for Paraguay. This was a great change, and a very effective absorption strategy, as it avoided larger production losses, and in fact, kept the sector afloat during the worse months of the crisis. But clearly, this implied more transport costs and the acceptance of lower sale prices.

Enabling environment risks

Land invasions and cattle rustling. The problem with land invasions in Paraguay happens more frequently in the Eastern Region but causes losses throughout the supply chain. It produces a reduction in livestock production due to death of animals and the destruction of on-farm infrastructure, and so forth. The largest impact on producer losses is in the reduction in the value of the land. Cattle rustling occurs throughout the entire country, but with more frequency in the department of San Pedro.

FAMILY FARMING

The family farming productive system (see box 3.3) shows in general a combination of three to four products for household consumption and one or two for market sale and household income, changing from region to region. Six of the cash crops (sesame, cassava, sugar cane, cotton, soy and vegetables) represent 90 percent of the gross value of agriculture production of family farms and make up 20 percent of the gross value of production of all agriculture products selected for this assessment. The cash crops dominate the production decisions of family farms and are the ones where farmers spend most money both in terms of working capital as in investment (see table 3.2 for a summary of family farming risks).

Cassava. Cassava is a traditional crop in Paraguay, with a great social and economic importance and strongly related to family farming, both for autoconsumption as for selling. It is a well-adapted crop to soil conditions and weather in Paraguay, generally tolerant to drought and degraded soils or low fertility. Its production and consumption cover the entire territory as it is a component of the basic diet of rural and urban families, although it has a greater concentration in the departments of Caaguazu and San Pedro, in the first place, followed by Itapua, Caazapa, and Canindeyu. Cassava occupies the fourth place in relationship to cultivated area, after soy, maize and wheat. A total of 225,327 farms, 78 percent of the total, cultivate cassava, and the planted surface per farm is 0.8 hectares per hectare (National Agriculture Census [CAN] 2008). In general, in cassava cultivation traditional practices are used, with low adoption of available technological knowledge. But the traditional technology is low cost given the relative tolerance and low incidence of pests and diseases in the crop and the use of their own seeds.

Beyond its consumption in fresh, part of the cassava production is destined for the production of starch. There are no official values about the destination of the production. In general it is estimated that 70 percent of cassava production goes for autoconsumption in the farms, be it for human or animal consumption, 20 percent is sold in fresh in markets and urban centers, and 10 percent goes for processing: cassava starch production (industrial and handcraft) and alcohol production. With respect to the main actors in the industrial chain, there are today 14 extractive plants for cassava starch; the main two companies, CODIPSA and ALMISA, have seven processing plants for cassava starch (four and three respectively). Current production is 60,000 tons per year of starch, but the industry has 50 percent of excess capacity.

BOX 3.3. FAMILY FARMING IN PARAGUAY

Conceptually, Family Farming (AF) is defined as "the rural productive activity that is executed using mainly family labor for production in a farm; and that hires in one year over 20 days of temporary labor in specific seasons related to the productive process, residing in the farm and/or nearby communities and that do not utilize—under any condition of ownership, rental or other relation—more than 50 hectares in the Eastern Region and 500 hectares in the Western Region, independently of the product produced."[a]

The rural population segment defined as AF possesses an important representation in numbers and in production in the country. In terms of numbers, AF represents 91 percent of all farms under the CAN 2008, above other countries in the region.[b] In productive terms, the available references indicate that AF has a significant contribution in the country's agriculture production. In other products, during the reference period of the CAN 2008 the contribution reached more than 90 percent of the volume produced in maize chipá, beans, cassava, banana, and pineapple; between 50 percent and 90 percent of sesame, milk, and sugar cane for industrial production; and less than 50 percent for maize tupí regular harvest and peanuts.[c] See table below.

However, even with the relevant economic and social weight, the capacity of the family farming units to be integrated competitively in productive chains and dynamic businesses has been varied, with a high percentage of them staying below productive efficiency levels. Average physical yields from most productive activities of AF (cassava, beans, peanuts, sugar, cotton) have stayed stagnant and in some cases with decreasing trends when comparing averages between 1981–89, 1990–99, and 2000–08. Some exceptions to the rule are tomatoes, locote, maize, crops that have shown significant increases in yields for those periods.[d]

The small changes within the productive operations of the majority of productive activities are attributable to the weak access to the main production means by their members:[e]

- In terms of land possession of the farms with less than 50 ha, which represent 91 percent of total farms, controlling 6 percent of land censed.

Product	Production ('000 Tons) National	Production ('000 Tons) AF	Percent of AF in the Total
Maize tupí normal harvest	990.6	206.6	20.9
Maize tupí between harvests (zafriña)	1,384.3	119.3	8.6
Maize chipá	85.8	79.1	92.2
Beans with hull	44.6	41.9	93.9
Cassava	2,218.5	2,075.6	93.6
Sugar cane	5,084	2,672.5	52.6
Peanuts with hull	30	11.3	37.7
Sesame	50	44.5	89
Banana	59.5	55.8	93.2
Pineapple	54.3	52.7	97.1
Milk ('000 liters)	1,982.6	1,058.6	54.9

Source: Quoted in MAG, Family farming agriculture production program, 2010, in database from CAN 2008.

- On the other hand, the proportion of AF productive units serviced by institutional credit has decreased from 33.6 percent in 1991 to 17.7 percent in 2008.
- Technical assistance, as a strategic resources to promote changes towards higher efficiency levels, covers 44,000 farms, around 15 percent of total censed farms in 2008.

The characteristics mentioned determined at last the poverty levels, which in 2011 affected almost 45 percent of rural population, or 1.2 million people, of which 782,000 people were in a situation of extreme poverty.[f]

[a] Strategic Agriculture Framework, 2009–18. Page 33.
[b] Strategic Agriculture Framework, 2009–18. Page 33.
[c] MAG. Family farming national food production program. Consultant report, 2011. Page 5.
[d] Strategic Agriculture Framework, 2009–18. Page 37.
[e] Strategic Agriculture Framework, 2009–18. Pages 35–0.
[f] DGEEC. Poverty and Income Bulletin 2011.

Production risks. According to what was identified in the interviews with producers, the most important production risk is *drought*. Although cassava is a crop that is quite resistant to water deficit, it is affected when drought is severe, like the event of the 2011–12 season. The most severe droughts occur in December–January; in this period the plant growth is impacted at the beginning of the root's "load," leading to a reduction in yields and production. Other weather risks are the *late frosts and hail*; but these risks have very localized impacts and are of low probability of occurring. Both have an impact in the plant's growth, and when they occur, they cause significant damage to farmers.

TABLE 3.2. SUMMARY OF THE FAMILY FARMING RISKS

Supply Chains/ Risks	Production	Market	Enabling Environment	Mitigation/ Absorption
Sesame	Pests and diseases: growing problem due to degradation of soils and larger disease outbreaks. Drought: generalized hazard; occurs in its severe form every 5 years, reduces yields and production and export volumes.(*) Hail: very localized; occurs occasionally, and causes large damages in affected areas.	Price volatility: export product subject to international market variations; sharp variations in farmer prices during 2003–04 to 2008–09 period, afterwards annual average prices have been relatively stable. Price drops are transmitted to farmers.	Export losses due to quality deficiencies: has occurred occasionally, the last one in January 2013 with a claim from Japan.	Pests and diseases: treatments are put in practice, but are insufficient. A better crop management is needed. (+)
Cassava (autoconsumption 70 percent, fresh 20 percent, and 10 percent for industry)	Drought: Cassava is quite tolerant to drought but is impacted when the drought is severe like in 2011–12. Pests: infrequent and with minor impact.	Price volatility: Reference price is the international market; short term variations are influenced by fresh product demand and supply. The risk to the industry is that it should supply itself during the periods in which prices are high for fresh product.		Pests: Are controlled with effectiveness.
Sugar cane (organic, as input to organic sugar production is majority over traditional sugar)	Drought: Occurs with a certain frequency and impacts yields. (*) Frost: The conjunction of drought and frost increases losses considerably.			Drought: Production diversification (autoconsumption products, animals, vegetables). (+)
Vegetable products	Drought and frosts: Apparently weather in the past few years has changed, with a reduction in rainfall and increase in temperature in January and February, increasing the weather risk for this period.		Oversupply in the market: entrance of products from neighboring countries due to exchange rate differences (tomatoes) or other reasons. Positive impact for the consumer, but it is not a problem for farmers who find it difficult to sell their products.	Drought: Irrigation, half shade, application of green fertilizer, and coverage.

TABLE 3.2. SUMMARY OF THE FAMILY FARMING RISKS (*Continued*)

Supply Chains/ Risks	Production	Market	Enabling Environment	Mitigation/ Absorption
Soy	Drought: It happens every 3–5 years; the most remembered ones were 2009 and 2011. Hail: affects localized areas. Pests and diseases: soy rust, related to excess humidity; army worms. The risk increases in relation to the absence of technical assistance to farmers.	Price volatility: given the high level of price variability is not a problem, but that it could impact severely small farmer cooperatives and intermediaries due to the differential between the buying and selling prices. Exchange rate variation: appreciation of the exchange rate between the moment when inputs are bought and when products are bought.	Ambiguity of the regulatory framework of neighboring countries (such as frequent changes in the Argentinean port regulations: results in an increase in the costs and reduction in business).	Drought: planting soy before the season (September) in order to avoid pests and diseases: pest and diseases are controlled regularly, although in an inefficient fashion. (+)
Cotton	Drought: Three years of intense drought between 2005 and 2013. Soil degradation is aggravating the situation. Hail: localized hazard. Pests: Some like oruga and perillero are controllable risks; picudo (anthonomus grandis) is established in most of the country and forces a permanent control; in some years its population grows significantly.	Price volatility: The industry transfers price variation to all actors. Exchange rate variability: impacts farmers mainly.		Prices: The government distributes compensation resources; high fiscal costs.

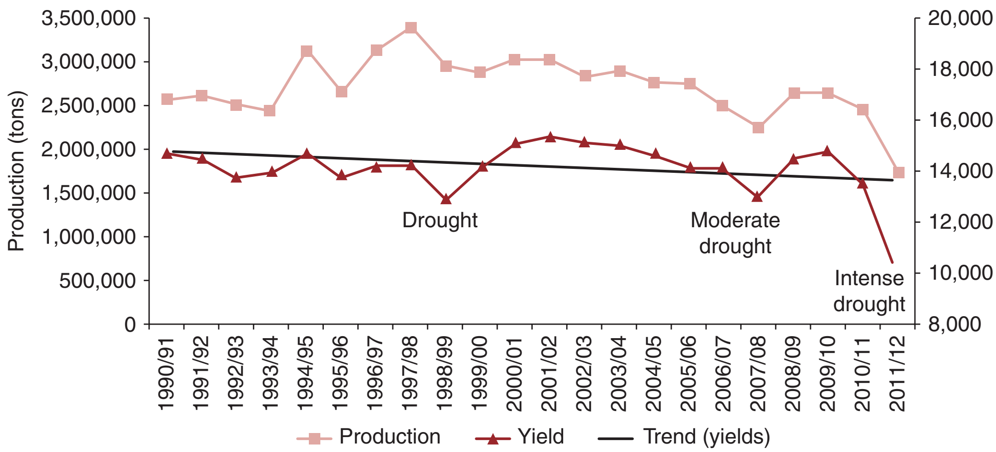
(*) Drought reduces yields and produces significant losses in terms of production and farmer income. Cooperatives face supply problems, which results in the increase in per unit cost of each transaction, making it difficult to repay credit and default risk. Absorption of risks.

(+) Normally applies for producers with a certain level of indebtedness, sale of animals, off-farm work, selling of land, and emigration. Faced with requests from farmers, the government transfers resources to compensate for losses incurred.

In graph 3.6 the spikes in yield losses for cassava are shown. They occur in the years 1998–99, 2007–08, and 2011–12, associated to drought.[13] However, the yield drops have not been as important as the ones verified in other crops; the drops of 1998–99 and 2007–08 were below 10 percent with respect to the average for that period, which is 14.1 ton/ha and even lower than the trend value for those years.

[13] It is to be noted the extraordinary low yield under the last campaign (2011–12), 9,800 kg/ha, given that in the entire historical series of cassava since 1980, yields have never been below 12,000 kg/ha. It is likely that that unusually low yield has been an estimation error (possible to be fixed by this year's season results) and not only the impact of drought, even as severe as it was.

GRAPH 3.6. CASSAVA (PRODUCTION IN TONS, YIELDS IN KG/HA)



Source: MAG.

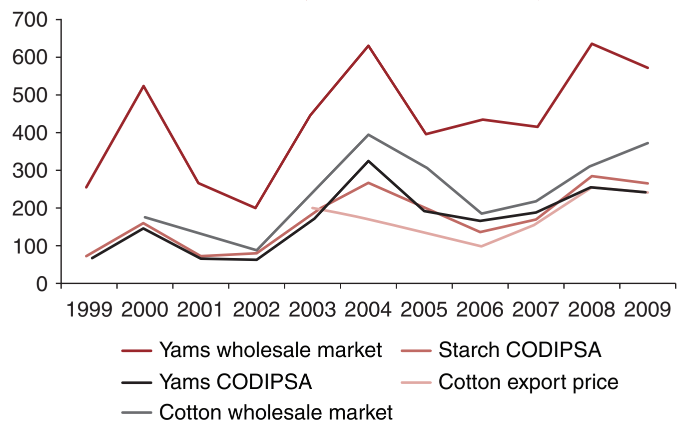
Finally, other production risks are the occurrence of *pests and diseases*. In general, losses to cassava farmers caused by pest and diseases are few compared to the impacts of weather risks; important attacks are very infrequent. Pests affect the plant growth as they attack the foliage and diseases reduce the energy of the plant, reducing foliage and causing the roots to rot.

Market risks. The main risk related to the market is *price volatility*: The reference price for cassava starch, which in turn determines prices throughout the supply chain, is the international market (see graph 3.7). International prices have shown great variability in the past years and the main ones impacted have been farmers linked to the industry, given that the latter translates backwards the price variation from the cassava starch exports to the former.

The prices paid by the industry for cassava and the starch prices, both the wholesale market and the prices offered by the industry, evolve jointly; the export price has an initial differentiated behavior, but as exported volumes increase in the past years, the behavior has been similar and evidently it is the one that determines the evolution of other prices. The cassava price in the wholesale market has some differentiated variations, but in general the trend throughout the year follows the evolution of the other prices considered.

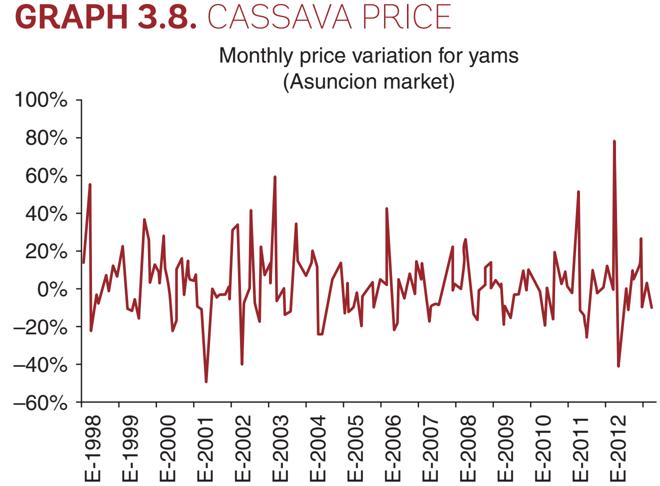
The volatility in the domestic market is shown in graph 3.8, where the monthly cassava price variations are presented for the Mercado de Asunción for a period of 15 years.

GRAPH 3.7. CASSAVA AND CASSAVA STARCH PRICES (GUARANIES/KG)



Source: Taken from Failde, A., Mondelli, M., Peixoto, C., "Insercion de la Agricultura Familiar en los Modelos de Gobernanza de las Cadenas Agroindustriales. Cadena del Almidon de Mandioca en Paraguay." CINVE, Uruguay, 2010. It was not posible to obtain updated data to expand the series.

GRAPH 3.8. CASSAVA PRICE



Source: World Bank data based on data from MAG.

It shows maximum increases of up to 78 percent during the month of January 2012, of 58 percent for January 2003, and 56 percent for February 1998, with sharp drops of 78 percent in March–April 2001 and 40 percent in February 2012 and 38 percent in March 2002. But even without going to extremes, these sharp monthly variations can cause important losses to farmers who decide to harvest cassava given an important increase in prices, but that by the time the cassava reaches the wholesale market in Asunción, price have dropped.

The other market-related risk for the industrial sector is the *lack of cassava in the domestic market due to sales to Brazil*. In some years when cassava production has dropped in Brazil and therefore domestic supply, prices in their internal market have increased significantly and the price wedge produced massive sales of fresh Paraguayan cassava toward Brazil. This has caused supply problems for the raw material for the starch industry (as they were not able to compete in prices with Brazilian buyers) and also problems for the Paraguayan cassava consumers as domestic prices have increased.

Sesame. Sesame is a relatively new crop in Paraguay. It started in the '90s with a private initiative, with the Eastern Region being the main producer and promoter. In the last years, production concentration seems to have resided in San Pedro and Concepción, reaching more than 80 percent of planted area. More than 95 percent of production is destined for export. By 2007 the country was the sixth largest world exporter of sesame and one of the main suppliers to Japan, the most stringent market for this product. Is a crop that has been adopted quickly by small producers as it is relatively easy to produce, with low costs and low labor requirement. According to the data from the National Agriculture Census 2008, over 40,000 farms were cultivating 70,000 hectares of sesame (an average of 1.7 hectares per farm), with a production of 50,000 tons. In following years, the crop continued growing, promoted by good export prices, reaching 100,000 hectares planted. However, it was later reduced to 70–80 thousand hectares due to weather and sanitary problems, and with the lowering of international prices. The severe drought of 2011–12 and disease outbreaks halted its recuperation: It is estimated that in the 2012–13 season the area with sesame was 60,000 hectares (there are no official figures yet).

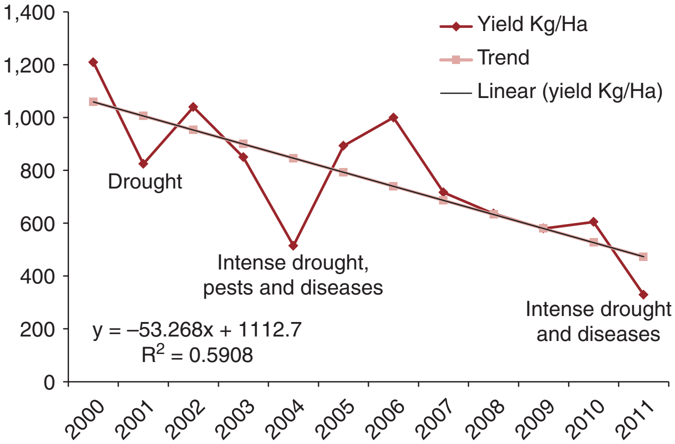
Beyond family farmers, other relevant actors in the sesame supply chain are exporters and intermediaries. Producers sell their production to one of the few businesses that store and export sesame seeds and in many cases the intermediary figure appears, usually bringing services to the farmer, from planting to harvest. There are about 30 exporting firms, initially linked almost exclusively to four or five large Japanese sesame buyers, that have been diversifying the export markets. Official technical assistance to sesame farmers has been quite limited, as with research. The majority of technical assistance has been provided by the storage and exporting firms, who also provide farmers with seeds and have introduced new varieties.

Production risks. The farmer organizations that were interviewed coincided in pointing out *drought* as the most severe risk which they face, being particularly serious in the years when the drought period (last weeks of December and first weeks in January) is accompanied by high temperatures. In general, severe droughts occur every five years. Droughts affect the husk formation, reduce yields, and produce significant production and income losses to farmers. Another weather-related risk is *hail*. This is a phenomena that occurs occasionally and in a localized way, but when it happens it causes large losses and damage in the impacted area. It impacts the plant's growth and can also impact the harvest. Finally, *excess rainfall* can affect sesame after harvest, when it is put to dry and there is continuous rain over periods longer than two days. This happened in 2011 in Concepción, but is very infrequent.

Following in importance, after drought, is the occurrence of pests and diseases, a risk that has increased over the past years. It impacts the plant during flowering and also during the formation of husks in the case of pests. The high or low humidity determines the incidence of different diseases produced by fungus: in dry years *macrophomina* attacks and in wet years *fusariosis*. In general, rainfall and temperature conditions determine the severity of the pest and disease outbreaks every year. In very critical years production can decrease up to 50 percent if adequate measures are not taken. The decrease in production impacts farmers, intermediaries, and exporters.

Graph 3.9 shows the relationship between the large drops in yields and the occurrence of adverse natural hazards (based on MAG data).

GRAPH 3.9. SESAME YIELDS (KG/HA)



Source: World Bank data based on data from MAG.

The realized risks that have cost the largest losses to the sesame supply chains are intense droughts and pest and diseases outbreaks. In the 2004/05 and 2011/12 seasons droughts powered the plant health problems. Yields decreased by 39 percent and 31 percent respectively in relation with the trend, and resulted in very important losses for the entire supply chain and in particular for farmers. The extraordinary low yields of the last season (2011/12), about 330 kg/ha, was the lowest in the entire series, with an intense drought and the development of diseases, and is an urgent plea for mitigating production risks. If not done, the crop can disappear as an attractive income option for family farmers.

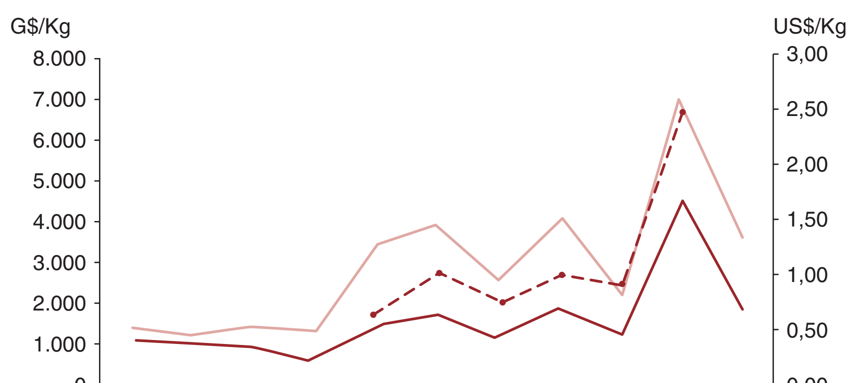
Market risks. The main market risk is *price volatility*. Since sesame is an export product, it is exposed to international price variations, which are hard to predict. Furthermore, traders transmit these variations to the farmers, resulting in farm revenue losses when prices drop. See graph 3.10.

Strong variations are observed during the 2002–09 period, after which prices tend to stabilize. Farmer prices, however, show greater volatility than international prices.

Enabling environment risks. The most important enabling environment risk is the loss of exports due to *quality issues*, mainly due to the presence of agrochemical residues in higher concentrations than the ones allowed by export markets. This has occurred occasionally, the last time in January 2013 with a batch going to Japan, which is a very strict market with respect to maximum residue content, and with lower tolerance levels than the ones accepted globally. This risk impacts the exporting firm directly, and indirectly the image of the country for buying markets.

Cotton. Cotton has been historically an agriculture production component never to be missed in the family farming sector in Paraguay. Data from the census indicates that in 1981 there were 138,000 farms cultivating 243,000 hec-

GRAPH 3.10. PRODUCER AND INTERNATIONAL PRICES IN GUARANIES AND US$, 1999–2009



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Producer price Gs.	1.300	1.263	1.347	1.200	3.340	3.850	2.491	3.974	2.182	6.958	3.375
Producer price US$	0.41	0,36	0,33	0,21	0,52	0,64	0,40	0,71	0,44	1,59	0,67
International price US$					0,64	1,01	0,76	1,00	0,89	2,49	

Source: World Bank data based on data from the Trade Directorate, MAG, and BCP.

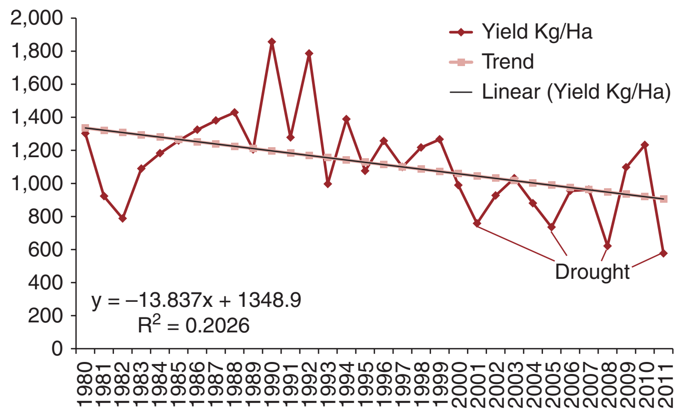
tares, with a global production of 317,000 tons of cotton on branches, in other words, a yield of 1,305 kg/ha. Ten years later in 1991, its importance in terms of quantity had increased, with 415,000 hectares in 190,000 farms and a total production of 632,000 tons and an average national yield of 1,523 kg/ha. During those times, cotton was the cash crop by excellence of the family farming system throughout the country, complementing the use of land for autoconsumption crops. During the growth period for the product, the country experienced an accelerated expansion of installed capacity for textiles, with more than 30 textile plants being accounted at one point.

The low productive results, associated with drastic price variations of the internal price, progressively disincentivized farmers. In the 2006–07 season the government decided to stop the practice of providing seeds and other inputs, causing the crop to virtually disappear from the national production scene. The CAN 2008 registered a sharp decline in cotton, with only 54,000 farms reporting the planting of 66,000 hectares. The following seasons (2008/09 and 2009/10) had very low levels, with 30,000 hectares and 18,000 tons in the first, and 13,700 hectares and 15,000 tons in the second. The fundamental productive base, soils, currently degraded in most part of the national territory, and the incidence of weather and health hazards (see below), along with international price volatility, causes one to think about long term combined strategies if a sustainable recovery of this activity is to be achieved.

Production risks. *Weather*. The large majority of people interviewed have agreed that the impact of weather factors have tended to increase over the past few years for cotton. The *water availability deficit in the soil* is the most important risk as it has been recurrent in the past years. According to sources, cotton production faced hydrological deficit events in the 2002/03, 2005/06, and 2009 and 2012 seasons. Out of all these events, the ones of 2009 and 2012 were reported as particularly severe, producing, according to the interviewees, losses of more than 50 percent. See graph 3.11.

The events related to water deficit cause the abortion of the flowers and the lack of fructification. Harvesting volumes decrease, and monetary flows towards the communi-

GRAPH 3.11. COTTON YIELD KG/HA



Source: MAG/DCEA: Historical series of agriculture production and interviews.

ties are reduced, impacting the households' capacity to pay and reducing loan repayments from local input suppliers.

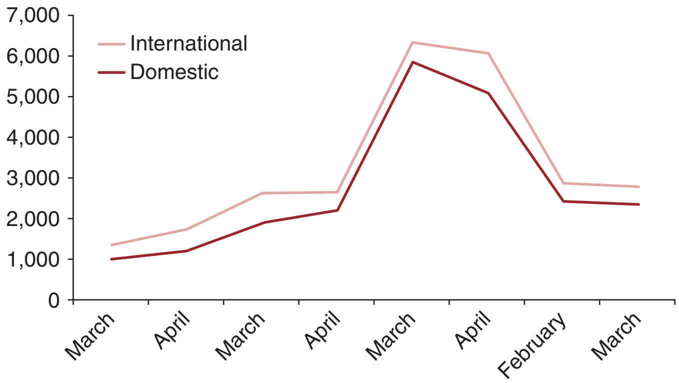
The second weather factor that has had an impact, although localized, has been *hail*. Events were reported in 2004, 2006 and 2011.

Pests. The main threat from plagues is by the picudo (beetle-like insect) which is present in the country since 1992. Since its introduction to the country three to five years ago, it has caused a commotion that translated into, among other things, an exponential increase in the application of insecticides in cotton farms. The increase in applications had a direct impact in the cost of production of at least 100 percent. In the case of farms planted with GMOs, the picudo continues to be the main threat in terms of pests. On the other hand, for farms planted with traditional seeds, the insect is controlled more effectively through early applications that are done to control the hatching. Other pests like perillero, oruga, and lagarta rosada are virtually prevented through the use of GMO seeds, but not for traditional varieties which need pesticide treatment. Out of the three, the most severe is the lagarta, of which an outbreak was reported in 2008 with an impact and damage of up to 60 percent of production.

Market risk

International price volatility. The price of the fiber in international markets tends to fluctuate permanently, with important drops in 2004, 2008, and 2012. The references obtained indicated that for all cases in the drop in international prices, this reduction is translated directly

GRAPH 3.12. COTTON: INTERNATIONAL AND DOMESTIC PRICE



Source: (1) BCP, Economic Report. (2) MAG/Direccion de Comercializacion, Price table at the level of industries and cooperatives.

to farmers, contributing to the depression of incomes of family farms. See graph 3.12 showing evidence of the transmission of international prices to the domestic market.

Exchange rate variability. The appreciation of the guarani in recent years, as well as the permanent price variations, has a negative impact in the possibility of the local industry to compete in international markets, and also introduces an uncertainty at all levels of the supply chain. In the last four years (2009/2012) the appreciation rate of the guarani with respect to the dollar was of 7 percent in 2009, 2.2 percent in 2010, 4.3 percent in 2011 and 7 percent in 2012. The exchange rate has a direct impact in the price formation to producers.

Sugar cane (family farming).[14] On the side of the use of resources, sugar cane production destined for the industry (CAN 2008) involved a total of 20,551 farms, with a planted surface of 82,000 hectares and a physical production of 5 million tons. Out of the total number of farms dedicated to sugar cane production for industry, 87 percent had less than 20 hectares, and 96 percent had less than 50 hectares. In terms of production, the farms with less than 50 hectares planted 55 percent of the total area and contributed with 52 percent of total production in 2008. With respect to the geographic distribution, the farms were localized mainly in the departments of Guaira (38 percent), Paraguari (20 percent), Caaguazu (15 percent) and Cordillera (6 percent). According to the interviews, the sugar cane supply chain faces serious problems in terms of farms (degraded soils without adequate management practices, lack of introduction of new varieties, equipment deficit for increasing efficiency of certain tasks like cutting, peeling, loading and transport), as well as with commercial practices being used (sales by volume and not by the total sugar content).

The traditional way for organizing the productive supply chain is based on the formation of sugar cane producer organizations, representing farmers in the negotiations with industry about prices, reception and delivery of product, and so forth; and in some experiences the associations have moved further in the acquisition and management of agriculture machinery for the provision of services to their members. There is a cooperative management model that is relatively recent in its evolution and that was noted to be favorable to growth prospects.

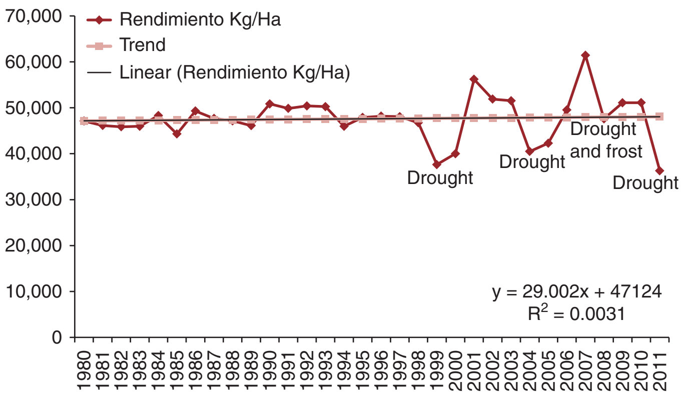
Production risks. The main production risk is the weather factor, which in some years has impacted yields significantly. *Hydrological deficit due to prolonged absence of rainfall and/or bad distribution of them*, has been referred to the one with the most impact over production in recent years. The most severe years were 2000–01, 2005–06, 2009, and 2012, with the first one producing losses of up to 70 percent of yields, while the others producing reductions between 20–30 percent. Beyond direct losses to production, damages were transmitted through the supply chain, reducing seasonal labor, delaying loan repayments (default) and the processing of new requests, and reducing the capacity of industries to meet their contractual obligations due to lack of raw material.

The occurrence of *frosts* has constituted another weather variable that has impacted sugar cane production, producing losses. The references obtained in the production areas indicate that frosts happened in 2008 and 2009 (with the latter having frost and drought associated), and 2011–12 when losses are estimated between 20 and 25 percent.

Graph 3.13 shows the evolution of yields associated with weather events that have produced production losses.

[14] The assessment focused on organic sugar cane.

GRAPH 3.13. SUGAR CANE YIELDS



Source: MAG.

Market risks

Price. During the assessment the organic sugar market was analyzed, which is relatively important for Paraguay. According to the interviews with actors of the organic sugar can supply chain, the business had been developed in the country on the basis of the sale of the product in certain niche markets, mainly the United States. The price formation of organic sugar had been originally maintained in a differentiated fashion from traditional sugar, avoiding the transmission of international price volatility into the price of organic sugar. However, as time passed, the price formation mechanisms have tended to converge with the traditional sugar cane market, increasing the price uncertainty for Paraguayan farmers. The current 2013 season finds the international market with an abundance of sugar, with a significant downward pressure on prices, with massive influx of sugar from Argentina and Brazil (contraband), and at the same time with a relative oversupply of sugar cane in the local market. The result of this interrelationship of forces has produced significant delays in the 2013 season due to the lack of agreement on a price for the raw material, and with the subsequent loss for organic sugar farmers.

Soy (family farming). According to data from CAN 2008, 72 percent of soy farmers have less than 50 hectares (20,000 farmers) but their contribution to national production is only 6 percent. In some cases it is small producers that plant the crop and in others, family farmers rent out the land to medium to large farmers.

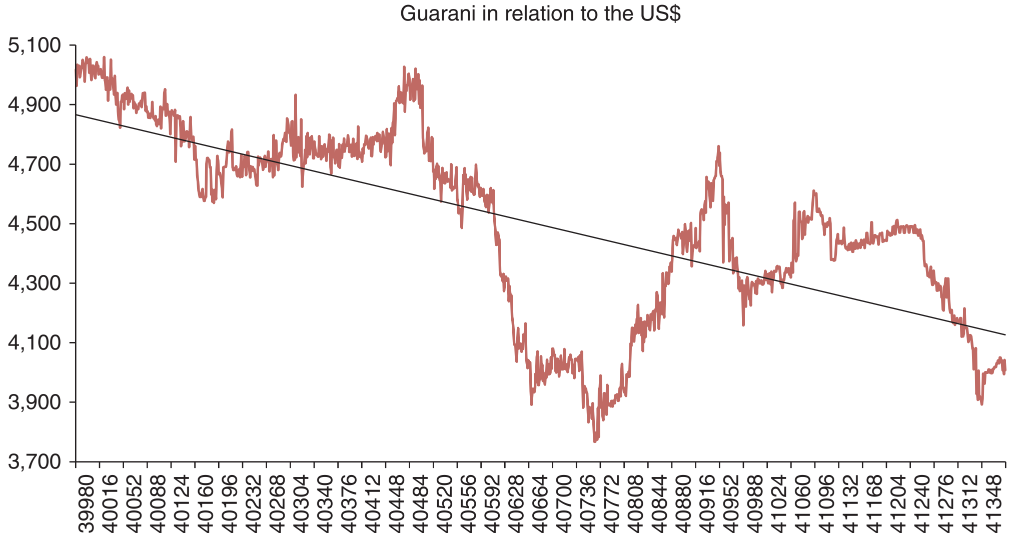
The small producers do not appear to be coordinated in an inclusive way with the soy supply chain, be it because the current soy production is at a technological level beyond their economic reach or be it because they participate marginally in the trade mechanisms of medium to larger farmers through cooperatives and local intermediaries, without being able to benefit extensively from current good market conditions nor the risk transfer mechanisms that other actors in the supply chain benefit from. Therefore, the rental of land is an ever increasing factor among small farmers, who ensure an interesting monetary income (1 to 2 million guaranties per hectare are being paid) at the same time that agriculture risks are eliminated.

When small producers are inserted into the supply chain, the industrial market is often closed to them. Eventually, productive conditions can be generated with a focus towards alternative markets, like soy milk, soy yogurt, soy cheese, and other niche products for exports. However, access to these markets requires a specific policy, in parallel to soy production and industrialization, coordinating with the other international commercial actors (fair trade, vegan product trade, biodanamic producer trade, for example).

Production risk. *Drought* is the most critical risk faced by small soy producers and cooperatives that group them. Be it due to low technological levels that dominate their production methods, to their dependency on the mechanisms of the structure markets for medium to large producers with economies of scale and insurance, or to the lack of financial capital or access to long term credit to face significant production losses, family farmers are very vulnerable to drought and other weather events. According to interviews with producers, drought hits every three to five years. The most remembered years are 2009 and 2011. Losses in the last one was more than 50 percent.

Pests and diseases, in particular soy rust, which is related to excess humidity, and the army work, is an important risk for farmers. This is due in part to the potential for producing losses, but also due to the high costs that are involved in controlling them. The risk and costs increase in light of the lack of technical assistance.

GRAPH 3.14. EXCHANGE RATE EVOLUTION



Source: Central Bank of Paraguay (BCP).

Empiric evidence on drought and other production risks are shown in the section on commercial agriculture soy production.

Market risk. *Price volatility and exchange rate*. Price risks are similarly to those faced by commercial farmers, although family farmers do not have access to the means nor the scale to purchase financial hedges. But given the high level of soy prices, price variability does not have a great impact today. The exchange rate appreciation risk between the moment of buying inputs for production and selling of the product can be a problem for both farmers and cooperatives. In the case of cooperatives the largest risk is with recovering loans for the purchasing of inputs by members. See graph 3.14 with information about the daily quote of the guarani with respect to the dollar since June 2009.

In summary, without appropriate technologies and without the means to transfer risks, soy production is not very viable for small producers. Costs are quite high and the risks to large.

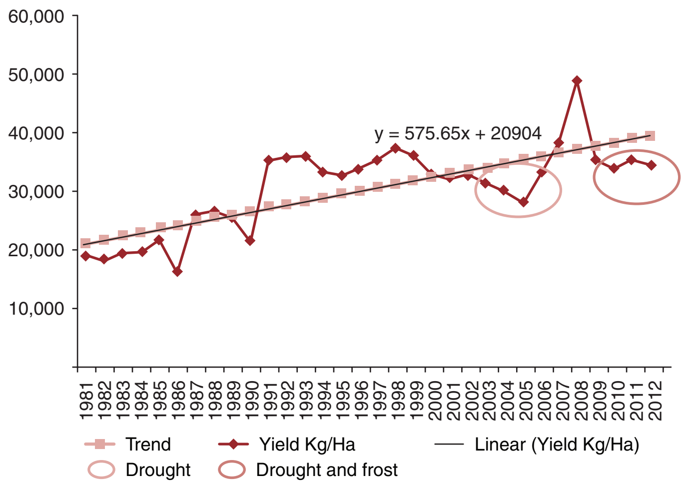
Vegetables. Vegetables and fruits make up a family of products that are expanding in Paraguay, although for now are almost all destined for domestic consumption. The exception is a few fruits like banana that are exported fresh to regional markets, and some derivatives of concentrated juice and ready to drink juices that are exported to neighbor countries. For these products, as it happens with other products of family farming, the dominant productive system is the one that combines agriculture and livestock activities for own consumption. However, the number of farms that are developing specialized systems for accessing markets is increasing.

According to CAN 2008, out of the total commercial farms, 94 percent were farms with less than 20 hectares. The departments with the highest concentration are Caaguazu (36 percent), Central (27 percent), Paraguari (6 percent), and San Pedro (6 percent). With respect to the main vegetable products, CAN 2008 registered 3,711 farms with tomatoes, 1,681 with locote, 749 with carrot, among the ones with most frequency. The average yield for tomato and locote increased at least 42 percent and 79 percent respectively during the 1981–2008 period, showing a clear lead over the performance of other family farming products.

For the trade of these products, some cooperatives and other organizations like chambers and associations have put stands in the main wholesale markets in the capital city, alternating its deliveries with other options like selling to intermediaries and supermarkets.

Production risks. *Weather*. The main weather hazards that impact or put at risk the regular performance of vegetable production include *excess humidity, drought, and frosts*,

GRAPH 3.15. TOMATO YIELDS



Source: World Bank data based on MAG.

according to interviews and data collected during field visits. Although here tomato was taken as reference, the events have an impact in the entire vegetable production. See graph 3.15.

The high probability of drought (high temperature and intense evapotranspiration) between the second half of November, December, and January makes it practically impossible at present to plant products like tomatoes and other vegetables in open air, as it was possible 25 years ago. The impact of risks has been felt during 2003–06 and 2010–12. In terms of relative excess air humidity and rainfall which always occur, they cause problems (mainly delays in the vegetative development, incidence of pests and diseases, reduced production), although not being able to become the main hazard. The time with the most frequency is between the months of February and April. Frosts are annual events, with a probability of reaching its maximum level during the second half of June and beginning of August. Damages could be total when there is a lack of infrastructure. According to references, severe damages due to frosts were recorded in 1999 and 2011–12, the period in which losses were estimated between 30–40 percent.

Market risks. *Oversupply of the market*. With some frequency the extraordinary entrance of products from neighboring countries occurs motivated by the exchange rate differential (tomatoes) and other reasons, like the production seasonality. This can benefit the consumers, but it is a problem for farmers, who have difficulties placing their products in the market.

THE PRICE VOLATILITY PROBLEM: THE CASE OF MAIZE

Although price volatility is not foreign to the operation of agriculture markets, it is not free of consequences. In fact, it has a negative impact on the economy and households of family farming and in the decision to produce cash crops. The problem is, to a certain extent, to be felt with less intensity, while the increasing trend in international commodity prices has been high and sustained, but the reversal of that trend, or the increase in the price of inputs, or the appreciation of the exchange rate, or other factors, could make the medium term price volatility problem even worse.

In this section we present the results of the maize volatility analysis, using the Farmer Market Information System/Ministry of Agriculture and Livestock of Paraguay data for the Asunción Market and DAMA for the 1993–2012 period. See appendix B with the details of the analysis.

In Paraguay, white maize is planted mainly for human consumption and produced mainly for family farming while red maize (yellow), which is typically an export product for animal and agroindustry consumption, is cultivated by commercial farmers. Family farming producers plant white maize for autoconsumption and for sale in order to have access to cash. They also plant some red maize for animal feed, although no information was found about the proportion with respect to white maize. Normally, the sale is local, so the price that makes it to family farmers is quite lower than the wholesale price at Mercado de Asunción and using this assessment.

The following conclusions were drawn. The domestic price of maize according to DAMA, in theory representative of the behavior of other national markets, presents a very high volatility in the short term, which cannot be explained entirely by seasonal variations nor responds to changes in the general price levels from the economy as a whole.

However, differences in behavior exist between white and yellow maize to the detriment of the former. Family farming producers (white maize) suffer from larger price volatility and benefit less from international price increases than the commercial farmers, who produce yellow maize for exports for agroindustry.

It is likely that the main cause for interannual volatility (short term) of prices is found in the yield variations of weather events, but could be other factors impacting, like contraband or other enabling environment context. Therefore, the impact would depend in the market risk management opportunities of the different actors throughout the supply chain(s).

CHAPTER FOUR

PRODUCTION LOSS QUANTIFICATION

Agriculture risks are inherent to the nature of Paraguay, and, as seen in chapter 3, Paraguay is exposed in an important way to production, market, and enabling environment risks. If one also takes into account that agriculture is a key sector for the Paraguayan economy (chapter 2), it is evident that the occurrence of risk events have important impacts on economic growth, public financing, supply chains, domestic markets, and food security of the vulnerable households. In particular, agriculture sector risks in Paraguay are susceptible to have an impact:

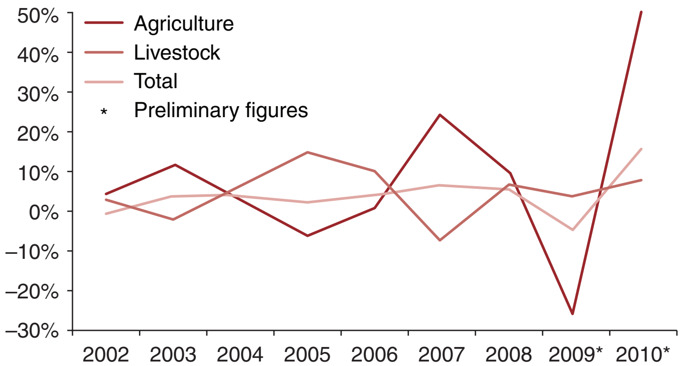
i. At the macroeconomic level, reducing exports and reducing economic growth in the short run.
ii. At the government level, reducing tax collection and increasing public expenditures to respond to compensatory measures for impacted population from drought and other disasters.
iii. In relation to the actors in the supply chain (intermediaries, exporters, cooperatives, producers, and so forth). It increases production costs (market risks), reducing profitability and producing losses, increasing indebtedness and reducing investments, even identifying market access.
iv. In relation to the domestic market, food supply disruptions.
v. In relation to the rural poor households affected by the domestic economy and putting at risk food security. All of these impacts are susceptible of being estimated.

MACROECONOMIC IMPACTS

Changes in gross aggregate value (VAB) of the agriculture sector have not been homogeneous during the past years due to the incidence of weather, sanitary, and other hazards. The agriculture and livestock behavior has been quite different reflecting the different type of risks faced by one and the other (see graph 4.1).

At any rate, the agriculture sector is key for the performance of the overall economy. In the country report from the IMF (2011) it reads: ". . . although Paraguay has registered important economic swings in the past 50 years, strong and persistent contractions of the total product have been relatively rare. In fact, the largest drop in GDP in half a

GRAPH 4.1. VARIATION IN THE GROSS AGRICULTURE VALUE



Source: MAG.

century was in 2009 (3.8 percent) after the severe drought that impacted the agriculture sector and in a context of averting a global crisis. However, the contracting period turned into recovery quickly with the greatest harvest of all times in 2010, contributing in a substantial manner to a record GDP growth of 15 percent".[15]

In the same year of the IMF 2011 report, another drought occurred, causing large losses in the agriculture sector, which was followed in 2012 with a soy bumper crop. Also, in 2011 an FMD outbreak occurred (referred to in chapter 3), with large consequences for meat exports and the loss of the Chilean market. This situation was reestablished throughout 2012 and 2013. See table 4.1 with the BCP projections about the economic growth of the agriculture and livestock sectors for the first quarter of 2012 and 2013, registering weather problems in the first one and sanitary ones in 2011, and in the second the good performance in 2012.

Based on this evidence, it is clear that production risks for soy and other crops from the soy cluster and livestock have great importance in relation to the overall economic growth and stability of Paraguay. A significant drop in production and soy exports have a notable impact in the global economic activity and aggregate demand, and with that public finances due to the reduced tax collection. This recent occurrence of bad and good years suggest two things: one that the weather behavior is every day more erratic and that requires increased mitigation actions; and two that the economic importance of soy and livestock are such that they have become a key aspect of an agriculture risk management strategy.

TABLE 4.1. PROJECTIONS OF TOTAL AND AGRICULTURE SECTOR ECONOMIC GROWTH

GDP Variation (percent)		
	First Quarter 2012 (Annual)	**First Quarter 2013 (Annual)**
Total GDP	−3	14.8
Non-Agriculture GDP	3.9	10.1
Agriculture	−28.5	47.4
Livestock	−3.8	10.8

Source: BCP.

ESTIMATING HISTORICAL LOSSES OF SUPPLY CHAINS

Table 4.2 show estimated losses throughout the supply chains as a result of the occurrence of production risks: Totals are in tons and guaranis and annual averages in guaranis and dollars. The crops that registered the highest values in terms of losses per year are soy, cassava, maize, and cotton, followed by wheat, sugar cane, and rice.

The average annual losses $237 million or 5.4 percent of agriculture GDP (8 percent of crop GDP only) are significant. But they are even more significant if one considers that that 5.4 percent of gross value of production represents more than half a percentage point of annual economic growth each year.[16] This is an important drag for the national economy, considering that they do not take into account livestock losses.

Furthermore, if recent years are analyzed when large natural disasters have occurred (drought, FMD, and so

[15] IMF, Country Report No. 11/239. Paraguay: Consulta del Articulo IV correspondiente a 2011, Agosto 2011.

[16] Calculation made based on an estimate from VAB/gross value of production (VBP) for the 60 percent of agriculture and a contribution to total GDP of agriculture of 16–20 percent based on production and price data from MAG and national accounts from BCP.

TABLE 4.2. LOSSES IN TONS, GS$ AND US$ PER CROP

Crop	Period	Volume of Losses (Tons)[A]	Total Value of Losses (Million G$)	Annual Average Losses (Million G$)[B]	Annual Average Losses (US$)[C]	Losses (% of Ag GDP)
Garlic	1990–2011	742	10,053	457	103,850	0.002%
Cotton	1990–2011	430,232	774,418	35,201	8,000,188	0.18%
Irrigated Rice	1990–2011	145,829	471,173	21,417	4,867,490	0.11%
Dryland Rice	1990–2011	15,796	51,036	2,320	527,230	0.01%
Sugar Cane	1990–2011	3,483,029	618,238	28,102	6,386,752	0.15%
Canola	2007–2011	5,498	9,435	1,887	428,855	0.01%
Onion	1990–2011	7,970	13,903	632	143,621	0.00%
Locote	1990–2011	8,260	51,624	2,347	533,310	0.01%
Maize	1990–2011	1,201,903	1,603,011	72,864	16,560,028	0.38%
Yams	1990–2011	2,495,542	1,629,589	74,072	16,834,596	0.38%
Beans	1990–2011	59,091	184,186	8,372	1,902,744	0.04%
Sesame	2000–2011	39,653	176,980	14,748	3,351,902	0.08%
Soy	1990–2011	7,897,436	14,789,291	672,241	152,781,932	3.48%
Tomato	1990–2011	52,868	171,161	7,780	1,768,191	0.04%
Wheat	1990–2011	684,782	637,532	28,979	6,586,075	0.15%
Carrot	1990–2011	19,827	3,470	158	35,844	0.00%
Total			21,195,098	971,575	220,812,608	5.02%

Source: MAG and BCP.

[A] Physical losses are calculated as the difference between real yields and trend values of the years when the real value is below 30 percent of the trend, multiplied by the area in that same year.

[B] For estimating the value in G$, average prices for 2010–12 were used. Agriculture VAB was used from 2011 at current prices.

[C] The exchange rate used was for the year 2012 to estimate losses in US$.

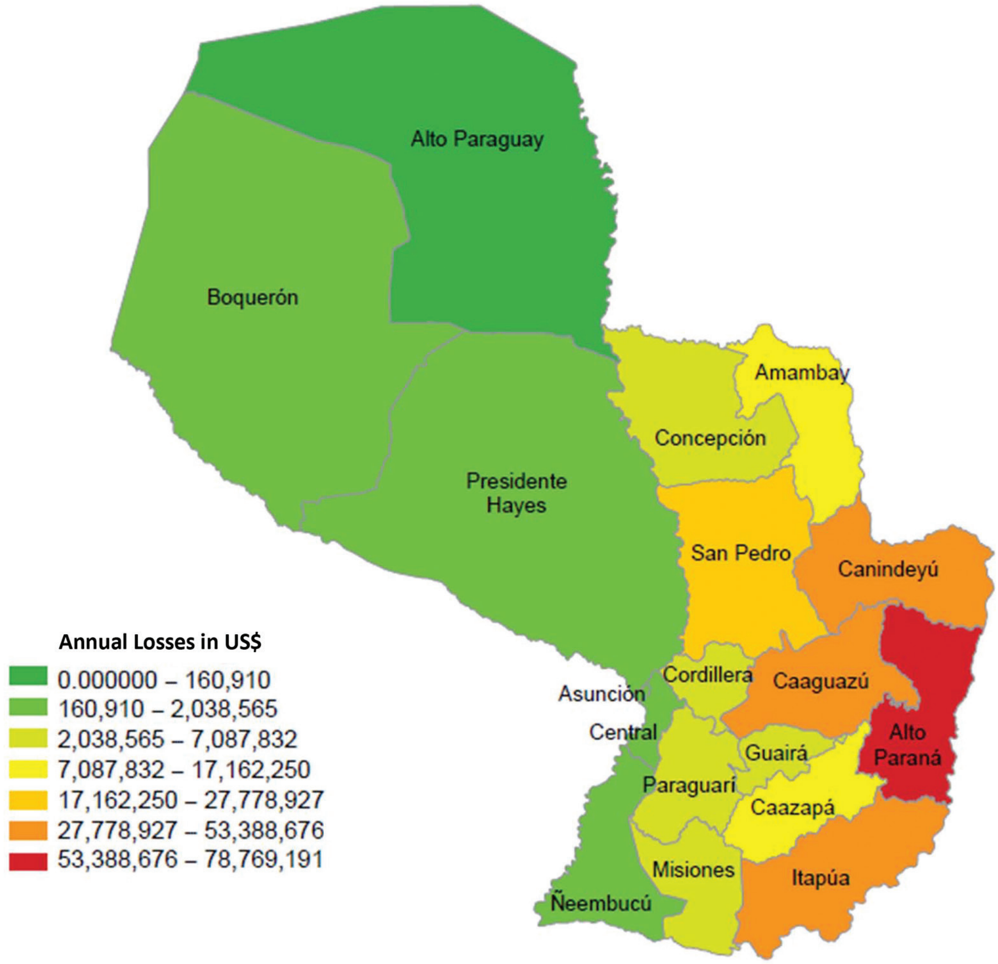
forth) producing large losses, the impact in the economy as a whole and in the farmer's economy, traders, industry, and so on have been of enormous proportions. In 2011, US$920 million were lost only in soy. This production drop in soy produced a loss of several percentage points in the total GDP, as seen above.

Also in 2011, due to drought, family farming incurred the following losses: cassava, $94 million or 385 of VBP; sesame, $13 million or 46 percent of VBP; and cotton, $3 million or 26 percent of VBP. Given the importance of cassava for food security and the domestic economy of rural households, these numbers do not express the overall social gravity of the problem.

In respect to as cassava, losses in the past drought years have been well above the annual average for the 1990–2011 period of 78,950 tons.[17] 125,934 tons in 1999–00, 117,382 tons in 2007–08 and 632,435 in 2011–12. Physical losses in 2011–12 represented 25 percent of the production of a normal year. In relation to cotton, the annual production loss for the period 1990–2011 was estimated around 19,556 tons of cotton in branch, valued at $8 million. But if the losses of the worst years are observed, we obtain magnitudes like: 35,284 tons in 2000–01, 51,463 tons in 2001–02, 20,949 tons in 2002–03 and 49,453 tons in 2005–06, with clear impacts between small producers and the rest of the supply chain. This increase in the production losses due to risks is part of the explanation for the abrupt reduction in cotton production in Paraguay.

[17] Result from dividing total losses from 1990–2011 period (2,495,542 tons) by the number of years (22).

FIGURE 4.1. AVERAGE DEPARTMENTAL LOSSES



Source: Author's calculations based on MAG data.

PRODUCTION VARIABILITY AND REGIONAL AND RURAL FOOD SECURITY IMPLICATIONS

There is a regional estimate for losses that coincide with the major production supply chains (soy, maize, wheat) and with cassava, which is the most common crop among the majority of family farmers. The departments with the largest losses in value have been Alto Parana and then Canindeyu, Itapua, Caaguazu, and San Pedro (see figure 4.1), which are also the ones with the largest planted land.

The geographic dimension to production variation. The difference between losses among departments depends on the size of production, but also on the risk exposure (or variation of production due to weather, sanitation, and so forth) observed in the different areas and departments of the country. In order to show this situation, maize was analyzed given that it is planted throughout the country, given its economic importance after soy, and given that is a product of family and commercial farming.[18] As a measure of production risk exposure the coefficient of variation[19] of departmental yields as taken

[18] In fact, no data was found, allowing to disaggregate production among the different types of maize in Paraguay, white and yellow.

[19] The coefficient of variation measures the relationship between the variability of the variable (standard deviation) and the size of the arithmetic average; expressed usually as a percentage. A greater value of the coefficient of variation greater heterogeneity is present in the values of the variable and the smaller the coefficient of variation the more homogeneous are the values of the variable.

TABLE 4.3. MAIZE: LOSSES AND COEFFICIENT OF VARIATION

Regions	Maize Production per Region, Average 2009–10 to 2011–12 (Tons)	Annual Average Losses (Tons)	Coefficient of Variation of Yields—Volatility
Concepción	30,255	1,914	31.99%
San Pedro	4,72,767	10,398	35.74%
Guaira	34,956	1,811	37.45%
Caaguazú	3,62,606	10,491	34.12%
Caazapá	1,28,746	3,488	27.50%
Itapúa	3,38,761	7,470	31.19%
Misiones	30,306	1,687	38.46%
Paraguarí	30,105	2,456	42.40%
Alto Paraná	8,52,941	15,924	23.12%
Amambay	1,10,130	2,209	32.24%
Canindeyú	7,70,276	9,894	25.63%
Total			**28.90%**

Source: World Bank data based on data from MAG and STP/DGEEC.
Note: Departments with marginal maize producers were excluded.

where maize is relatively important. In table 4.3 the results are shown.

The result is that the yield volatility differences are not drastic among the different departments, with a minimum and maximum of 23 percent and 42 percent. But the departments of Alto Parana and Canindeyu, which are by far the most important producers of maize and have the highest yields in the country, show the lowest coefficients of variation than the other departments, mainly due to improved technologies and risk management practices. On the other hand, the department with the least production (Paraguari) shows the highest yield volatility (42.4 percent), followed by other departments with low maize production (Misiones and Guaira). Departments with intermediary production (San Pedro and Concepción) also show a great degree of volatility (given their location in areas with less rainfall than the Eastern departments).

Variability and rural food security. Also basic food availability for rural households of family farming, mainly cassava and beans, register an important variability throughout the last 20 years. This can be seen in

GRAPH 4.2. PRODUCTION OF FOOD CROPS

Source: MAG.

TABLE 4.4. COEFFICIENT OF VARIATION IN REGIONAL PRODUCTION OF BEANS AND CASSAVA

	Coeficient of Variation	Production 2010–11 (Tons)
	Yams	
San Pedro	40%	474,981
Cordillera	43%	61,140
Guaira	29%	124,212
Caaguazú	30%	449,706
Caazapá	33%	227,106
Paraguarí	37%	134,930
	Beans	
San Pedro	31%	6,062
Cordillera	51%	2,780
Guaira	36%	3,147
Caaguazú	23%	10,891
Caazapá	33%	4,455
Paraguarí	31%	5,262

graph 4.2, showing the production in the departments with the highest concentration of family farms. Taking production as an indicator of food availability[20] and considering that the overall consumption comes from their own production, variability in production impacts family consumption directly.

The value of the coefficient of variation changes from department to department (see table 4.4), showing differences in climate, capacity to manage risks, and so forth, although the average is about 34–35 percent and in no case is below 23 percent with spikes in Cordillera for beans and cassava, and in San Pedro for cassava.

[20] These are products with no or little trade with external parties, and post-harvest losses and other uses outside human consumption are relatively constant year after year.

CHAPTER FIVE
IMPACT OF RISKS ALONG THE SUPPLY CHAINS

Risks have differentiated impacts on supply chain actors, depending on the severity of the event due to the risk exposure of each one of them and due to their initial capacity to manage risks with mitigation, transfer, and absorption strategies. Throughout this chapter findings are presented about how impact of the different risks are distributed to farmers and other supply chain actors and what are the management strategies that are used for the most common risks. Finally, relationships are established between vulnerability and exposure/risk management.

PRODUCTION RISK MANAGEMENT AND IMPACT ACCORDING TO THE ACTORS OF THE SUPPLY CHAIN

Soy. As was seen in chapter 3, the most important risk for commercial farmers in Paraguay are the drops in yields due to summer droughts with high temperatures. The impacts vary according to actors. The supply chain participants that are more affected are the farmers given that as production and income decrease significantly, their indebtedness increases and their capacity to invest is reduced. These circumstances can be catastrophic if two consecutive years of drought are recorded. In general, in a drought farmers can refinance their loans with suppliers or with the banks; usually that involves increases of 2 to 3 interest rate percentage points in dollars, although in some cases where farmers are integrated to cooperatives, the latter finance them at the same rates. The rest of the actors in the supply chain are affected by a reduction in their activities (less transport, intermediation volume and services, less industrial processing and exports), which translates in higher unit costs and a higher indebtedness level, with the exception of some firms that have international financing. All of this limits investments when the growth in grain production is facing bottlenecks linked to services and infrastructure.

Maize. The impacts of early frosts and summer droughts in the various supply chain actors are similar to soy, but in a smaller order of magnitude in percentage terms and for farmers, given that the weight of maize in total farm income is less than soy. For farmers, this involves a reduction in income, increasing debt, and less investment opportunities. For the rest of the supply chain actors, this means a reduction in activity, higher unitary costs, and indebtedness. In these cases, the risk of quality reduction and limitation for selling these grains increases during frost years. The maize bioethanol industry can contribute to mitigate this risk in the future. The biotic factors impacting soy also impact maize and their impact are similar, mainly reflected by cost increases and lower unit margins for farmers, due to the increase in the number of treatments needed in some years.

Wheat. In general, it can be said that greater yield stability is observed in the last decade and the relatively lower importance of the crop in farmer income, leads to affirm that the impact of risks at the level of farmers and other supply chain actors is lower than in soy and maize.

Rice. Enabling environment risks for rice worry farmers as well as service providers, processors, and exporters. In order to overcome the problem of the use of seeds without the necessary rights, some large producers are negotiating with a seed supplier from Uruguay to develop a new variety over which they will have the rights. Small farmers, who have less water conservation infrastructure and storage and must rent harvesting equipment, are especially exposed to droughts when they are extreme, which could leave them out of the market. In order to mitigate this risk they tend to plant early, in September, and harvest early in January. Pests and diseases tend to be controlled, but at the level of small farmers, it is only efficient when they are organized and can use their resources collectively (for example with air fumigation), otherwise costs are prohibitively high.

Livestock. Drought produces a series of impacts in the farmers' and meat industry's supply chain. At the level of farmers, a reduction in pastures impacts the production costs and reduces the profitability given that they have to sell the animals with less weight and in extreme cases, they lose animals. For small herders, drought is a major risk, given that their subsistence depends on their own milk and sometimes meat consumption. The industrial and export activity suffer from the availability of cattle with less weight and in extreme cases the supply of cattle can see a reduction. Also, floods for small herders could be severe, although their concentration is less in the Chaco region where flood is more common. FMD is a severe problem for the entire supply chain and this requires a strict surveillance from authorities.

Family farming. Drought at the level of family farms, when it's extreme and causes significant crop damage, can have severe impacts on the economy of farmers, making them reach unsustainable levels of debt, to the point of leaving them out of the market and forcing them to sell or rent land. This is due to their initial low level of capital, the high financing costs to which they have access, the high transaction costs given their small scale, and the almost virtual absence of long-term financing that allows them to recover productive activities after an economic shock due to drought. For the farmer cooperatives (where many small soy farmers participate), drought means an increase in the unitary cost and difficulties in recovering loans and increases in default rates.

In terms of the processing/exporting firms, they are impacted in a different way. For the sesame exporters, the loss of part of the production (be it due to drought or pests and diseases) generates monetary losses due to the financing provided to intermediaries and the inability of suppliers to meet their export contracts.

In the case of cassava, the reduction in production due to drought causes the reduction in the supply to the starch processing industry, which increases the exposure to intermediary financial institutions that finance cassava farmers that sell to the industry.

With respect to cotton, whose production risks are partially mitigated with the introduction of GMOs, it is to be noted that the tolerance of the material does not reach the picudo, so the farmer has to have a timely control of the insect. Therefore, the monitoring of pests and diseases and timely detection are the main tools for mitigation.

RISK MANAGEMENT

It could be affirmed that part of the variations in production and losses faced by farmers and other actors of the supply chain, in particular family farming, but not exclusively, are the results of non-mitigated risks. In other words, these risks could be managed with adequate farming practices, with infrastructure investments, and accurate and timely information. Better public research and extension services can make a significant difference, given that there is a serious technological problem due to the absence of R&D. Lastly, there is little use of insurance, which in general is considered expensive by farmers, and is not considered a massive risk transfer instrument.

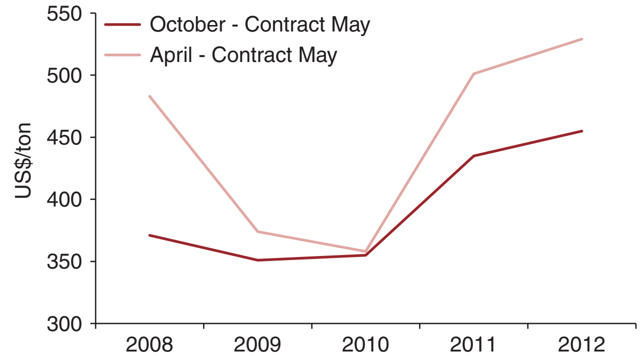
In general, the main weather risks (like drought) are only partially mitigated with appropriate practices (such as short cycle sesame varieties, early planting for sesame, cotton and soy), so the majority of family farmers who do not use these practices have tended to absorb these losses in the long run, reducing their disposable income, impacting their ability to make investments. The development of irrigation, which could be considered a good alternative to mitigate drought risk, is conditioned by the energy supply uncertainty and an ambiguous water use regulatory framework.

In organic sugar cane production, farmers facing weather risks adopt mitigation strategies such as diversification, including mainly autoconsumption crops and in some cases cash crops like vegetables, which offer short-cycle advantages. Between the members of the Furit-Horticola Chamber of Paraguay, around 20 percent of the 1,000 members have irrigation equipment and about 80 percent has half-shade cover systems. Both practices contribute to mitigate water deficit and prolonged levels of sunshine. Greenhouses, as a valid instrument for mitigating frost and hail, are only used by 10 percent of members. Hail is also mitigated with half-shade meshes as long as wind is not a factor.

Pest and disease risk in agriculture is mitigated to a large extent by all farmers, even family farmers, with pesticides. Although it is to be noted that for family farms these tend to be less and with higher costs than in technology-intensive commercial farms. Furthermore, the more technology-oriented farmers are conscious of the importance of crop rotation in order to reduce diseases.

In livestock, drought risk is mitigated with pasture reserves, feed storage, and reservoirs and Australian tanks to prevent the lack of water. With respect to FMD, the mitigation technique that is more effective is the vaccination of animals. Vaccinations are undertaken by the Animal Health

GRAPH 5.1. PRICE OF SOY FROM ANTICIPATED SALES



Source: Chicago Board of Trade.

Commissions (CSA), composed of representatives from the public and private sectors. The basic structure of the anti-FMD vaccination system is the following: SENACSA—CSA—Technical Coordinators—Auditors—Vaccinators. The audit is done to 100 percent of the farms with more than 100 heads, and for the ones with less than 100 heads it is up to authorized vaccinators to follow up. One difficulty that has persisted is the lack of updated data availability about the cattle population based on a census, although annual estimates are quite close to reality.

With respect to risk management of price volatility, it was observed a limited use of futures (basically only available for commercial farming) and a limited to no availability of market information. This lack of transparency leads to high transaction costs and a larger incidence of risks (production risks as well as market risks) which impact those actors with less market power, farmers.

The ones with capacity to purchase coverage and choose selling periods have the advantage to limit their exposure to price variations, especially to relative input-output prices for each season. See appendix C on soy risk transfer. The absence of a good weather forecasting system and market information is a weakness for all crops.

Without a doubt, small farmers are the ones with have less capacity to transfer risks through futures. Large cooperatives, exporters, and so forth, however, can cover themselves much better to international price volatility. See graph 5.1 comparing soy futures for October contracts, around planting, and April, just before harvest. The ones

TABLE 5.1. SUMMARY OF THE MAIN RISK MANAGEMENT PRACTICES

Risks	Mitigation	Transfer	Absorption	Comments
Production Drought	Crop diversification Cycle of varieties Respecting the planting window Crop management Irrigation by pivot (commercial farming) Pasture reserves, feed storage, water storage, and so on (livestock)	Refinancing of inputs Agriculture insurance	Investment reduction Increasing indebtedness Bankruptcy or sale of assets Sale of rental of land Off-farm labor	Low irrigation R&D, bureaucratic problems for irrigation permits, problems with regular energy supply Low R&D on local agronomic topics
Production Sanitary Problems	Chemical applications Crop rotation Vaccination (FMD)			
Market Prices	Farmers can sell futures and options to hedge relative prices Cooperatives and exporters hedge prices Joint sale and storage of harvest (AF)	Only part of the risk is transferred to the brokers in Chicago	Farmer margins are reduced Investments are reduced	Lack of training and information Lack of monthly price and supply and demand information

who do a previous hedge can achieve significant reductions in price volatility.

Family farmers have little means available to mitigate price volatility. Some interviewed producers mentioned that they had tried to defend the sales price as a group or storing the crop waiting for prices to come back up. The usual way for cassava farmers that sell to the industry for protecting themselves against drops in the international starch price is the sale of fresh cassava. Farmers who supply the starch industry have been reticent to adopting varieties more in line with industry demands, with a higher dry material content, and cultivate in turn cassava with a double purpose: direct consumption in fresh and for industry. This allows farmers to sell to the fresh market if prices are better, or on the contrary to industrial production.

With respect to risk absorption by family farmers, interviewed producers mentioned the main practices used according to losses are refinancing of loans, savings, animal sale, out-of-farm labor, land sale, and migration. In the case of exporters, the absorption mechanisms are the reduction of profit margins or borrowing in extreme circumstances. In isolated cases in the past years, the government has absorbed risks by farmers providing compensation or condoning bank loans.

In table 5.1 the main risks and management practices used by the different actors are summarized according to the field visits.

VULNERABILITY SPOTS

The capacity to overcome and adapt after a shock, going back to the ex-ante situation, is known as resilience, and its opposite is vulnerability.[21] This section focus on the main factors that determine the vulnerability towards these risks. Paraguay has a great portion of its population residing in rural areas (41 percent) and the majority of the poverty of Paraguay is in rural areas; almost half of the rural population is poor (1.2 million people with 787,000 in extreme poverty). But the vulnerability situation is not the same

[21] Resilience is a term originally from ecology that has been applied in the last decades in relation to humans and communities.

BOX 5.1. PUBLIC AGRICULTURE RESEARCH AND EXTENSION SERVICES

The Agriculture and Livestock Extension Service (DEAg) of MAG began operating in January 1953 with five local agencies. In 1967 it had two local well-equipped offices and a well-trained staff. The structure of these agencies, although small, allowed for a satisfactory extension performance of the area being covered. In the '80s, the DEAg begun the Small Farmer Technology Project, with the technical and financial cooperation of the United States Agency for International Development (USAID). The project was successful due to extensionists being dedicated almost exclusively to extension activities and having enough and timely operating resources available. Another successful experience was the Joint Action Program, executed by the National Development Bank (BNF). Through this program technical and financial services were offered to farmers in a coordinated fashion.

Starting in the '90s, a process of decay of the services of DEAg begun, in part due to: lack of resources for field operations, drainage of extensionists towards the private sector, and academia, constant reduction in training activities, and technical updating of staff, and so forth. With the approval of the new organizational chart of MAG in 1992, DEAg was left as a part of the Agriculture Viceministry. In the 2000s, a new restructuring of DEAg, mainly at the field level, created the Agriculture Development Centers (CDA), looking for coordination between the departments and municipalities. The weaknesses of DEAg continue, with the implementation of MAG projects without coordination with DEAg and with the establishment of a human resources policy that favors the hiring of technical personnel for short periods (six months) without the necessary training. All of this is added to their own and deep weaknesses, which has made DEAg's image worsen even more.

Today, DEAg's strengths are seen as their presence in almost all departments of the country, the acceptance of their services by farmers, and the increasing integration of the CDAs with local governments. DEAg's weaknesses are the need for training technical staff on new production and marketing techniques, incorporation of human resources with lack of qualifications, low levels of pay, lack of budget for operational expenses, the weak presence of technical staff in CDA, and DEAg's own district offices with little coordination with ongoing projects.

Agriculture research, on the other hand, has not received an adequate budget in relation to the importance of the agriculture sector in Paraguay. The source of innovation in the past years has been based in the importing of technologies originating from Brazil and to a lesser extent, Argentina, with mixed results. Only in 2010 the Paraguayan Institute of Agriculture Technology (IPTA) was created as an autonomous agency of a private-public nature, destined to capture private and public funds, and expected to establish a technology stock for the country. IPTA is inheriting the Agriculture Research Directorate (DIA), created through a restructuring of MAG in 1994, and which also led to the creation of the Agriculture and Forest Research and Extension Directorate. IPTA has a total of two experimental units (three research centers and nine agriculture and livestock field laboratories), with research programs and support services distributed at the national level and which need to be optimized on one hand and strengthened with construction and laboratory equipment on the other. It has 544 staff, out of which 151 have university degrees, 18 with masters and five with doctorates, with only 75 being agronomists and 38 agriculture technicians dedicated exclusive to knowledge management. IPTA's budget during its first year was $7.3 million and for the current year is $9.3 million.

The R&D process can be seen in the following way (Stads and Santander 2008):[1]

- The total agriculture R&D capacity shrunk considerably during the 1991–2006 period.
- The agriculture R&D expenditures increased in an uneven way but have increased in the past years mainly due to the support of the IDB, university research, and the separation of SENAVE from MAG, which led to an increase in financing for seed and chemical trials.
- Agriculture R&D is financed to a great extent by the national government and resources generated internally. In-kind donations also play an important role in the financing of research activities done by DIA.
- The levels of university staff in agriculture research in Paraguay are among the lowest in Latin America and the Caribbean.
- The recent creation of IPTA could bolster the capacity and expenditure in agriculture R&D during the next years.

Given that IPTA is such a young institution, it is still premature to evaluate it.

between the poor. For example, having a land title facilitates access to credit, education helps access off-farm labor markets, and the availability of infrastructure (rural roads, electricity, and so forth) facilitates marketing. In other words, these assets reduce vulnerability and increase the resilience in light of the risks. Access to the following assets determine to a great extent the vulnerability and resilience: land title, financing resources, technological innovation, education, and basic and productive infrastructure.

47 percent of farms have definite land title, 22 percent has a temporary document, 8 percent is rented land or in partnership, and the rest are other forms of land tenure. Only 18 percent of farms have access to the formal financial market, with 16 percent of family farmers receiving some type of credit. Basically, the latter ones access credit, in their great majority, through the Credito Agricola de Habilitacion (CAH), and financing from cooperatives According to data from the last two census, the number of farms receiving credit was reduced by half between 1991 and 2008. 14 percent of the family farms receive technical assistance compared to 38 percent of the medium to large farmers. More than half of family farms receive technical assistance from some public sector agency like the Agricultural DEAg of MAG, while the medium and large farmers receive technical assistance from private sources like specialists from private input suppliers. The difference in service quality is evident. See box 5.1. In terms of education, a third of heads of family farms have primary education up to third grade or totally lack schooling, which is in sharp contrast to medium and large farmers that have higher or technical education and in part at the university level. In relation to production infrastructure, family farms tend to use common wells, regular water distribution systems, and natural springs, while medium to large farmers use water from reservoirs, private wells, dams, and Australian tanks (UNDP 2011). These assets are key during drought periods.

According to these considerations, family farmers and their households are the ones with the largest risk, first, given their initial vulnerability situation and second, due to their low capacity to efficiently manage production and market risks. To change this situation, it would be necessary both to improve the risk management conditions of small farmers as well as modify the factors that cause the initial vulnerability situation. Without solving this, it would be difficult to reduce the risks along supply chains like cotton or vegetables, and also to increase the viability of small scale production in chains such as soy and others.

CHAPTER SIX

PRIORITIZATION AND RISK MANAGEMENT

RISK PRIORITIZATION

In tables 6.1, 6.2, and 6.3 the commercial agriculture, livestock, and family farming risks of major importance are summarized respectively, identified based on their potential to causing damage, their frequency, and the capacity of the actors to manage them.

TABLE 6.1. COMMERCIAL AGRICULTURE RISK PRIORITIZATION

Probability/ Impact	Low	Moderate	Critical	Catastrophic
Very high	Pests and diseases	Variability of the international price differentials (soy)		
High	Exchange rate risk	Conflicts of water use due to ambiguous regulatory framework (soy, maize)	Drought, approximately every three years (soy)	
Medium	Drought (rice)	Brazil's erratic import policy (rice)		
Low	Hail		Early frost (zafriña maize) Loss of market access to Brazil for possible claim against the irregular use of seeds (rice)	

Source: Authors.

TABLE 6.2. LIVESTOCK RISK PRIORITIZATION

Probability/ Impact	Low	Moderate	Critical	Catastrophic
Very high				
High		Flooding due to rain	Drought	
Medium				FMD[a]
Low	Cattle rustling	Land Invasions		

Source: Authors.

[a] At present, periodic vaccination is underway and the Permanent Veterinary Committee of the Southern Cone and the Panamerican Center of Foot and Mouth Disease are controlling SENACSA.

TABLE 6.3. FAMILY FARMING RISK PRIORITIZATION

Probability/ Impact	Low	Moderate	Critical	Catastrophic
Very high		Frosts (vegetables)		
High	Pests and diseases (soy, cassava)	Exchange rate volatility (soy) Price volatility (soy, cassava) Pests (sesame, cotton) Drought (sugar cane)	Diseases (sesame) Drought + frosts (sugar cane) Drought (soy, sesame, cotton, vegetables) Oversupply of the market due to changes in exchange rates, and so forth with neighboring countries (vegetables)	
Medium	Frost (sugar cane)	Price volatility (sesame) Excess rainfall (vegetables)		
Low	Hail (soy, cassava, cotton) Late frosts (cassava)	Early frost (soy) Hail (sesame) Lack of raw material for industry for Brazil (cassava) Rejection of exports (sesame) Drought (cassava)		

Source: Authors.

Note: Underlined means that the risks are currently being mitigated or transferred, at least partially.

RISK MANAGEMENT PRIORITY MEASURES

In this section, a series of proposals to reduce non-mitigated risks are presented, according to what was identified in previous sections. It is to be noted that many identified deficiencies are being addressed by public action at present, at least partially, and that these have been taken into account in order to design final recommendations. Tables 6.4, 6.5, and 6.6 contain a set of actions that have not been filtered and that were presented to stakeholders as a result of interviews and a workshop undertaken on June 27, 2013.

It is to be noted that many of the recommendations relative to enabling environment risks, which without a doubt impact the agriculture productive sector, are part of public policies that go beyond the agriculture public sector entities and that require a more integrated action by the government, possibly in coordination with private sector.

Finally, it is to be highlighted that the proposed actions related to the commercial farming sector reference market instruments that allow to improve risk management and for which the public sector role would only be reduced to one of facilitator, while family farming may require public policies to intervene directly in order to mitigate and absorb more effectively the risks phased by these households.

TABLE 6.4. COMMERCIAL AGRICULTURE RISK SOLUTIONS

Risks	Solutions	
	Mitigation	**Transfer**
Production	Improve the weather forecasting and early warning systems. This means training, technical assistance, infrastructure components, and a close coordination among UGR of MAG, the Federacion de Cooperativas de Produccion Ltda. (FECOPROD), and INBIO. Increase the capacity of public and private R&D. Furthermore, the public sector must achieve an improved knowledge of the state of the natural resources and its utilization capacity. Promote the use of complementary and supplementary irrigation, as the environmental and productive objectives are being aligned. It is necessary to: (i) define a policy of NDE in order to facilitate access to energy in rural areas and ensure its regular supply; (ii) increase public R&D in irrigation of main crops; (iii) implement long-term credit for financing irrigation infrastructure and equipment. Implement long-term credit for rice in order to finance the construction and rehabilitation of water reservoirs, silos and equipment through committees and farmer associations.	Promote the revision of the contractual characteristics and conditions imposed by insurance companies in order to reduce insurance costs and promote demand. Furthermore, it would be necessary to provide transparency to the policies related to insured risks. For example, insurance companies refuse to provide indemnity payments for *macrophomina* in farms affected by drought, arguing that this risk is not covered, although it is known that the development of the fungus is caused by drought.
Market	Develop an integrated market information system, including production projections, marketable supply, demand and prices, accessible by producers and other market players (recommendation also valid for family farmers). Analyze the possibility of establishing an agriculture commodity exchange, as in neighboring and other markets (cash markets, forward sales and eventually futures, including other training and arbitration functions). In principle, given the limited volume of operations, it could be possible to start with a cash market (spot and forwards), postponing the development of a futures market. Evaluate the possibility of implementing long-term public policies related to export logistics, trade negotiations with neighboring countries, and enabling environment risks that tend to reduce the variability in the levels of price differentials for domestic soy prices.	Develop a permanent program for training in futures and options markets for the different actors of the supply chain (farmers, intermediaries, cooperatives, industries, exporters). A program of this type is a mandatory response to the high international market volatility situation, associated with high price levels and low levels of stocks.
Enabling Environment	Undertake negotiations with Argentina to build a port that can provide services for barge transfers to inter-ocean liners at the Parana River. Increase consultations between private and public sectors to establish negotiations with Brazil about rice exports. Improve road and port infrastructure. The significant increase in exportable production and future projects is a solid justification for putting in place an ambitious roads program. Define regulatory framework based on scientific knowledge for water and land use. Today there is ambiguity and weaknesses that disincentivize productive investments. Promote the participation of IPTA and the National Plant and Seed Health Quality service (SENAVE) to validate rice seeds and regularize the irregular legal situation. Furthermore, develop research programs on rice at IPTA. Develop strategic plans for crop development (rice, soy, and so forth).	

TABLE 6.5. LIVESTOCK RISK SOLUTIONS

Risks	Solutions: Mitigation	Solutions: Transfer
Production	With respect to the FMD control, it is necessary to have: good sanitary practices; mandatory traceability throughout the supply chain; FMD risk analysis methodology (multiple criteria analysis based on GIS); continuous rigorous vaccination process control (electronic vaccination registry); and vaccine quality control (ISO 9000). SENACSA has to strengthen its services. In order to reduce the impact of extreme weather events (drought and so on), it is necessary to improve: best practices for the management of sustainable production systems; integrated productive systems (crop, livestock, and forestry); and improving rainfall water retention and storage techniques (reservoirs, and so on). Coordination between SENACSA-DEAg is required. In order to prevent severe flooding impact, it is necessary to implement an early warning system for floods managed by MAG.	Free vaccination against FMD (up to 10 animals). Livestock insurance.
Enabling environment	Road surveillance for cattle rustling.	

TABLE 6.6. FAMILY FARMING RISK SOLUTIONS

Risks	Solutions: Mitigation	Solutions: Absorption
Production	Use drought tolerant varieties (in general) and short-cycle varieties (sesame), disseminating research from IPTA and developing new research Ensure appropriate public technical services that allow to: (i) introduce best agriculture practices (crop rotation, soil improvement, conservation agriculture, green fertilizer, and so on); (ii) undertake pest monitoring and early detection (such as picudo); (iii) achieve timely pest control; (iv) disseminate appropriate irrigation techniques; (v) promote the installment of greenhouses (vegetables); (vi) promote crop diversification.	Create a contingency fund to support family farms affected by adverse natural disasters in a transparent manner and with minimum discretionary power by the public sector. Establish long-term credit lines for small producers through CAH or other financial institutions in order to allow investments and consolidate debt from farmers that are not repaying due to past natural disasters.
Market	Develop an integrated market information system, including production projections, marketable supply, demand and prices, accessible by producers and other market players. Promote the strengthening of coordination mechanisms throughout the supply chains, such as disseminating the experience with marketing plans of the cassava starch industry or establishing municipal level services for claims of contractual obligations (consumption products). Train staff of farmer cooperatives for operating futures markets. Promote the joint marketing of production among producer groups of a lower organizational level.	Develop a permanent program for training in futures and options markets for the different actors of the supply chain (farmers, intermediaries, cooperatives, industries, exporters). A program of this type is a mandatory response to the high international market volatility situation, associated with high price levels and low levels of stocks.
Enabling environment	Establish market observatories in order to compile information about the main partners to be used in trade negotiations and thus reducing the risk for facing non-tariff barriers or trade regulations (ports). Improving the customs controls in order to avoid the entry of products without the required sanitary certification, as well as to control the standards of products being exported (such as sesame).	

CURRENT PROJECTS AND PROGRAMS AND GAPS

Many of the actions indicated above are already being incorporated to a certain extent in public policies and programs. A special mention is warranted for the Risk Management Unit of MAG, which represents the most clear institutional response to the recognition of the importance of agriculture risks in the sectoral public policies. Within its functions are the undertaking of historical studies, supply of up-to-date meteorological information, forecasting, and early warning systems. It is mainly addressing weather risks. For the moment it is a project in development, and it does not reach farmers massively, with a need to strengthen it and integrating it to other ongoing initiatives.

In appendix D, a current inventory of projects is presented, many of them financed through loans from international institutions, which include actions like the ones identified in this report, even when none of them are solely concentrated on managing risks. Table 6.7 compiles the analysis done to match the proposals with the set of current initiatives in the country, mainly targeting family farming.

The result is a proposed short list of solutions, where the most urgent measures are highlighted.

In summary, the set of identified actions include: (i) risk mitigation, actions that occur before (ex ante) the risk event materializes; (ii) risk transfer, market transfer instruments (agriculture insurance, price hedging); and (iii) risk absorption once the event occurs (ex post).

The priority solutions are the following:

MITIGATION:

- Improve the efficiency and coordination of existing technical services (DEAg, IPTA, SENAVE) relative to production and trade of products.
- Develop an integrated market information system.
- Improve the weather forecasting and early warning systems.
- Promote the concerted development of supply chain strategic plans between public and private sector.
- Take actions related to the regulatory framework, negotiations with neighboring countries, and investments in basic infrastructure.

TRANSFER:

- Study the details for the creation of an agriculture commodity exchange.
- Undertake necessary actions to develop a more competitive agriculture insurance market.

RISK ABSORPTION:

- Create a contingency fund to address emergency situations.
- In volume 2 the proposed solutions are assessed in detail among these thematic areas: technological innovations, agriculture commodity exchange, agriculture insurance, contingency fund, selected supply chain coordination.

TABLE 6.7. SHORT LIST OF SOLUTIONS

Risks	Summary of Solutions (Long List)	Current Projects	Prospective Risk Solution from Current Projects	Gap Exists?	Proposed Solutions (Short List)
	Use drought tolerant varieties (in general) and short-cycle varieties (sesame), disseminating research from IPTA and developing new research.* Ensure appropriate public technical services that allow to: (i) introduce best agriculture practices (crop rotation, soil improvement, conservation agriculture, green fertilizer, etc.); (ii) undertake pest monitoring and early detection (such as picudo); (iii) achieve timely pest control; (iv) disseminate appropriate irrigation techniques; (v) promote the installment of greenhouses (vegetables); (vi) promote crop diversification.* Create a contingency fund based on precise and transparent rules that ensure an appropriate productive emergency response quickly and effectively. Refinance debt due to natural disasters. Improve the weather forecasting and early warning systems. Implement best sanitary practices; traceability; and so forth, for controlling FMD.	PPR (IFAD) PRODERS (World Bank) Agriculture Supports (IDB) PMRN/2KR Paraguay Inclusivo Project (FIDA) Family farming food production promotion Program (MAG)	Limited, given geographic coverage and number of beneficiaries	Yes	Improve the efficiency and coordination of technical services available (DEAg, IPTA, SENAVE) in order to promote the proposals indicated with.* Create a contingency fund to address the emergency situation. Study the creation of an agriculture commodity exchange. Undertake actions to develop a more competitive agriculture insurance market. Promote negotiations with neighboring countries about trade logistics. Promote local norms that can facilitate coordination mechanisms among producers and industry to comply with contracts. Intensify the marketing activities in programs by DEAg, in order to increase the organizational structure and sale of products by family farmers and other risk reduction measures. Undertake training (MAG) to cooperative leaders and other actors for operating in futures markets. Improve the weather forecasting and early warning system. Develop an integrated market price information system Establish market observatories. Evaluate the effectiveness of sanitary services linked to exports and propose complementary policies. Evaluate in detail the current state of basic infrastructure for grain transport and develop improvement programs. Strengthen the FMD control services of SENACSA. Promote the concerted development of supply chain development between public and private sector.

Risks	Summary of Solutions (Long List)	Current Projects	Prospective Risk Solution from Current Projects	Gap Exists?	Proposed Solutions (Short List)
Market	Promote the strengthening of coordination mechanisms throughout supply chains, such as disseminating the experience of the marketing plans of the cassava starch industry or establishing municipal level services for filing claims for breaking contractual obligations (consumption products). Train staff from farmer cooperatives for operating in the futures market. Promote the joint commercialization of production among farmer groups of lower organizational structure.	PPR (IFAD) PRODERS (World Bank) Paraguay Inclusivo Project (IFAD)			
Enabling environment	Establish market observatories in order to compile information about marketing partners to be used in trade negotiations and to reduce the risk of facing non-tariff barriers and trade regulations (ports). Improve customs controls in order to avoid the entry of products with no sanitary certification, as well as to control the complying with export norms (such as sesame). Improve road infrastructure and access to ports, increasing dredging and signaling of the grain transport rivers. Develop strategic plans for crops (soy, rice, and so on).	Paraguay Inclusivo Project (IFAD)			

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APPENDIX A

YIELD AND RAINFALL DATA CORRELATION

This appendix describes the process implemented for: (i) estimating meteorological drought events through a standardized precipitation index (SPI), and (ii) calculating the correlation between the yield variables recorded by MAG authorities and accumulated rainfall data measured by meteorological stations.

YIELD DATA

The work included data for annual production, planted area, and yields for 39 crops at department level: 28 of them were seasonal crops and 11 permanent crops. The database was provided by MAG and is made up of a time series with discontinuities and with gaps in the data. The longest time series is the one for the database of 1980–11, while the most recent one is between 2007–11. Due to the larger concentration of data for seasonal crops at the beginning of 1990, it was decided to exclude the data for the 1980s from the analysis. Table A.1 shows the initial and final years of data considered for each crop.

RAINFALL DATA

Monthly data was provided for 24 meteorological stations, with data from January 1960 to December 2010. Due to the fact that there was no clear reference to the beginning of the operation of each of the station, it was assumed that all stations started operating in January 1980. The range of missing data for these stations is from a minimum of 0 percent to a maximum of 78.57 percent. Due to the high level of missing data, only the stations with series with less than 75 percent of missing data was used (1980–2010). This criteria led to the selection of 11 meteorological stations. Table A.2 shows the meteorological stations selected according to the above criteria.

RAINFALL PATTERNS

Rainfall in Paraguay shows a bimodal behavior of high values between the months of October and March, and of low values between April and September. In spatial terms, there is a clear variation between the regions of the country: Average annual values tend to decrease from southeast to northwest, going through an average of 1,900 mm to over 600 mm per year (DMH, ND). On the other hand, the data analysis of selected meteorological stations show standard deviations from a minimum of 34 percent to a maximum of

TABLE A.1. INITIAL AND FINAL DATE REGISTERED FOR PRODUCTION AND PLANTED AREA PER CROP

Id	Type of Crop	Crop	Initial Registry	Final Registry	Number of Years
1	Seasonal	Garlic	1980	2011	32
2	Seasonal	Cotton	1980	2011	32
3	Seasonal	Irrigated Rice	1980	2011	32
4	Seasonal	Dryland Rice	1980	2011	32
5	Seasonal	Peas	1980	2011	32
6	Seasonal	Sweet Potato	1980	2011	32
7	Seasonal	Sugar Cane	1980	2011	32
8	Seasonal	Canola	2007	2011	5
9	Seasonal	Onion	1980	2011	32
10	Seasonal	Strawberry	1980	2011	32
11	Seasonal	Sunflower	1980	2011	32
12	Seasonal	Habilla	1980	2011	32
13	Seasonal	Ka'a He'e	2002	2011	10
14	Seasonal	Locote	1980	2011	32
15	Seasonal	Maize	1980	2011	32
16	Seasonal	Yams	1980	2011	32
17	Seasonal	Peanuts	1980	2011	32
18	Seasonal	Mint	1980	2011	32
19	Seasonal	Potato	1980	2011	32
20	Seasonal	Bean	1980	2011	32
21	Seasonal	Sesame	2000	2011	12
22	Seasonal	Soy	1980	2011	32
23	Seasonal	Sorghum	1980	2011	32
24	Seasonal	Tobacco	1980	2011	32
25	Seasonal	Tomato	1980	2011	32
26	Seasonal	Tártago	1980	2011	32
27	Seasonal	Wheat	1980	2011	32
28	Seasonal	Carrot	1980	2011	32
29	Permanent	Banana	2002	2011	10
30	Permanent	Coffee	2002	2011	10
31	Permanent	Lemon	2002	2011	10
32	Permanent	Tangarine	2002	2011	10
33	Permanent	N. Dulce	2002	2011	10
34	Permanent	N. Agrio	2002	2011	10
35	Permanent	Pineapple	2002	2011	10
36	Permanent	Grapefruit	2002	2011	10
37	Permanent	Tung	2002	2011	10
38	Permanent	Grape	2002	2011	10
39	Permanent	Yerba Mate	2002	2011	10

Source: World Bank data.

TABLE A.2. SELECTION OF METEOROLOGICAL STATIONS ACCORDING TO PERCENTAGE OF MISSING VALUES, 1980–2010

ID	Station	Latitude	Longitude	% Missing Values	Selected
1	Adrian Jara	−19.5	−59.4	19.89%	No
2	Bahia Negra	−20.2	−58.4	45.16%	No
3	Prats Gil	−22.7	−61.5	25.81%	No
4	Misiones	−22	−60.6	0.27%	Yes
5	Puerto Casado	−22.2	−58.1	0.00%	Yes
6	Pedro Juan Caballero	−22.6	−55.9	2.69%	Yes
7	Pozo Colorado	−23.3	−59.2	30.11%	No
8	Concepción	−23.4	−57.5	0.00%	Yes
9	General Bruguez	−24.4	−58.6	38.71%	No
10	San Pedro	−24.1	−57.1	66.40%	No
11	San Estanislao	−24.7	−56.4	12.10%	No
12	Salto Del Guaira	−24.1	−54.5	13.71%	No
13	Asunción	−25.2	−57.7	0.00%	Yes
14	Paraguari	−25.8	−57.3	85.48%	No
15	Villeta	−25.7	−56.5	0.00%	Yes
16	Coronel Oviedo	−25.3	−56.4	34.95%	No
17	Gua	−25.4	−54.5	64.52%	No
18	Ciudad Del Este	−25.4	−54.8	11.83%	No
19	Pilar	−26.8	−58.3	1.08%	Yes
20	San Juan Bautista	−26.7	−57.2	0.27%	Yes
21	Caazapa	−26.2	−56.4	3.49%	Yes
22	Capitán Meza	−26.8	−55.5	1.08%	Yes
23	Capitán Miranda	−26.9	−55.8	4.57%	Yes
24	Encarnación	−27.2	−56	0.27%	Yes

Source: World Bank data.

163 percent above the estimated average monthly values for the period 1980–2010. Figures A.1 and A.2 show the spatial and time variations of the rainfall values of the country.

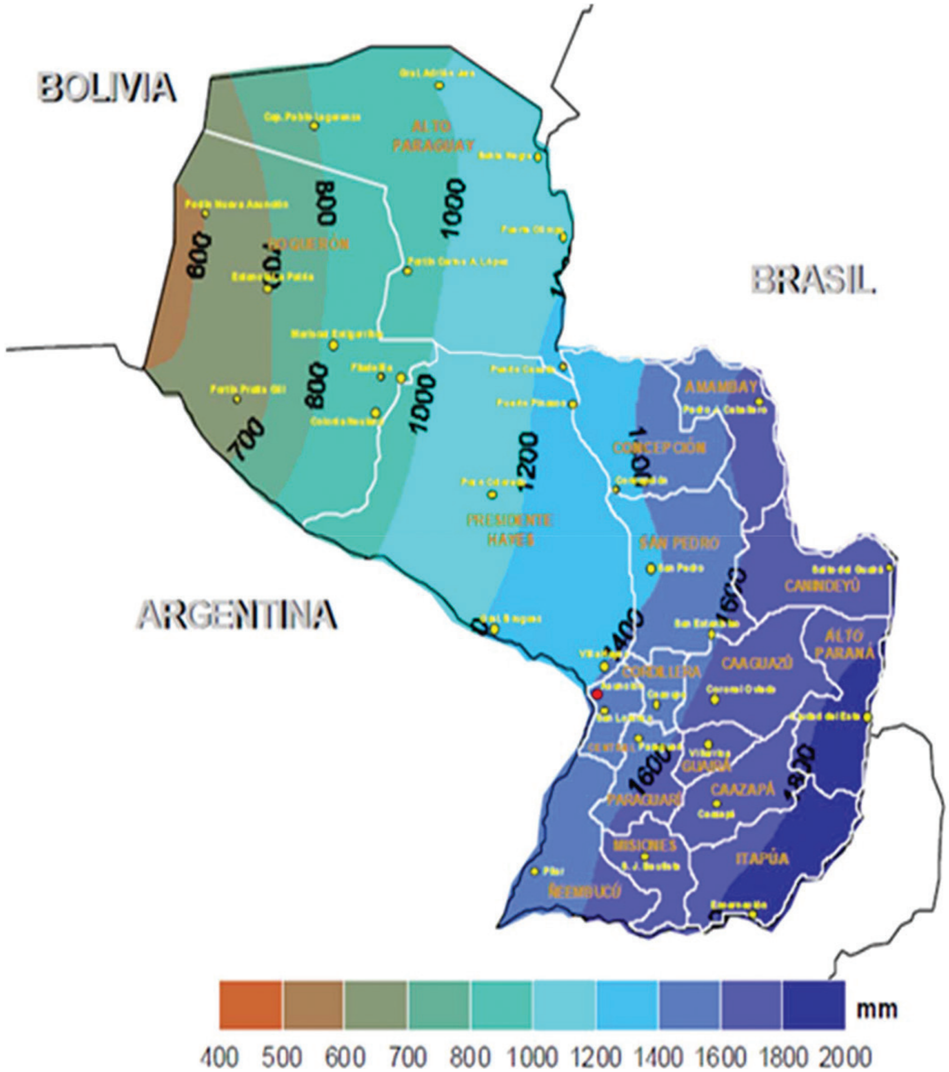
STANDARDIZED PRECIPITATION INDEX (SPI)

The SPI was calculated from the monthly rainfall data. This index indicates that the number of standard deviations of rainfall values fall (increase) in relation to the average. The utility of this index is in its power to assess hydrological excess or deficit and compare its intensity across areas (meteorological stations) with different climate conditions. Therefore, positive SPI values indicate humid conditions while negative values show water deficit and values between −1 and 1 indicate normal humidity conditions.[22] In relation to the definition of drought, this was defined when the SPI values presented two or more negative consecutive values up to the moment when SPI goes back to normal or positive terrain (Agencia Estatal de Meteorologia [AEMET, ND]).

[22] In order to determine the intensity of drought, the following ranges for SPI values were used. The different values here below are classified into seven categories:

Classification	Range		
Severe humidity	2.00	a	more
Moderate humidity	1.50	a	1.99
Weak humidity	1.00	a	1.49
Normal	−0.99	a	0.99
Weak drought	−1.49	a	−1.00
Moderate drought	−1.99	a	−1.50
Severe drought	lower		−2.00

FIGURE A.1. WEATHER NORMS FOR PARAGUAY, 1971–2000

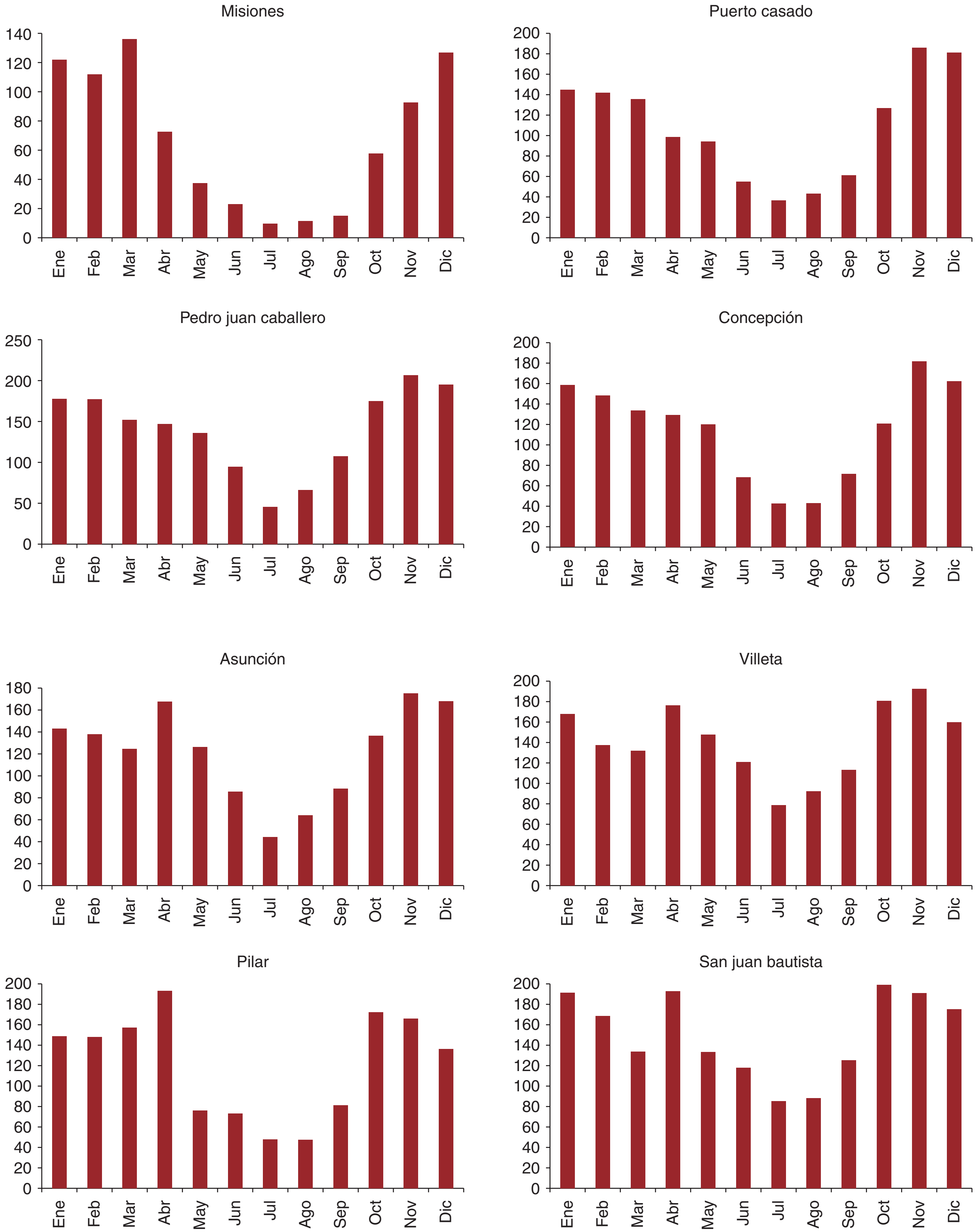


Source: DMH.

SPI estimations based on monthly data were calculated for each of the selected meteorological stations. The results of the analysis show a reduction in the Moderate to Severe Humidity events registered in those stations since the 1980s to 2000s, going from 11 registered cases between 1980–89 to only 5 at the end of 2000. On the other hand, the SPI shows a slight increase in the number of Moderate to Severe Drought events during the same period. Table A.3 shows the number of Moderate to Severe Humidity and Drought events, respectively, per meteorological station.

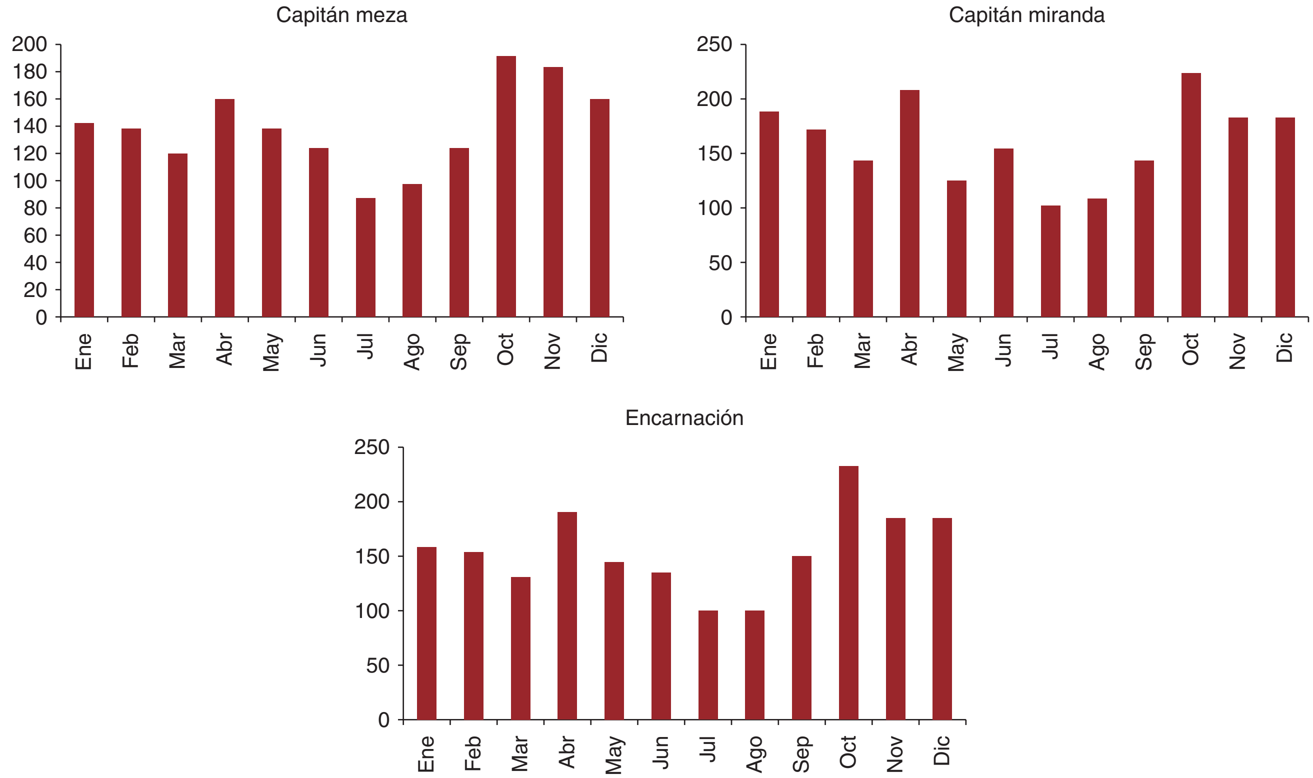
Years where the humidity conditions are moderate to severe were registered in at least 30 percent of the stations during the years 1983, 1997–98, and 2002. On the other hand, the maximum number of stations registering moderate to severe droughts in any given year was equal to 2 (or 18 percent of the total). The years when those events were recorded were 1981, 1999, and 2008. For 2009, it was pointed out recurrently in interviews with MAG specialists and by a farmer group as a dry year, but only Misiones station (SPI = −1.97) showed values moderately under normal values (SPI = −0.99 to 0.99). However, when analyzing data at a more disaggregate level such as monthly data—the SPI show that weak droughts began to be recorded in most observation points in the spring of 2008, and then those situations dissipated during the fall of 2009. It is important to note that those humidity adverse conditions coincide with the planting calendars of several crops, which could have generated yield losses for those groups interviewed.

FIGURE A.2. ANNUAL AVERAGE RAINFALL VALUES FOR 11 METEOROLOGICAL STATIONS, 1980–2010



(Continued)

FIGURE A.2. ANNUAL AVERAGE RAINFALL VALUES FOR 11 METEOROLOGICAL STATIONS, 1980–2010 (*Continued*)



Source: AEMET.

TABLE A.3. MODERATE TO SEVERE EXCESS HUMIDITY AND DROUGHT EVENTS ACCORDING TO SPI ESTIMATES DURING THE PERIOD 1980–2009

	Moderate to Severe Excess Events			Moderate to Severe Drought Events		
Name of Station	**1980–89**	**1990–99**	**2000–09**	**1980–89**	**1990–99**	**2000–09**
Misiones	3	-	-	-	-	1
Puerto casado	2	1	-	-	1	-
Pedro juan caballero	1	2	-	1	-	-
Concepción	2	2	-	1	1	-
Asunción	-	3	-	-	-	-
Villeta	-	3	1	-	1	1
Pilar	1	1	-	-	1	1
San juan bautista	1	2	-	-	-	1
Capitán meza	-	2	2	1	-	-
Capitán miranda	-	-	1	-	-	1
Encarnación	1	1	1	-	-	-

Source: World Bank data.

CORRELATION CALCULATIONS

A small percentage of agriculture in the country is done under irrigation; and for this reason variations (positive or negative) of the values of rainfall over a productive area are expected to cause losses in crops. In order to identify to which extent the rainfall variable explains crop behavior two types of correlations were estimated: (i) between yield and SPI data at an annual level (calendar year); and (ii) between the crop yield and accumulated rainfall during the plant growth cycle. For the latter, the process is detailed below.

TABLE A.4. PLANTING DATES PER CROP AND METEOROLOGICAL STATION

Name of Met Station	Department	Garilic	Cotton	Irrigated Rice	Maize	Yams	Peanuts	Potato	Beans	Soy	Tomato
Asunción	Pte. Hayes	April			Aug	Jul	Nov		Aug	Oct	Continuous
Capitán Meza	Itapua	April	Oct	Oct	Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Capitán Miranda	Itapua	April	Oct	Oct	Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Concepción	Concepción	April	Sep	Feb	Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Encarnación	Itapua	April	Oct	Oct	Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Misiones	Misiones	April	Oct	Oct	Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Pedro J. Caballero	Amambay	April			Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Pilar	Neemucu	April	Sep	Sep	Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Puerto Casado	Alto Paraguay	April			Aug	Jul	Nov		Aug	Oct	Continuous
San Juan Bautista	Misiones	April	Oct	Oct	Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Villeta	Guaira	April			Aug	Jul	Aug	Mar	Aug	Oct	Continuous
Duration of Productive Cycle (months)		6	5	4	5	12	5	3	3	4	12

Source: Authors.
Note: In the case of tomato, this has a duration of approximately four months and is planted throughout the year by complementary irrigation. With the objective of undertaking this analysis, annual yield data were correlated with the accumulated rainfall during the agriculture year (July year 1 to July year 2).

As a first step, the meteorological stations were associated with a **geographic space** (departments) through GIS.

The second step was to identify those crops from where a reduced **planting window** was available. This information was obtained from different manuals and agriculture guides prepared by MAG. From this exercise, 10 crops were selected including: garlic, cotton, rice with irrigation, maize, cassava, peanuts, potato, beans, soy, and tomato.

For each of the selected crops different plant growth periods were obtained. Unfortunately, that information was only available for soy: The definition of the plant growth periods for soy were normally adjusted to monthly periods in order to correlate it with rainfall (annual accumulation for each period). For the rest of the cases, accumulated rainfall was used during the corresponding production cycle. Table A.4 shows the planting month for each crop per meteorological station and department.

Lastly, the **accumulated rainfall** values were calculated for each station according to the duration of the crop or stage in order to **correlate** the resulting values with the yield values for each crop in the corresponding departments. Due to gaps in the yield data, however, an arbitrary rule was established for the correlation calculations where it would be completed if and only if a minimum of 15 consecutive years was available for yields in the respective department.

STANDARDIZED PRECIPITATION INDEX (SPI): CORRELATION RESULTS

The results obtained in the analysis between the annual SPI and the yield values of crops show mixed results (see table A.5). For example, the SPI measured at the Misiones station explains 55 percent of the behavior of sweet potato. This value indicates that the more rain, the greater the possibility of obtaining higher yields for this crop. Although these results are encouraging, such patter is not registered in the other selected stations where correlation values do not go beyond 15 percent, and even register negative values. These negative values could be interpreted as yields increasing when there are low levels

TABLE A.5. CORRELATION COEFFICIENTS (R^2) BETWEEN RAINFALL AND YIELD VARIABLES FOR DIFFERENT CROPS

Crop	Met Station										
	Misiones	San Juan Bautista	Asunción	Concepción	Encarnación	Capitán Meza	Capitán Miranda	Pedro Juan Caballero	Pilar	Puerto Casado	Villeta
Ajo	26.02%	10.02%	N/A	9.17%	1.03%	−0.35%	19.41%	−18.06%	12.85%	N/A	−2.07%
Algodón	46.38%	37.34%	14.70%	2.28%	32.00%	1.66%	29.83%	−7.77%	30.49%	−27.52%	34.33%
Arroz con riego	−31.68%	8.80%	N/A	15.24%	6.08%	14.08%	23.09%	4.43%	−26.04%	N/A	−6.78%
Arroz Secano	−39.68%	15.68%	15.08%	9.75%	−3.61%	26.56%	10.92%	4.24%	39.83%	N/A	−10.20%
Arveja	2.60%	3.74%	−24.89%	8.38%	−20.91%	1.05%	2.64%	4.36%	21.25%	N/A	12.91%
Banano	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Batata	55.10%	4.85%	−24.91%	−0.08%	−4.07%	−6.78%	−18.87%	10.68%	−11.90%	14.97%	10.43%
Cafeto	−25.03%	−6.63%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Caña De Azücar	−24.86%	−15.47%	−24.53%	21.37%	−16.84%	12.39%	−19.78%	−14.77%	−15.20%	1.33%	33.22%
Cebolla	−8.04%	−7.80%	−42.14%	4.59%	−3.37%	4.54%	16.47%	−0.10%	−13.79%	N/A	−23.23%
Frutilla	−34.01%	2.14%	N/A	−3.63%	−0.67%	26.58%	24.86%	5.14%	N/A	N/A	6.23%
Girasol	−19.31%	7.87%	N/A	8.36%	−14.60%	18.27%	−9.29%	−9.12%	−4.68%	N/A	1.27%
Habilla	40.09%	34.48%	−16.19%	11.62%	6.43%	26.56%	34.69%	−3.80%	22.41%	N/A	24.80%
Limón	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Locote	−26.18%	19.01%	11.00%	19.20%	10.42%	42.83%	33.74%	20.93%	−9.15%	−2.29%	−14.09%
Maíz	−17.83%	6.89%	−4.35%	−20.95%	−9.53%	27.23%	−1.93%	17.22%	29.47%	16.26%	11.65%
Mandarina	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mandioca	−6.39%	−22.19%	−42.72%	−13.41%	−13.31%	−9.74%	−21.43%	−18.94%	−11.55%	−2.98%	−5.49%
Maní	37.09%	−21.49%	15.15%	16.89%	17.11%	−12.38%	1.50%	−9.16%	6.53%	12.00%	6.96%
Menta	N/A	N/A	11.60%	10.66%	22.08%	−17.59%	8.03%	0.93%	2.75%	N/A	−12.67%
N Agrio	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N Dulce	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Papa	5.07%	12.29%	17.42%	8.19%	−4.74%	14.34%	−20.18%	37.54%	7.26%	N/A	−20.22%
Pita	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.87%
Pomelo	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.25	−8.26%
Poroto	−25.05%	−17.68%	−10.28%	−9.44%	4.56%	16.74%	19.30%	−12.19%	20.49%	8.99%	40.43%
Soja	−33.96%	10.50%	N/A	−26.93%	3.54%	36.85%	24.84%	10.08%	−3.08%	12.27%	23.17%
Sorgo	−24.07%	−0.34%	−7.59%	−8.46%	−17.11%	−10.69%	−22.93%	5.79%	18.31%	19.38%	23.85%
Tabaco	−17.24%	−0.79%	N/A	15.06%	−18.09%	7.66%	−3.31%	6.29%	0.06%	6.95%	−9.06%

(*Continued*)

TABLE A.5. CORRELATION COEFFICIENTS (R^2) BETWEEN RAINFALL AND YIELD VARIABLES FOR DIFFERENT CROPS (*Continued*)

Crop	Misiones	San Juan Bautista	Asunción	Concepción	Encarnación	Capitán Meza	Capitán Miranda	Pedro Juan Caballero	Pilar	Puerto Casado	Villeta
	Met Station										
Tsrtago	20.03%	−12.33%	−18.37%	1.61%	−5.56%	−28.10%	−1.50%	−8.48%	11.39%	N/A	−14.98%
Tornate	−15.00%	13.32%	12.97%	0.03%	4.33%	33.36%	25.07%	20.77%	3.09%	2.39%	30.76%
Trigo	−29.82%	−24.63%	N/A	−5.83%	−46.45%	−27.29%	−36.75%	3.88%	N/A	N/A	−3.78%
Tung	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vid	−36.10%	−26.95%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Yerba Mate	−52.82%	−7.73%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Zanahoria	−8.66%	24.32%	27.80%	−3.64%	−11.02%	24.49%	4.74%	29.97%	0.08%	−15.09%	−0.36%

Source: Author's calculations with MAG and AEMET data.
Notes: Canola, kaahee, and sesame are not included in this analysis. N/A indicates that the correlation analysis was not completed due to yield data missing.

of SPI (negative deviations of accumulated rainfall with respect to the norm). In none of the cases do correlation values go beyond an R^2 of 56 percent and −56 percent, respectively.

CORRELATION RESULTS BETWEEN YIELD AND ACCUMULATED RAINFALL DATA FOR THE PLANT GROWTH CYCLE OF CROPS

The correlation values obtained from accumulated rainfall during the productive cycle are not significant. Soy was the only crop with an R^2 over 53 percent (Capitán Miranda Station). However, negative correlation values were equally recorded in one of the stations (−24.15 percent, Misiones Station) for the same crop. This represents a similar behavior for other crops analyzed. Table A.6 summarizes the correlation results between average yields and accumulated rainfall per productive cycle.

With respect to the correlation values obtained in each of the soy plant growth stages, these show a slight improvement especially in stage 3 when the highest R^2 values were obtained equivalent to 62 percent and 74 percent in the Encarnación and Capitán Miranda Stations respectively. Although these values are significant, such pattern does not repeat itself in the rest of the selected meteorological stations. This shows that accumulated rainfall per productive cycle and plant growth stages (such as soy) do not clearly explain yield behavior for these crops in these departments. Table A.7 shows the correlation coefficient values per stage for soy.

The results obtained previously do not contradict; however, the hypothesis is that the rainfall variable is one of the productive factors that most impacts crop behavior. Among the reasons that can explain why it was not possible to obtain higher correlation values from this analysis we can mention:

The accumulated rainfall data per productive cycle and plant growth stages (the latter applies only for soy) could hide prolonged drought periods, or few days of excessive rainfall. Excessive rainfall in short periods of time could accumulate rainfall values within the historical norm, but when falling all at once is not necessarily easily absorbed/used by crops. For this reason, excessive aggregation of days could be hiding partial or total losses registered by cultivated crops in non-irrigated areas.

Annual yield registries reported by MAG are based on the average of the different planting windows. Weather

TABLE A.6. CORRELATION COEFFICIENTS (R^2) BETWEEN RAINFALL AND YIELD VARIABLES FOR DIFFERENT CROPS

Name of Met Station	Department	Garlic	Cotton	Irrigated Rice	Maize	Yams	Peanuts	Potato	Beans	Soy	Tomato
Asunción	Pte. Hayes	N/A	N/A	N/A	−4.74%	−18.90%	6.73%	N/A	4.97%	N/A	−15.79%
Capitán Meza	Itapúa	−13.92%	−35.30%	18.00%	48.47%	13.71%	−25.65%	3.66%	−0.14%	41.30%	22.61%
Capitán Miranda	Itapúa	−4.79%	5.79%	26.50%	16.46%	3.41%	5.62%	−2.96%	12.72%	53.21%	9.97%
Concepción	Concepción	26.14%	−19.59%	13.33%	−6.20%	23.62%	20.57%	−10.21%	15.89%	26.72%	−2.61%
Encarnación	Itapúa	−19.21%	1.73%	−17.20%	26.04%	7.19%	−0.66%	11.29%	11.59%	36.73%	−10.91%
Misiones	Misiones	18.14%	8.07%	−31.10%	−12.36%	22.44%	39.75%	−9.25%	20.24%	−24.15%	−16.33%
Pedro J. Caballero	Amambay	−5.54%	N/A	N/A	9.64%	−2.67%	31.46%	2.62%	6.92%	33.12%	11.99%
Pilar	Ñeembucú	8.07%	23.13%	7.80%	9.37%	−10.80%	8.28%	21.05%	7.59%	32.92%	−15.18%
Puerto Casado	Alto Paraguay	N/A	N/A	N/A	19.38%	4.34%	24.41%	N/A	−16.63%	25.94%	10.27%
San Juan Bautista	Misiones	2.16%	13.86%	38.67%	10.12%	−2.94%	−19.32%	5.42%	−6.37%	43.61%	2.41%
Villeta	Guairá	4.30%	N/A	N/A	23.94%	9.31%	17.21%	−20.77%	−12.16%	14.61%	19.29%

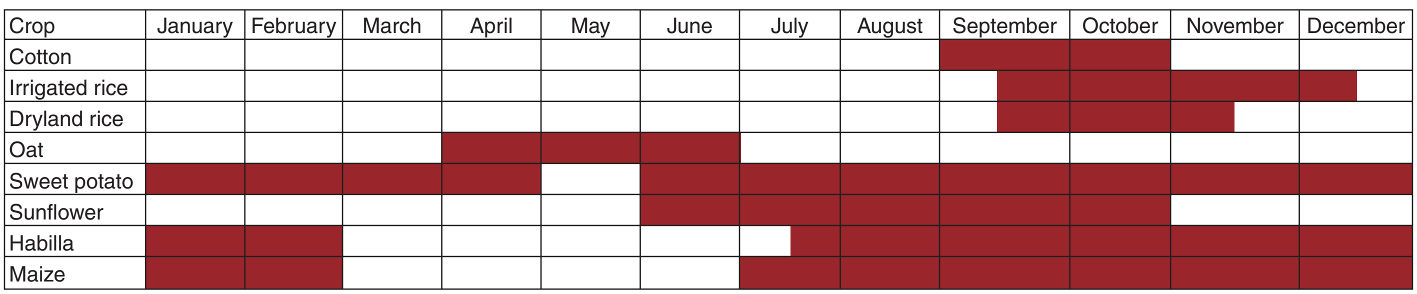
Source: Authors' calculations based on MAG data.
Note: N/A means that the defined criteria for the calculation of the correlation were not met.

TABLE A.7. CORRELATION COEFFICIENT (R^2) BETWEEN ACCUMULATED RAINFALL VARIABLE PER PLANT GROWTH STAGE AND ANNUAL YIELD DATA FOR SOY

Soy/Name of Met Station	Department	Stage 1	Stage 2	Stage 3	Stage 4
Asunción	Pte. Haves	−37.12%	−32.37%	−14.13%	11.33%
Capitán Meza	Itapúa	37.06%	2.57%	46.67%	8.74%
Capitán Miranda	Itapúa	38.56%	−9.05%	74.73%	8.44%
Concepción	Concepción	27.52%	2.63%	17.28%	22.67%
Encarnación	Itapúa	42.61%	−13.41%	62.42%	−7.06%
Misiones	Misiones	−27.58%	−8.35%	−24.16%	11.02%
Pedro J. Caballero	Amambay	−8.95%	−7.99%	39.61%	24.41%
Piiar	Ñeembucú	−8.77%	7.27%	44.59%	14.90%
Puerto Casado	Alto paraguay	N/A	N/A	N/A	N/A
San Juan Bautista	Misiones	35.38%	7.77%	54.39%	−7.50%
Villeta	Guaira	−3.67%	1.87%	27.26%	7.97%

Source: AEMET.
Note: N/A means that the defined criteria for the calculation of the correlation were not met.

GRAPH A.1. PLANTING CALENDAR FOR SOME CROPS IN PARAGUAY



Source: MAG, ND.

conditions (rainfall) in the country allow farmers to select different planting dates, and therefore, with different exposure to risk and productivity levels. Due to the fact that no precise information was available regarding the distribution of planted area by crop throughout the year, single planting dates were assumed per meteorological station and per department. Graph A.1 shows the range of the planting windows for some of the crops in the country.

The plant growth characteristics for some crops allow them to recover after suffering hydrological stress (excess or deficit of humidity). In the case of cotton, for example, new flowering could happen after long drought periods. This is a natural reaction by the cotton plant; however, it would lead to a prolonged productive cycle. This would produce that the periods under analysis would differ from the effective production period.

Rainfall is an heterogeneous variable from the spatial and temporal point of view. Registered data in the selected meteorological stations is valid only for a specific area of influence and the yield values were selected at the department level. For example, the surface of the department of Presidente Hayes is so large (72,907 Km^2) that this includes isohyets that go from 1,400 mmm to less than 1,000 mm per year, and the number of selected weather stations for this analysis was only one located in the extreme southeastern point of the department.

APPENDIX B
MAIZE PRICE VOLATILITY

Paraguay produces white maize mainly for human consumption, produced mostly by family farmers, and red maize (yellow) mainly for export for animal consumption and industrial use, produced by commercial farmers of different size. Family farmers produce white maize for autoconsumption and for selling to obtain cash income. They also produce some red maize for animal feed, although no information was found about the proportion of production with respect to white maize. Usually the sale is local, so the price that makes it to the family farmers is much lower than the wholesale price at the Mercado de Asunción, which was used for this analysis. Today, yellow maize is part of the set of products that make up the soy cluster, which, according to geographic location, includes maize, soy, wheat, and sunflower, all cultivated in rotation and with modern technologies and capital injections.

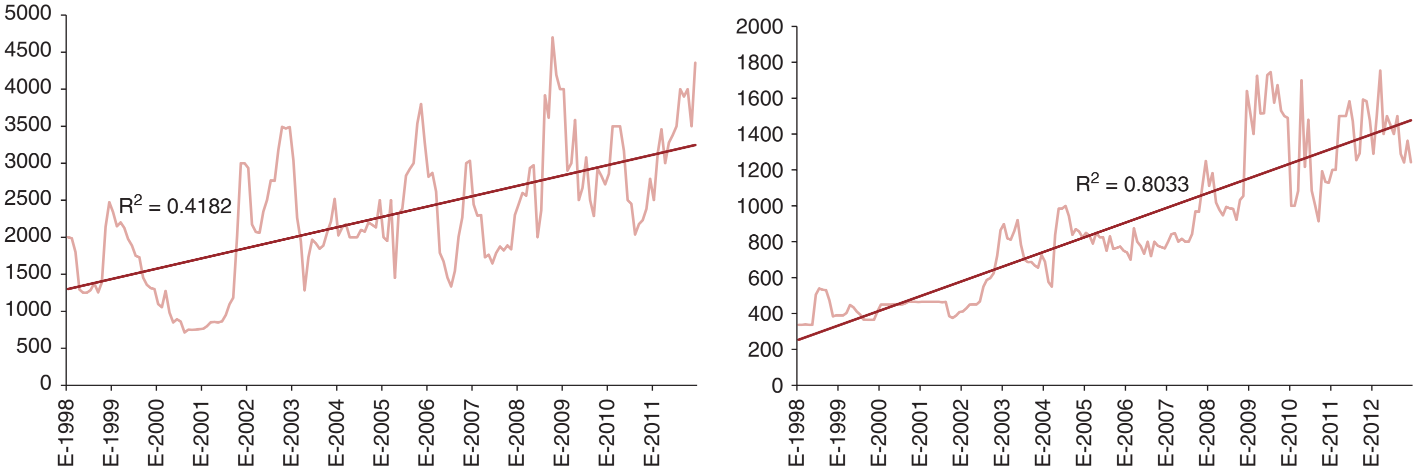
The purpose of this analysis is to look at the variability of domestic maize prices in Paraguay, using data from SIMA/MAG for the Mercado de Asunción—DAMA for the period of 1993–2012. All the graphs and statistical indicators were prepared based on data from SIMA/MAG.

Although price volatility is not foreign to the functioning of agriculture markets, it is not free of consequences. In fact, it has a negative impact on the economy of family farmers and on the production decision of commercial farmers. The problem can be felt to a lesser degree now when there has been a sustained increase in international agriculture commodity prices, but the reversal of this trend or the increase in input prices or the appreciation of the exchange rate or other factor would make the situation unsustainable in the medium term.

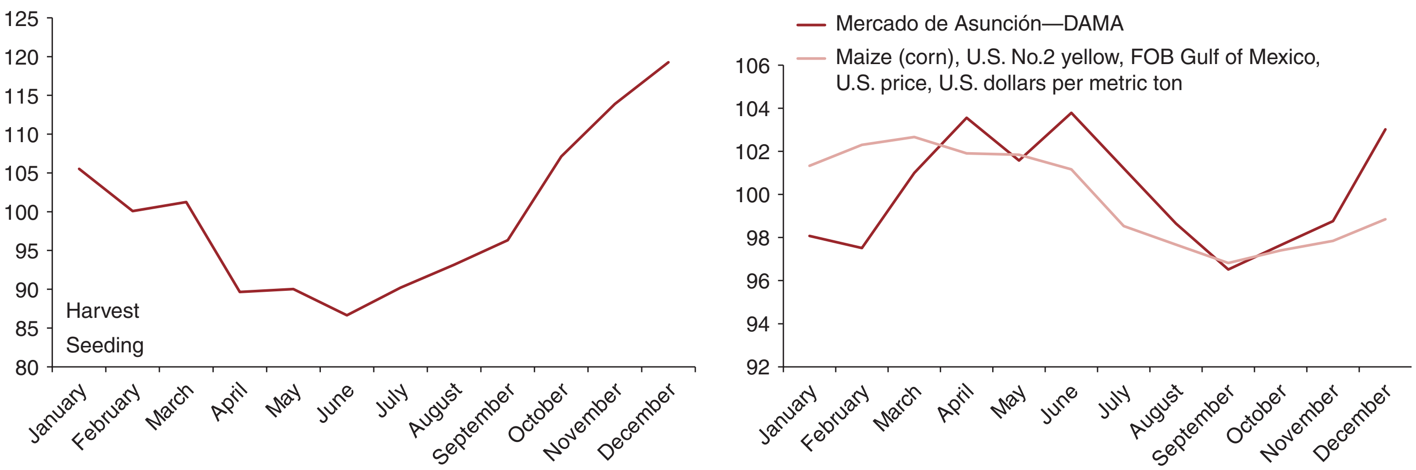
The domestic maize price, both white and yellow, taking the Mercado de Asunción—DAMA as reference, shows great variability in the past fifteen years around an increasing trend in current guaranis (see graph B.1).

In white maize part of this variation can be explained by seasonal variations measured through the stationary price index (graph B.2). The average correlation index between the values of each month and the seasonal values is less than 50 percent. The largest increase is observed at the beginning of the harvest in December and the lowest level

GRAPH B.1. AVERAGE MONTHLY PRICES FOR WHITE MAIZE AND RED MAIZE, ASUNCIÓN MARKET—DAMA, G$/KG



GRAPH B.2. SEASONAL PRICE INDEX FOR WHITE AND RED MAIZE, ASUNCIÓN MARKET—DAMA



in June. Yellow maize, on the other hand, shows a stationary behavior strongly related to the seasonality of international prices, as a result of its export orientation where the lowest level is produced in September coinciding with the seasonal minimum in the Gulf of Mexico.

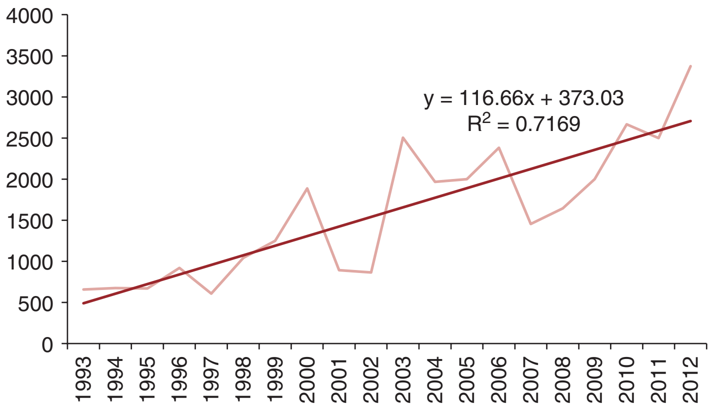
Taking into account prices in a specific point of the year, say in June, when the harvest is completed and is nearing planting,[23] we avoid the seasonality effect and obtained a volatility that is constant. This can be observed in graph B.3.

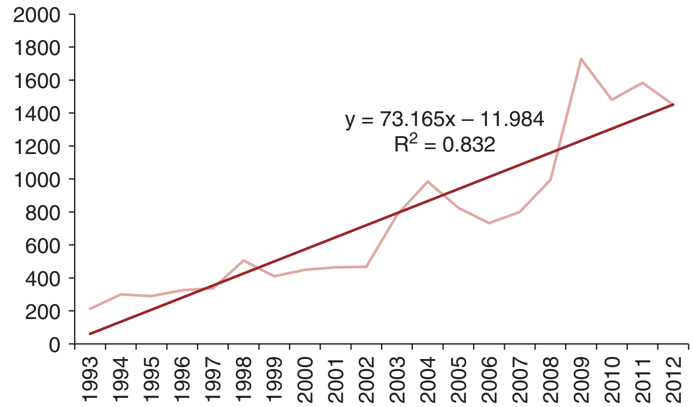
In graph B.4, the increasing trend and the high volatility is apparent. In both series, very high standard deviations are shown (868 and 491, respectively, for white and yellow maize), which in relative terms result in coefficient of variation[24] of 51 percent and 63 percent respectively. Actually, the lower value of the coefficient for white maize does not mean less volatility for yellow maize, but a higher value

[23] According to MAG's publication, Planting Calendar.

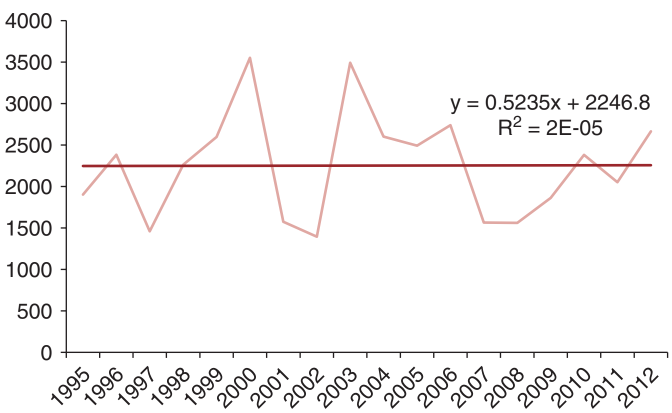
[24] The coefficient of variation expresses the standard deviation as percentage of the arithmetic mean of a series. The higher value of the coefficient, the greater the heterogeneity of the values of the variable. However, this indicator is variable against changes in the value of origin As the value of origin increases, the lower the coefficient given that the mean is sensible to changes at the origin.

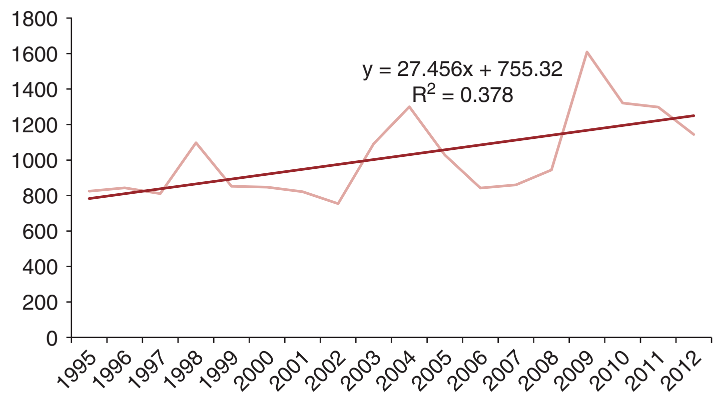
GRAPH B.3. PRICE OF WHITE MAIZE AND RED MAIZE IN JUNE, ASUNCIÓN MARKET—DAMA, G$/KG





GRAPH B.4. PRICE OF WHITE MAIZE (LEFT) AND RED MAIZE (RIGHT) IN JUNE, ASUNCIÓN MARKET—DAMA, DEFLATED BY THE CPI, G$/KG





at origin (see the formula in graph B.4, 373 against 12), and rather the graph's observation appears to suggest the contrary.

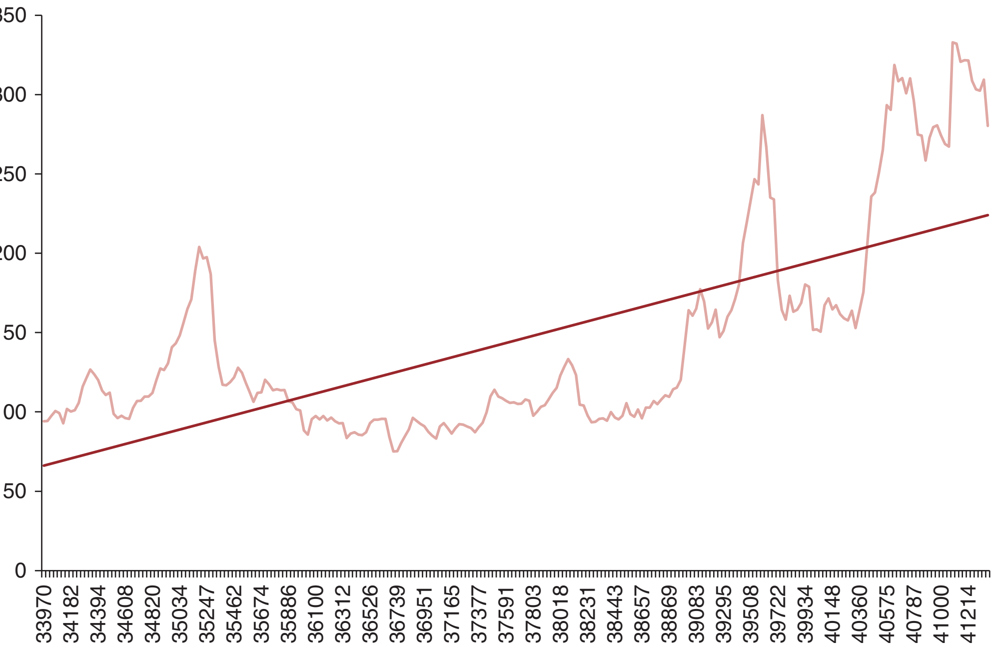
Looking to isolate the price variations corresponding to changes in the general price levels, the June prices were deflated by the respective general price consumer index values, originating a series that we can say represent the wholesale prices in real terms (see graph B.5). It is to be noted, however, that inflation in Paraguay was never too high during this period.

The result is that the wholesale price trend for white maize is not increasing during the period (1995–96 to 2011–12[25]) although high observed volatility does persist in nominal prices. The standard deviation is at 833, very similar to the nominal prices series. On the other hand, domestic wholesale prices for yellow maize maintains its increasing trend since 2006, likely responding to the increasing trend in the international market (see graph B.4), and has reduced its volatility somewhat (standard deviation of 336 against 491 of nominal prices).

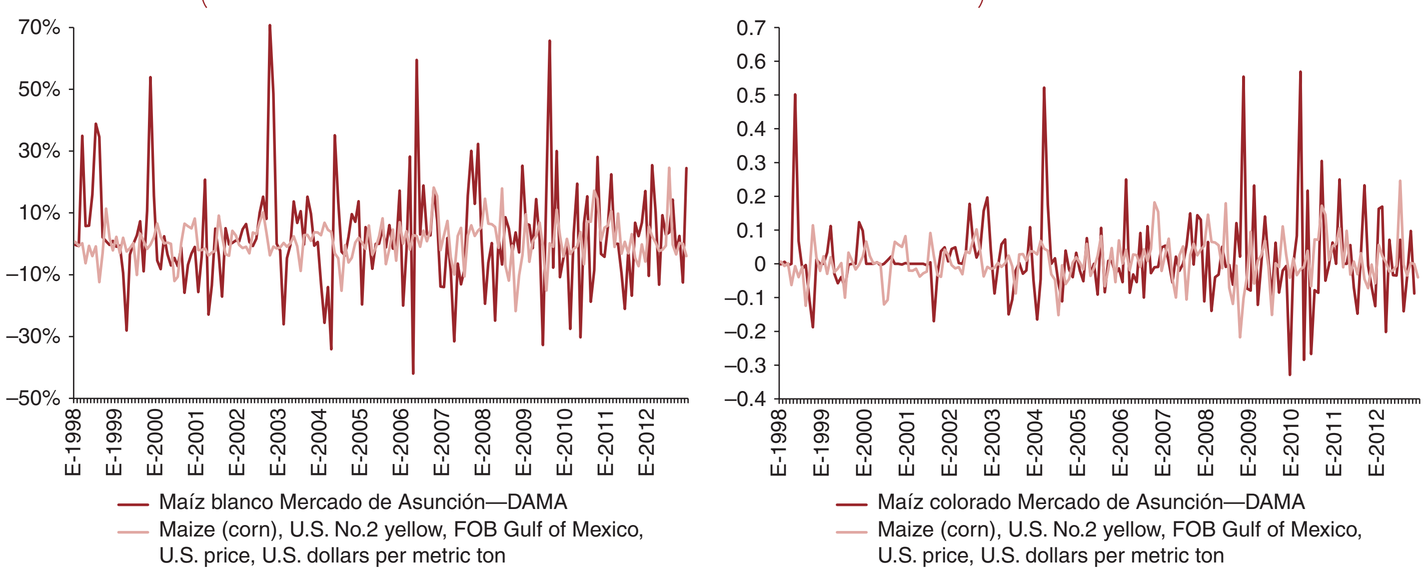
In other words, family farmers that produce white maize are more exposed to price volatility than commercial farmers producing yellow maize (and other rotation crops). Furthermore, the latter have been able to benefit from the increase in international prices since 2006, achieving real increases in internal prices, while white maize has varied for family farmers around the same real price for the past 15 years.

[25] The series was reduced by two years given the inability to find complete data on consumer price indices for the period 1993–95.

GRAPH B.5. MAIZE (CORN), U.S. NO. 2 YELLOW, FOB GULF OF MEXICO, U.S. PRICE, U.S. DOLLARS PER METRIC TON



GRAPH B.6. MONTHLY VARIATION OF THE PRICE OF WHITE MAIZE AND RED MAIZE (ASUNCIÓN MARKET VS. INTERNATIONAL MARKET)



Finally, the price of maize in Paraguay shows greater volatility in the international price. This is clear from graph B.6, comparing variations in monthly percentages of the wholesale price of white and yellow maize in Paraguay with the international price variations, taking as reference the yellow maize price in the Gulf of Mexico.

The series with the monthly percentage variations in the wholesale domestic price of white and yellow maize have a standard deviation of 17 percent and 12 percent respectively, against 6 percent in the international price for yellow maize for the period 1998–2012. Again, this shows a greater price volatility in white maize.

Conclusion and findings

The domestic price of maize according to data from Mercado de Asunción (DAMA), supposedly represents the behavior in other national markets, showing high volatility in the long term, which cannot be explained entirely by the seasonal variations nor by the general changes in the prices of the economy as a whole, and which it is larger than the volatility of international maize prices.

However, there are differences in the behavior of white and yellow maize, in detriment of the former. Family farmers (white maize) suffer from greater price volatility and benefit less from the increases in international prices than commercial farmers who produce yellow maize for export to the agroindustry.

Therefore, it would be appropriate to analyze further the maize market in both dimensions, family farming and commercial agriculture, looking to determine the causes of such volatility and finding opportunities for the different actors throughout the supply chain to manage market risks. Certainly, the main cause of the interannual (short-term) volatility in prices is due to yield variations due to weather events, but there could be other factors impacting prices, such as contraband and enabling environment risks.

TABLE B.1. AVERAGE MONTHLY PRICES FOR WHITE MAIZE, ASUNCIÓN MARKET—DAMA, G$/KG

	Month											
Year	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1993	94.1	94.25	97.54	100.49	99.22	92.73	101.89	100.31	101.03	105.77	115.93	121.23
1994	126.72	123.65	120.11	113.42	110.6	112.08	98.73	96.16	97.61	96.11	95.61	102.56
1995	106.9	106.98	109.63	109.64	111.93	120.01	127.31	126.3	130.51	140.82	143.21	148.19
1996	156.67	164.71	170.96	189.03	204	196.64	197.62	186.82	145.24	128.61	117.14	116.84
1997	118.7	121.75	127.86	124.71	118.61	112.58	106.42	111.95	112.24	120.24	117.4	113.6
1998	114.37	113.62	113.84	106.69	105.97	101.75	100.9	88.36	85.71	95.49	97.38	95.32
1999	97.45	94.56	96.43	94.04	92.72	92.95	83.6	86.38	87.12	85.65	85.41	87.22
2000	92.95	95.08	95.17	95.54	95.53	84.04	75.06	75.24	80.15	84.71	88.94	96.22
2001	94.3	92.38	91.01	87.55	85.08	83.16	90.75	92.88	89.74	86.27	89.88	92.31
2002	91.97	90.73	89.86	87.11	90.33	93.17	99.7	109.89	113.94	109.65	108.65	107.01
2003	105.75	106.04	105.06	105.25	107.82	106.99	97.61	100.31	103.22	104.17	108.03	111.98
2004	115.09	122.91	128.43	133.39	129.3	123.23	104.48	104.04	97.76	93.37	93.75	95.59
2005	95.98	94.36	99.94	96.39	95.27	97.56	105.6	98.64	96.99	101.5	95.97	102.66
2006	102.7	106.92	104.89	107.82	110.57	109.55	114.24	115.21	120.26	142.17	164.08	160.66
2007	165.1	177.35	169.52	152.58	156.44	164.5	147.13	151.01	160.05	164.09	171.06	180.25
2008	206.53	219.95	233.85	246.67	243.46	287.11	266.94	235.16	233.91	182.96	164.27	158.16
2009	173.24	163.13	164.52	168.72	180.31	178.83	151.76	152.01	150.57	167.22	171.61	164.58
2010	167.21	161.63	159.01	157.66	163.77	152.87	163.92	175.6	205.84	235.7	238.24	250.63
2011	265.29	293.4	290.36	318.7	308.47	310.46	300.8	310.24	296.21	274.78	274.23	258.44
2012	272.85	279.46	280.66	274.21	268.79	267.23	332.95	332.17	320.72	321.63	321.54	308.72
2013	303.29	302.5	309.49	280.27								
Coefficient of Variation			51.01%									

Source: MAG/DC/SIMA.

TABLE B.2. AVERAGE MONTHLY PRICES FOR RED MAIZE, ASUNCIÓN MARKET—DAMA, G$/KG

	Month											
Year	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1993	273	232	225	217	216	213	216	224	220	266	276	285
1994	262	296	300	319	300	300	300	300	289	285	295	299
1995	297	288	290	288	290	290	287	290	279	275	288	290
1996	294	318	325	325	325	325	331	325	337	337	338	337
1997	337	335	341	350	337	337	337	331	338	337	338	337
1998	337	337	339	337	337	506	540	532	530	474	385	390
1999	390	390	403	448	435	410	394	366	365	365	365	410
2000	450	450	450	450	452	450	450	455	465	465	465	464
2001	465	465	465	465	465	465	463	465	386	375	389	408
2002	411	429	450	451	451	467	550	587	598	624	722	864
2003	898	819	812	859	921	783	700	686	688	668	655	726
2004	690	576	550	837	984	984	1,000	943	838	871	857	823
2005	850	833	790	850	825	825	750	830	760	767	773	750
2006	740	700	875	800	775	733	800	720	800	778	770	763
2007	800	843	847	800	817	800	800	843	969	967	1,106	1,250
2008	1,111	1,183	1,018	978	947	995	986	983	922	1,033	1,055	1,640
2009	1,520	1,400	1,725	1,515	1,516	1,729	1,745	1,575	1,673	1,531	1,500	1,490
2010	1,000	1,000	1,083	1,700	1,217	1,480	1,085	1,000	914	1,193	1,133	1,129
2011	1,200	1,200	1,500	1,500	1,500	1,583	1,471	1,254	1,292	1,592	1,583	1,475
2012	1,290	1,500	1,754	1,400	1,500	1,450	1,400	1,500	1,289	1,242	1,363	1,243
2013	1,500	1,500										
Coefficient of Variation			62.75%									

Source: MAG/DC/SIMA.

APPENDIX C

MARKET RISKS AND RISK TRANSFER: THE CASE OF SOY

As mentioned in chapter 3, the advantages of soy are realized from the differentials (discounts) in relation to several future contracts in Chicago. From the information on differentials to the FAS prices in ports in the Parana River,[26] the months for the Chicago contracts were identified in order to define the prices paid for export in FAS conditions (May, July, August, September, November, and January).

In table C.1, the May and July contracts are presented as examples where the magnitude of the price[27] changes can be appreciated in a single contract.

Therefore, as an example, in 2012, the one who fixed the May contract price at the soy planting date (October 2011) defined a base price of 455 US$/ton, while the one who fixed the month previous to the closing (April 2012) had a base price of 529 US$/ton. The comparison of the Chicago prices for several years also shows significant variation. For example, in the case of the May contracts, the April sales (the ones that approach the spot prices) were done with the following values between 2008 and 2012: 483, 374, 358, 501, and 529. This compares with the lower variability of those who obtained future price coverage at the moment of planting in October (371, 351, 355, 435, and 455).

All these variations show that those who have the capacity to buy price hedges and for selecting sales period, have significant advantages to limit the impact of price variations, especially in terms of the input-output price relation for each agriculture season. Without a doubt, small farmers are the ones with less capacity to transfer risks through futures. Large cooperatives, exporters, and so forth can hedge themselves against international price volatility. See the soy futures price comparison in graph C.1

[26] Data provided by the Cooperativa Colonias Unidas.

[27] In Chicago, these contracts are negotiated with several years' anticipation, but here we only take some months previous to the commercial cycle given that it is expected that producers and buyers fix the majority of their operations during the months near but previous to the dates in those contracts.

TABLE C.1. SOY PRICES IN THE CHICAGO FUTURES MARKET* (MONTHLY AVERAGE IN US$ PER TON)

Month for Price Fixing	May Contract					July Contract				
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
October **	371	351	355	435	455	247	354	355	437	458
November **	399	338	374	465	438	266	341	376	466	441
December **	435	324	384	489	427	269	328	386	490	431
January	470	368	363	516	446	281	372	366	518	450
February	515	342	348	516	464	300	344	351	519	467
March	500	332	350	500	497	301	331	353	503	499
April	483	374	358	501	529	298	372	361	505	531
May						307	419	351	499	521
June						325	445	349	500	522

Source: World Bank data based on daily market data from Chicago.
Note: * A few months previous to the date of each contract were considered (in Chicago the sales have greater anticipation).
** It refers to the months of the previous year.

TABLE C.2. VARIATIONS IN SOY DIFFERENTIALS FOR FAS RIO PARANA* (US$ PER TON)

Reference Contracts	Harverst 2007–08	Harverst 2008–09	Harverst 2009–10	Harverst 2010–11	Harverst 2011–12	Harverst 2012–13
May	−72.9	−38.03	−47.33	−36.61	−36.8	−77.42
July	−88.42	−22.4	−35.29	−47.62	−34.93	−76.83
August	−93	−18	−16.86	−55.79	−39	sd
September	sd	−6	−6	−38.06	34	−73
November	−70	−4	0	−44.5	sd	sd
January	−55	−57	−30	−45	−14	sd

Source: Information provided by Cooperativa Colonias Unidas.
Note: *Puerto Triunfo o Puerto Trociuk. Transport to port costs 11 to 16 US$ per ton.

TABLE C.3. FAS RIO PARANA PRICES ESTIMATED FROM CHICAGO PRICES AND DIFFERENTIALS* (US$ PER TON)

Reference Contracts	Harverst 2007–08	Harverst 2008–09	Harverst 2009–10	Harverst 2010–11	Harverst 2011–12	Harverst 2012–13
May	410	336	311	464	492	441
July	237	423	314	452	487	483
August	460	369	360	444	563	N/A
September	sd	386	370	463	584	N/A
November	269	351	427	401	sd	N/A
January	264	322	454	375	521	N/A

Source: Data from Chicago market and table 5.2.
Note: *For the Chicago prices, monthly averages were used for the previous month of each contract; N/A: without data.

GRAPH C.1. COMPARISON OF FUTURES SALES IN THE CHICAGO BOARD OF TRADE

between October, around planting, and in April, before harvest. Those who can get an advance hedge can reduce significantly the price volatility.

In table C.2, we show the differentials of the different months of the Chicago market, in other words, the discounts used to calculate FAS prices in the ports in Rio Parana. We observe significant inter and intra annual variations. The level and degree of variation of the discounts are related to logistic problems in the country and infrastructure and regulatory issues in neighboring countries were Paraguayan grains exit for export.

From the data on differential and Chicago market prices for the various contracts, FAS prices in dollars per ton were calculated and are shown in table C.3. It can be seen again that there are significant differences between advanced sales and sales during the harvest month.

APPENDIX D
INFORMATION ABOUT PROGRAMS AND PROJECTS THAT INCLUDE RISK MITIGATION ACTIONS

TABLE D.1. FAMILY FARMING

Name of the Project or Program	Execution Period	Objective, Beneficiaries and Geographic Coverage (Departments)	Components and Key Activities (Indicate Risk Management Activities)	Executing Unit and Institutional Arrangements	Cost Per Component (US$)	Financing Sources (US$) (Government, Loan, Donor, and so on)
1. Family farming food production promotion program (PPA)	2010–20	Objectives: • Increase the national production of quality food • Promote access to these foods • Support communities in socioeconomic activities (organization, technology, production, basic services, access, marketing) • Improve the incomes of family farmers Beneficiaries: 1. Family farmers 2. Indigenous communities 3. Rural households in extreme poverty; and 4. Other families belonging to family agriculture through organizations Coverage: The entire country. 85,000 beneficiaries	1. Organizational capacity 2. Investment 3. Technical assistance 4. Trade 5. Program management and administration 6. The benefits of PPA are the following: • Technical assistance for production, marketing and organization • Provision of basic inputs for food production (seeds of autoconsumption crops, small tools) • transfer of incentives for the adoption of production technologies • management of community services through coordination with other institutions (water, energy, roads, health, education)	MAG through the Vice ministry of Agriculture and other institutions		Government budget: 14.9 million (2013)

Name of the Project or Program	Execution Period	Objective, Beneficiaries and Geographic Coverage (Departments)	Components and Key Activities (Indicate Risk Management Activities)	Executing Unit and Institutional Arrangements	Cost Per Component (US$)	Financing Sources (US$) (Government, Loan, Donor, and so on)
2. Empowerment of Rural Organizations and Coordination of Investment Project (Paraguay Rural Inclusivo—PPR)	2007–13	Objectives: • Ensure that the rural poor of the five departments and their organizations are strengthened, with access to productive resources and to technical and financial services, including the beneficiaries in the national socioeconomic development process Beneficiaries: 1. Rural poor households who in part are landless agriculture workers and in part farmers that belong to weak organizations 2. In some case cooperatives that have endured difficult circumstances 3. 19,000 beneficiaries in total • The PPR is implemented in the departments of Caazapa, Caaguazu, San Pedro, Concepción, Guaira.	1. Building and strengthening of social capital: grouping project activities and actions for the strengthening of organizations. • Subcomponent for the empowerment of social and economic organizations with a focus on gender. • Subcomponent of preinvestment in agribusiness and non-farm opportunities. 2. Coordination of productive investments, including actions to provide a supply of technical and financial resources to ensure the development of business plans. 3. Policy dialogue and partnerships: includes activities for policy dialogue and knowledge management for rural development	MAG	• Building and strengthening of social capital: 5.09 million. • Coordination of productive investments: 7.04 million. • Policy dialogue and partnerships: 0.19 million. • Executing unit: 2.13 million.	IFAD: Loan of 12.02 million Government: 2.2 million Beneficiaries: 0.25 million (an extension of 10 million is being processed)

(*Continued*)

TABLE D.1. FAMILY FARMING (*Continued*)

Name of the Project or Program	Execution Period	Objective, Beneficiaries and Geographic Coverage (Departments)	Components and Key Activities (Indicate Risk Management Activities)	Executing Unit and Institutional Arrangements	Cost Per Component (US$)	Financing Sources (US$) (Government, Loan, Donor, and so on)
3. Sustainable Rural Development Project (PRODERS)	2008–13	The objective is to improve the quality of life of small farmers and indigenous communities in the project area in a sustainable fashion, through support measures that can strengthen community organizations and the management of natural resources, increasing the socioeconomic situation of producers and communities. The project promotes an integrated management model that addresses environmental, economic, and social aspects, with a participatory approach, using the microwatershed and indigenous territories as the unit of planning. 16,800 beneficiaries total. The project intervenes in San Pedro and Caaguazu.	Components: 1. Development of local organizations and training. 2. Extension and adaptive research. 3. Investment fund. 4. Animal health improvement. 5. Project management, monitoring, and evaluation.	Ministry of Agriculture and Livestock (MAG), Direccion Nacional de Coordinacion de Proyectos (DINCAP)/ Direccion General del Proyecto (DGP)	Component 1: 2.39 million Component 2: 10.18 million Component 3: 24.89 million Component 4: 4.09 million Component 5: 3.9 million	World Bank: 37.5 million Government: 3.86 million Beneficiaries: 3.39 million Other: 2 million
4. Agriculture Development Program for the Eastern Region of Paraguay. 2KR	1979/not defined	Objective: contribute to the increase in food production, through the sale of machinery, equipment and inputs for agriculture, forestry and fisheries; and the financing of socioeconomic development projects. Supports family farming. 500 beneficiaries per year. Coverage is the entire country.	A. Sale of machinery, equipment, and agricultural inputs. B. Financing socioeconomic development projects. C. Loan recovery.	MAG, DINCAP		Funds from the national budget: 1.8 million (2013)

Name of the Project or Program	Execution Period	Objective, Beneficiaries and Geographic Coverage (departments)	Components and Key Activities (indicate risk management activities)	Executing Unit and Institutional Arrangements	Cost Per Component (US$)	Financing Sources (US$) (government, loan, donor, and so on)
5. Modernization of the Management of Agriculture Public Supports	2007–15	Objective: contribute to the improvement of productivity and income increase of small and medium size producers by doing the following: (i) increase the adoption rate of environmentally appropriate agriculture technologies with positive economic returns; and (ii) partially and temporarily compensate the drop in incomes due to the elimination of supports for the supply of inputs by MAG and its decentralized institutions.	The programs searches to improve the deficiencies observed in the current ad-hoc agriculture support policies where the government provides subsidies based on the provision of inputs, with a policy of providing a partial subsidy for the adoption of improved technologies. Components: 1. Administration and supervision; 2. Support to technology adoption; 3. Direct supports to family farming.	MAG, DINCAP	a. 16.5 million b. 10 million c. 2 million	IDB: 31.5 million Government: 3.5 million
4. Sustainable Natural Resource Management Project	2007–12 (III phase being negotiated)	Objective: contribute to the conservation and rehabilitation of natural resources and biodiversity, supporting to stabilize incomes of rural population in the long run. (i) introduction of agriculture and forestry management systems for small and medium size farms in selected areas; (ii) financing incentives for inputs and technical assistance for adoption of soil conservation measures, agroforestry systems, reforestation and forest management. Coverage: departments of Concepción, San Pedro, Canindeyu, Caaguazu, Paraguari, Caazapa, and Guaira. Beneficiaries: 11,500 families	Components: 1. Soil Management: soil management practices through direct planting and use of green fertilizers in farms; 2. Forestry management: introduction of management practice for native forests, reforestation, agroforestry systems, natural regeneration and implementation of forest nurseries.	MAG, DINCAP		KfW: €16.8 million (donation) Government: €2.7 million

(*Continued*)

TABLE D.1. FAMILY FARMING (*Continued*)

Name of the Project or Program	Execution Period	Objective, Beneficiaries and Geographic Coverage (Departments)	Components and Key Activities (Indicate Risk Management Activities)	Executing Unit and Institutional Arrangements	Cost Per Component (US$)	Financing Sources (US$) (Government, Loan, Donor, and so on)
3. Inclusion of family farms in supply chains project (Paraguay inclusive)	2013–18	Objective: contribute to increase assets, income and quality of life of poor family farmers and the rural population through their sustainable inclusion through representative social organizations in supply chains with a gender view and the conservation of the environment by doing the following: (i) strengthen rural organizations; (ii) facilitate the link between family farmers and supply chains; (iii) facilitate access to investment and working capital credit for family farmers; (iv) promote productive diversification processes, appropriate technology adoption, increase production and food security in family farms; and (v) increase employment opportunities for the rural poor, with emphasis on women and youth. Coverage: Eastern Region. Beneficiaries: 14,500 families (72,500 people). Indirect beneficiaries: 10,000 families (50,000 people)	Components: 1. Promotion and Preinvestments 2. Investments. 3. Project administration, monitoring and evaluation. Three criteria are established for selecting supply chains: (i) potential to include poor family farms; (ii) to have markets in expansion; and (iii) can demonstrate stable marketing channels. During the design of the project four chains were prioritized: (i) cassava for starch for export; (ii) sesame for export as grain; (iii) sugar cane for organic sugar production for export; and (iv) milk for the domestic market. In all of them there are successful experiences in their coordination between family farms and firms in the supply chain.	MAG, DINCAP	• 15 million • 21.6 million • 2.4 million	IFAD: 10 million Government: 3.5 million Companies: 3.8 million IFIs: 5.2 million Beneficiaries: 3.3 million

LIVESTOCK: EXTENDED STRATEGIC AGRICULTURE FRAMEWORK—2009–18

GENERAL OBJECTIVE

To promote the livestock and farm production and productivity increase to improve sector participation in internal consumption and meet external demand, improving farmers' incomes.

SPECIFIC OBJECTIVES

- Train human resources for the livestock farm development.
- Develop and promote research programs targeting improvements in productivity, genetic quality, sanitary status, and diversification of large and small livestock.
- Promote non-traditional farm species for small and medium size producers, addressing the specificities of their production systems, in particular of indigenous communities.
- Promote the adoption of technologies for traceability, food safety, and quality of livestock and farm production, best practices for management and manufacturing of final products.
- Promote farm development programs with a systems vision considering the role of women, head of households, play in the productive arena, in particular with respect to food production for household consumption and the sale of surplus in the market.
- Contribute to building a cluster that integrates agriculture with livestock production.
- Promote the establishment of supply chains that include livestock and farm production.
- Promote the dissemination of intensive systems of livestock production, rationalizing land use and increasing the direct and indirect employment generation.
- Contribute to the establishment of financing lines appropriate to livestock and farm production.
- Promote and strengthen Public-Private Partnerships for the design of livestock and farm development plans and programs.

Programmatic lines: The lines of intervention defined as a whole are to promote the strengthening and diversification of livestock and farm production, promoting and supporting the dissemination and implementation of best practices and improved technologies under environmentally sustainable conditions as a process targeting farm income, food security, and the improvement of the quality of rural life.

The lines of action are disaggregated thematically under the following components:

a) Training and human resources capacity building

This component prioritizes training and improving the technical capacity focused on staff and field agents in production techniques, manipulation, preparation, and trade of livestock products and subproducts among others.

b) Research, validation, and technology development

This component prioritizes research and technological validation over basic aspects of sector development, such as adequate animal genetics of diverse species and productive lines, animal feeding and nutrition, including the use of non-traditional feed, and the development and validation of technologies for the maintenance and improvement of the sanitary status of national livestock production.

c) Identification and development of supply chains

This component prioritizes the identification and development of supply chains that incorporate various livestock species like milk, pigs, goats, poultry, rabbits, fish, and others, based on the availability or capacity of food production, geographic characteristics, and farm size, in order to optimize supply chain behavior.

d) Promotion of livestock farming

This component is set up in order to improve the use of physical and financial resources to improve competitiveness supported by the establishment of PPPs, generating employment and income opportunities for farmers, adapting to the different productive system characteristics who have women as leaders, youth, or indigenous communities who incorporate their ancestors' knowledge.

Implementation strategy: The instrument design process for programmatic lines must address the following basic aspects:

- » Integration of farm production in the small and medium size farms must be done based on existing supply chains.
- » The promotion of agrosylvo-pastoral systems must address environmental considerations.
- » The adoption of more intensive cattle production under adequate technological standards and the efficient use of resources and environmental sustainability.
- » The reintroduction of institutional financing and the permanent technical support at the production level of small and medium size farms.

STATISTICAL APPENDIX

TABLE S.1. SUMMARY OF PRODUCTION AREA, PRODUCTION, AND YIELDS BY DEPARTMENT (AVERAGE 2009–10 TO 2011–12)

Department	Cotton (F)	Sugar Cane (F, E)	Sesame (F)	Tomato (F)	Sweet Potato (F)	Habilla (F)	Locote (F)	Maize (F, E)	Peanut (F, E)
	Area (Has)								
Concepción	1,156	289	24,937	55	498	1,542	26	9,517	398
San Pedro	2,136	2,296	40,756	72	770	144	102	133,258	3,238
Cordillera	67	6,684	282	74	167	78	18	5,613	1,092
Guaira	524	40,964	210	8	72	97	5	10,252	608
Caaguazu	7,921	15,989	1,431	704	572	462	285	99,118	3,778
Caazapa	5,525	5,434	436	13	103	302	5	39,692	1,738
Itapua	2,782	598	1,392	38	187	875	47	89,228	1,206
Misiones	2,166	2,072	90	15	175	40	5	10,440	320
Paraguari	3,703	21,549	74	94	475	31	43	11,668	1,652
Alto Parana	1,572	297	265	59	255	478	25	217,789	1,624
Central	88	2,993	106	293	742	0	117	917	81
Ñeembucu	1,196	99	74	3	770	4	4	4,904	337
Amambay	0	1,352	2,218	8	128	237	7	33,198	75
Canindeyu	215	5,697	2,206	7	135	251	7	214,884	802
Pte. Hayes	430	38	594	2	99	0	2	350	2,619
Alto Paraguay	0	1	16	0	0	0	1	19	7
Boqueron	44	0	4,074	0	0	0	0	30	5,598
Total	**29,524**	**106,352**	**79,163**	**1,447**	**5,150**	**4,543**	**700**	**880,875**	**25,172**
%	**0.59%**	**2.12%**	**1.58%**	**0.03%**	**0.10%**	**0.09%**	**0.01%**	**17.59%**	**0.50%**
Area according to the National Agricultur Census 2008 (Has)									
Technology/Commercial Agriculture (Has)									
Family Farming (Has)									
	Production (Tons)								
Concepción	923	10,536	12,654	1,415	4,759	1,420	202	30,256	218
San Pedro	1,962	87,447	20,682	1,977	7,694	124	935	472,767	2,136
Cordillera	41	332,692	144	2,129	1,060	52	97	7,758	670
Guaira	318	1,881,273	99	164	527	66	25	34,956	372
Caaguazu	6,052	784,445	725	24,661	5,868	429	3,001	362,606	2,496
Caazapa	5,046	284,579	233	409	1,040	221	20	128,746	1,190
Itapua	2,749	21,968	706	801	1,885	616	350	338,761	884
Misiones	1,675	82,668	45	331	1,270	24	34	30,306	181
Paraguari	2,697	1,021,584	33	2,729	3,240	20	295	30,105	974
Alto Parana	1,917	12,209	137	1,958	2,753	389	172	852,941	1,103

Area (Has)									
Yams (F)	Beans (F)	Irrigated Rice (E)	Canola (E)	Sunflower (E)	Soy (F, E)	Sorghum (E)	Wheat (E)	Total	
10,155	4,669	24	0	119	31,205	300	498	85,390	
30,211	8,269	1,890	1,398	3,322	262,935	3,050	7,059	500,907	
8,310	3,110	1,600	0	0	1	0	0	27,096	
10,232	4,098	18	98	347	12,883	0	4,595	85,012	
29,827	10,670	248	7,591	17,203	364,039	720	76,242	636,800	
14,722	4,413	13,439	5,319	7,120	138,875	60	71,080	308,276	
20,914	6,101	29,559	15,674	29,407	503,648	10,319	179,512	891,487	
4,320	2,452	24,840	425	1,103	31,914	1,780	7,048	89,207	
14,861	6,046	58	0	0	52	137	0	60,444	
12,854	4,129	436	26,207	23,735	791,090	1,250	188,385	1,270,451	
1,308	648	436	0	0	0	0	0	7,729	
1,936	1,246	0	0	0	0	0	0	10,573	
3,785	1,030	93	0	887	128,110	1,050	7,037	179,216	
13,362	2,869	51	6,755	12,660	532,822	1,516	40,281	834,520	
98	394	0	0	0	0	0	0	4,626	
17	5	0	0	0	300	0	0	368	
27	389	0	0	0	3,500	1,300	0	14,961	
176,937	**60,414**	**72,694**	**63,467**	**95,903**	**2,798,842**	**24,992**	**581,736**	**5,007,911**	
3.53%	**1.21%**	**1.45%**	**1.27%**	**1.92%**	**55.89%**	**0.50%**	**11.62%**	**100.00%**	
								4,824,173	**96.33%**
								5,800,000	
								3,800,000	
								2,000,000	
Production (Tons)									
118,164	2,989	59	0	132	68,251	1,957	1,061		
436,398	4,875	6,406	2,141	4,661	552,533	17,175	17,545		
56,173	2,235	7,748	0	0	2	0	0		
114,122	2,531	44	150	487	27,404	0	11,886		
413,176	8,758	1,070	12,554	27,581	869,400	3,277	189,511		
208,658	3,582	72,373	8,743	11,058	315,496	304	183,891		
285,687	4,508	154,599	25,443	47,149	1,183,728	58,821	471,337		
43,036	1,503	127,514	607	1,990	69,529	10,690	16,732		
123,970	4,231	225	0	0	29	642	0		
191,114	3,173	1,690	43,344	39,244	1,982,307	7,860	464,437		

(Continued)

TABLE S.1. SUMMARY OF PRODUCTION AREA, PRODUCTION, AND YIELDS BY DEPARTMENT (AVERAGE 2009–10 TO 2011–12) (*Continued*)

Department	Cotton (F)	Sugar Cane (F, E)	Sesame (F)	Tomato (F)	Sweet Potato (F)	Habilla (F)	Locote (F)	Maize (F, E)	Peanut (F, E)
	Area (Has)								
Central	54	127,024	56	12,412	4,818	0	1,185	1,563	40
Ñeembucu	862	3,399	38	51	5,956	2	19	6,100	172
Amambay	0	42,837	1,116	322	1,231	206	44	110,130	46
Canindeyu	147	190,941	1,261	195	1,696	211	28	770,276	554
Pte. Hayes	342	1,686	297	61	759	0	11	721	3,062
Alto Paraguay	0	28	7	0	0	0	9	32	9
Boqueron	38	0	1,261	0	0	0	0	51	6,716
Total	**24,822**	**4,885,317**	**39,499**	**49,615**	**44,557**	**3,778**	**6,424**	**3,178,074**	**20,824**
	Yields (Kg/Ha)								
Concepción	919	36,717	513	26,617	9,555	921	7,517	3,210	547
San pedro	1,058	38,418	513	26,980	9,993	865	9,115	3,582	660
Cordillera	716	50,212	517	29,279	6,335	662	6,072	1,396	614
Guaira	699	46,329	479	24,841	7,282	681	5,265	3,443	611
Caaguazu	880	49,492	512	34,953	10,252	927	10,213	3,694	661
Caazapa	1,052	52,834	540	28,391	10,077	730	4,529	3,276	684
Itapua	1,138	37,029	513	21,661	10,095	704	7,129	3,834	733
Misiones	891	40,258	500	24,209	7,255	582	7,470	2,931	566
Paraguari	839	47,825	449	29,334	6,816	624	6,977	2,605	590
Alto parana	1,404	41,544	522	43,127	10,798	814	7,654	3,955	679
Central	707	42,816	531	31,882	6,493	0	9,870	1,721	501
Ñeembucu	830	34,706	515	25,438	7,731	499	5,222	1,256	512
Amambay	0	31,953	509	40,593	9,629	870	6,926	3,350	615
Canindeyu	786	33,814	578	23,521	12,574	840	4,509	3,620	691
Pte. Hayes	918	44,716	505	33,545	7,637	0	6,198	2,085	1,169
Alto paraguay	0	26,823	404	0	0	0	7,500	1,675	1,200
Boqueron	995	0	313	0	0	0	0	1,721	1,200
Total	**968**	**29,547**	**505**	**34,367**	**8,652**	**859**	**6,490**	**2,647**	**827**

			Area (Has)					
Yams (F)	Beans (F)	Irrigated Rice (E)	Canola (E)	Sunflower (E)	Soy (F, E)	Sorghum (E)	Wheat (E)	Total
8,982	414	1,057	0	0	0	0	0	
14,372	645	0	0	0	0	0	0	
48,616	582	243	0	1,155	305,473	5,320	16,921	
191,134	2,279	123	10,759	16,492	1,328,835	7,680	102,169	
627	309	0	0	0	0	0	0	
116	3	0	0	0	450	0	0	
164	198	0	0	0	5,775	6,099	0	
2,254,507	**42,822**	**373,153**	**103,741**	**149,951**	**6,705,063**	**141,237**	**1,475,489**	
			Yields (Kg/Ha)					
11,603	645	2,428	0	1,104	2,204	6,522	2,130	
14,404	594	3,400	1,531	1,406	2,118	5,630	2,485	
6,741	725	4,857	0	0	2,164	0	0	
11,122	623	2,428	1,531	1,406	2,144	0	2,586	
13,813	817	4,327	1,653	1,606	2,407	4,551	2,485	
14,134	818	5,401	1,643	1,556	2,290	5,067	2,586	
13,622	744	5,245	1,622	1,606	2,369	5,700	2,625	
9,934	620	5,148	1,429	1,807	2,196	6,005	2,373	
8,318	705	3,885	0	0	563	4,692	0	
14,826	776	3,885	1,653	1,657	2,524	6,287	2,464	
6,846	646	2,428	0	0	0	0	0	
7,404	521	0	0	0	0	0	0	
12,807	570	2,623	0	1,305	2,403	5,067	2,404	
14,264	800	2,428	1,592	1,305	2,513	5,067	2,535	
6,406	789	0	0	0	0	0	0	
6,684	514	0	0	0	1,500	0	0	
6,016	508	0	0	0	1,650	4,692	0	
12,706	**714**	**3,727**	**1,634**	**1,357**	**2,414**	**5,651**	**2,533**	

TABLE S.2. GROSS VALUE OF AGRICULTURE PRODUCTION

Crop	Price G$/Ton Average 2010–12	Production 2011 (Tons)	Gross Value of Production (Price x Production) G$	Total Value of Production (Price x Production Exchange Rate 2012) US$
Garlic	13,553,800.00	222	3,008,943,600	683,851
Cotton	1,800,000.00	28,802	51,843,600,000	11,782,636
Irrigated rice	3,231,000.00	395,998	1,279,469,538,000	290,788,531
Dryland rice	3,231,000.00	4,207	13,592,817,000	3,089,277
Peas			-	-
Sweet potato	812.5	45,405	36,891,563	8,384
Sugar cane	177,500.00	4,209,974	747,270,385,000	169,834,178
Canola	1,716,000.00	110,500	189,618,000,000	43,095,000
Onion	1,744,350.00	4,924	8,589,179,400	1,952,086
Strawberry	9,070,000.00	2,050	18,593,500,000	4,225,795
Sunflower			-	-
Habilla			-	-
Ka'a He'e			-	-
Locote	6,250,000.00	5,302	33,137,500,000	7,531,250
Maize	1,333,727.00	3,079,524	4,107,244,305,948	933,464,615
Yams	653,000.00	1,685,600	1,100,696,800,000	250,158,364
Peanuts	7,323,000.00	11,874	86,953,302,000	19,762,114
Mint			-	-
Potato	2,135,000.00	3,840	8,198,400,000	1,863,273
Beans	3,117,000.00	26,432	82,388,544,000	18,724,669
Sesame	4,463,250.00	27,959	124,788,006,750	28,360,911
Soy	1,872,670.00	4,344,960	8,136,676,243,200	1,849,244,601
Sorghum			-	-
Tobacco			-	-
Tomato	3,237,500.00	45,256	146,516,300,000	33,299,159
Tártago			-	-
Wheat	931,000.00	1,560,599	1,452,917,669,000	3,30,208,561
Carrot	175,000.00	11,686	2,045,050,000	464,784
Banana	2,273,000.00	60,021	136,427,733,000	31,006,303
Coffee			-	-
Lemon			-	-
Tangarine			-	-
Pineapple			-	-
N. Agrio			-	-
Pineapple	955,000.00	56,412	53,873,460,000	12,243,968
Grapefruit	882,200.00	53,120	46,862,464,000	10,650,560
Tung			-	-
Grape			-	-
Yerba mate			-	-
Total				**4,052,442,871**

TABLE S.3. GROSS VALUE OF PRODUCTION OF SELECTED CROPS FOR THE RISK ANALYSIS

Crop	Gross Production Value TOTAL—US$	Gross Production Value of Family Farming—US$
Garlic	683,851	683,851
Cotton	11,782,636	11,782,636
Dryland rice	3,089,277	3,089,277
Irrigated rice	290,788,531	
Onion	1,952,086	1,952,086
Locote	7,531,250	7,531,250
Maize	933,464,615	140,019,692
Yams	250,158,364	250,158,364
Potato	1,863,273	1,863,273
Sesame	28,360,911	28,360,911
Tomato	33,299,159	33,299,159
Carrot	464,784	464,784
Wheat	330,208,561	
Sunflower	sd	
Canola	43,095,000	
Soy	1,849,244,601	277,386,690
Sugar Cane	169,834,178	33,966,836
TOTAL	**3,955,821,077**	**790,558,808**
	98%	**20%**
	Percentage of the GVP of selected products over the total for the country	**Percentage of the GVP of the selected products of family farming over the total of selected products**

VOLUME 2
STRATEGY AND ACTION PLAN FOR AGRICULTURE RISK MANAGEMENT

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ACRONYMS AND ABBREVIATIONS

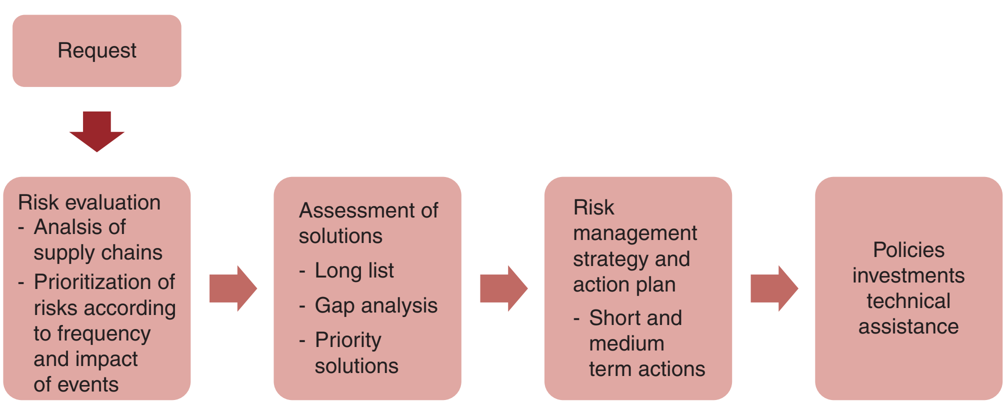
ARP	Rural Association of Paraguay
BCP	Central Bank of Paraguay
CAN	National Agriculture Census
CAT DDO	Catastrophe Deferred Drawdown Option
CBOT	Chicago Board of Trade
CME	Chicago Mercantile Exchange
CVP	Permanent Veterinary Committee of the Southern Cone
DAAF	Family Farming Directorate
DEAg	Agriculture Extension Directorate
DINCAP	National Project Coordination and Administration Directorate
DMH-DINAC	Meteorological and Hydrological Directorate
FAO	Food and Agriculture Organization
FECOPROD	Federacion de Cooperativas de Produccion Ltda.
FMD	Foot and Mouth Disease
FNC	National Farmer Federation
FOMIN	Multilateral Investment Fund
GDP	Gross domestic product
GOP	Government of Paraguay
INAN	National Food and Nutrition Institute
IPTA	Agriculture Technology Institute of Paraguay
MAG	Ministry of Agriculture and Livestock
MECID-DAR	Interinstitutional Departmental Coordination Table for Agriculture and Rural Development
OIE	World Animal Health Organization
OPS	Panamerican Health Organization
PANAFTOSA	Panamerican Center for FMD
PNMCRS	National Soil Management, Conservation and Recovery Program
PPA	Family Farm Food Production Promotion Program
PPR	Paraguay Rural Project
PRODERS	Sustainable Rural Development Project
PRONAFOPE	National Livestock Promotion Program
ROFEX	Mercado a Termino de Rosario S.A.
SEN	National Emergency Secretariat
SENACSA	National Animal Health and Quality Service
SENAVE	National Vegetable and Seed Health and Quality Service
SETTA	Agriculture Technology Extension and Transfer System
SIGEST	Integrated System for Agriculture and Rural Development
UGR-MAG	Risk Management Unit—MAG
UNA	National University of Asunción
VBP	Gross value of production
VMA	Viceministry of Agriculture

CHAPTER ONE
INTRODUCTION

The World Bank, at the request of the Ministry of Agriculture and Livestock (MAG), has been undertaking an assessment of agriculture sector risks in Paraguay. The methodology used includes a two stage process. The first stage, risk evaluation, involved one mission in June 2013, when the most important agriculture risks were identified, quantified, and prioritized in terms of their impact on sector product volatility. As a result, and considering the most important risks given their frequency and severity, a series of possible additional solutions to the ones already undertaken by the various public policies and programs were identified. This is contained in volume 1 of the current report.

This volume (2) presents the results of the second phase of the sector risk assessment, which addresses the proposal for solutions. In November 2013, the results in volume 1 were presented to the MAG, remembering the need to continue the process to arrive at a strategy and action plan. Therefore, the team proceeded to the second phase to evaluate some of the proposed solutions and prepared an agriculture risk management strategy and action plan. With this objective, at the request of the Government of Paraguay (GOP), a second mission visited Paraguay in March–April 2014. This volume 2 is the result of said mission. In figure 1.1 the process is detailed.

FIGURE 1.1. SECTOR WIDE RISK ASSESSMENT PROCESS



The results of the March–April 2014 mission were presented at a workshop organized by MAG in Asunción on April 10, 2014, where an opportunity was given to compare proposals with public and private sector specialists. The results of this assessment are detailed in the next sections.

CHAPTER TWO

AGRICULTURE RISK MANAGEMENT FRAMEWORK FOR PARAGUAY

PRIORITY RISKS[28]

Agriculture gross domestic product (GDP) in Paraguay is much more volatile than total GDP or than other non-agriculture sectors according to a study by the World Bank.[29] Agriculture GDP has varied 12 percentage points since the first quarter of 1994, which compares to 4.7 percentage points of variation of total GDP. The differences in volatility between the agriculture sector and the rest of the economy have increased in the past years due to very severe risk events on crops and livestock. Furthermore, shocks to the agriculture sector also impact other sectors of the economy and cause them to also be volatile in part. The most affected activities are input provision such as machinery, storage, and transport, but also sectors like construction and financial services who suffer from agriculture shocks.

Production risks are the most frequent and with greater impact on the agriculture sector of Paraguay, in particular drought. It is estimated that Paraguay losses on average $237 million every year in production losses or 5 percent of agriculture GDP (1990–2001). The most notable risk given its global magnitude of losses reported in the past is drought. In 2011, the last year when an important drought was recorded, $920 million were lost only in soy. Family farming crops also suffered significant losses: cassava, $94 million or 38 percent of VBP; sesame, $13 million or 46 percent of VBP; cotton, $3 million or 26 percent of VBP. A significant decline in production and exports of soy produces a notable impact on global economic activity and aggregate demand, as it occurred in recent years, but a reduction in food availability among family farmers has a direct impact on food security, leading to requests for assistance and could lead to social instability.

Pests and diseases also present important risks to production, although they are generally controlled with chemicals and resistant varieties. But the main

[28] See volume 1 for more details on this.

[29] World Bank, Growth Volatility in Paraguay: Sources, Effects & Options, 2013.

impact is related to the increase in production costs, which affects especially family farms.

Market risks also lead to farmer losses. Prices of export products of family farms, like sesame and cotton, are subject to large variations transmitted to producers, who are impacted by sharp drops in prices. In soy, on the other hand, farmer prices vary according to the international price and as a function of differentials (discounts in relation to the Chicago Board of Trade [CBOT]). Enabling environment risks are important for the agriculture sector in Paraguay, given its landlocked situation and given the weakness in investments in basic infrastructure and technology.

In livestock, foot and mouth disease (FMD) outbreaks have had catastrophic economic consequences. It has resulted in the almost total paralysis of meat exports, losing the very important entry of foreign currency. Its impact reaches all actors of the supply chain. Paraguay suffered two FMD outbreaks in the past years, in 2002 and 2011. Weather risks, like drought, flood, and frosts, also cause important losses to livestock producers.

The distributional impact of risks throughout the supply chains is varied. The most affected actors tend to be farmers, and the final result is often the increase in indebtedness and the reduction of investment capital. It can be affirmed that part of the production variations and losses faced by farmers and other actors of the supply chain, especially family farmers, but not exclusively, are the results of non-mitigated risks—in other words, risks that can be managed with appropriate agriculture practices, with insurance, with infrastructure investments, and with accurate and timely market information.

Family farms and their households are the ones most at risk, first due to their initial vulnerability situation and second due to their low capacity for efficiently managing production and market risks, not to mention their low technological level. To change this situation it would be necessary to both change the conditions under which small farmers manage risks as well as to modify the factors that cause their vulnerability in the first place.

The high coefficient of variation of cassava and bean yields in the departments with the highest concentration of family farms demonstrates the variability of production and the availability of food for household consumption. See table 2.1. This shows the low technology use.

TABLE 2.1. VARIABILITY OF MAIN FAMILY FARMING CROPS

	Coefficient of Variation	Production 2010–11 (Tons)
Yams		
San Pedro	40%	474,981
Cordillera	43%	61,140
Guaira	29%	124,212
Caaguazú	30%	449,706
Caazapá	33%	227,106
Paraguarí	37%	134,930
Beans		
San Pedro	31%	6,062
Cordillera	51%	2,780
Guaira	36%	3,147
Caaguazú	23%	10,891
Caazapá	33%	4,455
Paraguarí	31%	5,262

Source: Authors' calculations based on MAG data.

The relatively low costs of an agriculture risk management strategy (presented in the following sections), compared to the high level of historical losses, justify its implementation. Table 2.2 shows historical losses for the agriculture sector (1990–2001) per crop, resulting in the risk identification in volume 1. Mostly they are losses due to weather variations. Table 2.3 shows the estimated costs for each strategic line of the action plan. We see that losses in just one year (US$237 million) are above the cost for all the actions proposed for years 2014–19.

CURRENT AGRICULTURE RISK MANAGEMENT PRACTICES

Agriculture sector losses due to weather events are generally absorbed by farmers who have few mechanisms or instruments for good risk management, especially family farmers. Usually the main weather problems (like drought) are only partially mitigated by appropriate management practices (such as using short-cycle sesame varieties, early planting for

TABLE 2.2. LOSSES IN TONS, GS$ AND US$ PER CROP

Crop	Period	Volume of Losses (Tons)[1]	Total Value of Losses (Million G$)	Annual Average Losses (Million G$)[2]	Annual Average Losses (US$)[3]	Losses (% of Ag GDP)
Garilic	1990–2011	742	10,053	457	103,850	0.002%
Cotton	1990–2011	430,232	774,418	35,201	8,000,188	0.18%
Irrigated Rice	1990–2011	145,829	471,173	21,417	4,867,490	0.11%
Dryland Rice	1990–2011	15,796	51,036	2,320	527,230	0.01%
Sugar Cane	1990–2011	3,483,029	618,238	28,102	6,386,752	0.15%
Canola	2007–2011	5,498	9,435	1,887	428,855	0.01%
Onion	1990–2011	7,970	13,903	632	143,621	0.00%
Locote	1990–2011	8,260	51,624	2,347	533,310	0.01%
Maize	1990–2011	1,201,903	1,603,011	72,864	16,560,028	0.38%
Yams	1990–2011	2,495,542	1,629,589	74,072	16,834,596	0.38%
Beans	1990–2011	59,091	184,186	8,372	1,902,744	0.04%
Sesame	2000–2011	39,653	176,980	14,748	3,351,902	0.08%
Soy	1990–2011	7,897,436	14,789,291	672,241	152,781,932	3.48%
Tomato	1990–2011	52,868	171,161	7,780	1,768,191	0.04%
Wheat	1990–2011	684,782	637,532	28,979	6,586,075	0.15%
Carrot	1990–2011	19,827	3,470	158	35,844	0.00%
Total			**21,195,098**	**971,575**	**220,812,608**	**5.02%**

Source: MAG.

[1] Physical losses were calculated as the difference between real yield and the trend value in years when the real value was below 30 percent of the trend value, multiplied by the area in that same year.

[2] In order to estimate the value in G$ average prices were used 2010–12. The VAB was used in 2011 at current prices.

[3] The average exchange rate for year 2012 was used to estimate losses in US$.

TABLE 2.3. ESTIMATED COSTS FOR THE ACTION PLAN FOR AGRICULTURE RISK MANAGEMENT (US$)

Estrategic Line	2014	2015	2016–19	Total
Solutions for sanitary and food safety risks of livestock supply chains	19,883,667	51,296,167	126,905,167	198,085,001 (*)
Strengthening of the Agriculture Innovation System for the mitigation of family farming risks	3,105,000	6,726,500	13,541,500	23,373,000
Price risks and the development of an agriculture commodity exchange	70,000	58,000		128,000
Agriculture risk financing strategy	123,400	874,300	1,067,150	2,064,850
Total			**223,650,851**	

Source: Authors.

*This includes every identified action in the gap analysis undertaken by the World Animal Health Organization (OIE).

sesame, cotton and soy, and so on). Therefore, most farmers who do not use these practices tend to absorb losses in the long run. The development of irrigation, which could be considered a good alternative to mitigate drought risk, is limited by the inelastic demand related to energy supply and by the lack of a water use regulatory framework.

As modern risk management mechanisms are not available, many farmers adopt traditional mitigation measures to manage risks. In organic sugar cane, family farmers adopt weather risk mitigation strategies such as diversification, including especially the production of food for autoconsumption and vegetables that offer short-cycle advantages. Weather risk mitigation in the production of vegetables is quite advanced among commercial and organized farmers. Here irrigation is well disseminated as well as the half-shade cover systems. Greenhouses, as a valid instrument for mitigating frosts and hail, are used by some of these farmers organized in associations.

Pest and disease risk are mitigated in large part by all farmers, including family farmers, through pesticides. Although it is to be noted that at the level of family farmers, results are inferior and costs are higher than in the commercial farming sector. Furthermore, the producers with higher levels of technology are conscious of the importance of crop rotation in order to reduce the incidence of diseases, reducing risks and improving average yields.

In livestock, drought risk is mitigated by pasture reservoirs, feed, and for lower water deficit the use of reservoirs and Australian tanks. As far as FMD, the most effective mitigation technique is animal vaccination. The audit is done in 100 percent of the herds above 100 heads, with the ones with less than 100 heads being left to the responsibility of authorized vaccinators. One difficulty that persists is the lack of availability of census data about the bovine population, although annual estimations are close to reality.

In terms of risk management for price volatility, it was found that there is a limited use of futures market (basically only available for commercial farmers and for some commodities like soy, meat, and other grains) and a limited and untimely availability of market information. This lack of transparency results in high transaction costs and higher risk incidence, impacting those actors with less market power, producers, and especially family farmers. Those who do have the capacity to hedge themselves and choose the selling periods have important advantages for limiting the impacts of price volatility, especially relative prices of input-output for each agricultural season.

INSTITUTIONAL INITIATIVES FOR AGRICULTURE RISK MANAGEMENT

Responding to the recurrent exposure to hydrometeorological events and their economic impact, MAG created in 2009 the Agriculture Risk Management Unit (UGR) as the one responsible for providing services to mitigate, transfer, and respond to sector risks. The main responsibilities of UGR is to produce agro-meteorological bulletins jointly with the Meteorological and Hydrological Directorate (DMH-DINAC), elaborate risk and land use maps, and work in the formulation of base studies and proposals for the development of agriculture insurance for family farming. Furthermore, with the technical cooperation of the Inter-American Institute for Agriculture Cooperation (IICA), UGR is developing a project[30] of Early Warning System, which has an objective to detect and prevent pests and diseases due to meteorological events.

The Federation of Production Cooperatives Ltda. (FECOPROD) has invested close to $1 million in the creation of an information system that operates based on their own infrastructure of agrometeorological states (23 in total). The system allows them to monitor drought indices for each place of weather measurement and infer about their impact on productivity of selected crops.

In relation to risk transfer, the insurance company Tajy is processing a technical assistance project with the Multilateral Investment Fund (FOMIN) to design and implement a weather index-based agriculture insurance scheme in the San Pedro department. This project would have a duration of four years (2014–18), and intends to take advantage of the network of cooperatives of FECOPROD for the distribution of insurance products. At the end of the project it is expected that risk transfer instruments would be available to more than 15,000 families producing sesame, maize, beans, and chia (Balsevich 2014).

Also, with respect to risk transfer, the National Farmer Federation (FNC) has proposed the creation of a Production Guarantee Fund. This fund would work through the definition of an agro-climatic index, activating compensatory payments to producers

[30] This project has the participation of the following institutions: UGR, DEAg, the Agriculture Technology Institute of Paraguay (IPTA), DMH-DINAC, the National Animal Health and Quality Service (SENACSA), the National Vegetable and Seed Health and Quality Service (SENAVE), UNA, and the Catholic University of Our Lady of Asunción.

TABLE 2.4. PRIORITY SOLUTIONS PROPOSED BY THE RISK ASSESSMENT AND RISK PRIORITIZATION

	Commercial Farming	Family Farming	Livestock*
Mitigation	Improve the information and early warning system (also benefits family farming). Evaluate the current state of grain transport infrastructure (roads, river). Public policies for export logistics, negotiations with neighboring countries, and so forth.	Improve the efficiency and coordination of the existing public sector technical services (DEAg, IPTA, SENAVE, PPA, and so on) to introduce best agriculture practices, improve the monitoring and early detection of pests, disseminate appropriate irrigation technologies, promote crop diversification, and so forth.	Strengthen SENACSA's control services for FMD and other diseases. Evaluate the effectiveness of sanitary services linked to exports and propose complementary policies. Emergency strategy for drought and/or frost situations.
Transfer	Asses the viability of establishing an agriculture commodity exchange, that could also bring more market transparency. Develop the agriculture insurance market (more coverage), reaching more producers with a diversity of instruments.	Create a financing mechanism to address weather emergency situations (insurance-fund).	
Absorption	Assess options for responding to catastrophic events with fiscal losses and macroeconomic impact.	Create a financing mechanism to address weather emergency situations (insurance-fund).	Create a contingency fund for addressing emergency situations when an outbreak of FMD or other disease.

*Livestock is listed separately to commercial and family farming because in practice, livestock farmers are exposed to a different set of risks that could be addressed when they are separated from agriculture production risks.

localized in the area at risk where losses exceed 50 percent. Authorities of the UGR assessed its technical and operational viability. However, at the moment, it is unknown what the conclusions of the assessment of such proposal were.

The National Emergency Secretariat (SEN) is the entity responsible for organizing, coordinating, planning, and controlling the activities related to civil defense and protection in light of a catastrophe. Although SEN has supported affected farmers in the past, there are no funds earmarked for the agriculture sector. For this reason, many of the emergency response activities for the agriculture sector have been undertaken by national sector agencies (such as MAG) and with international organizations.

PRIORITY SOLUTIONS FROM THE RISK ASSESSMENT AND RISK PRIORITIZATION[31]

The priority solutions proposed include risk transfer and mitigation instruments for production risks, market mechanisms for price hedging, supply of public services for animal health, and direct support and response for a more effective risk management by family farmers. Table 2.4 shows all proposals. It is to be noted that the proposals related to commercial farming risks are beyond the reach

[31] See volume 1.

of this sectoral study (infrastructure, logistics) or they are already underway by other public initiatives (early warning system). The other aspects of the strategy were analyzed and the conclusions are part of this report. In the last chapter, an action plan is presented.

EXPECTED IMPACT OF THE PROPOSED SOLUTIONS ON POVERTY REDUCTION

The risks to family farming tend to jeopardize the households' capacity to generate income and their already reduced means for investments, deepening their food insecurity and poverty situation. An effective risk management strategy through the mitigation and transfer/absorption of risks would allow family farmers to maintain more stable incomes and improve their welfare during drought periods or through other risk events. Therefore, they would have a more confident projection to invest in their farms, increasing productivity in the medium term. This would contribute to the reduction of rural poverty in Paraguay and to improve the rural economic development.

The proposed solutions include two types of mechanisms that act directly on the production risks in family farms: the introduction of technological innovations for reducing the exposure to weather risks and pests and diseases and/or limit the impact of these events (drought tolerant varieties, appropriate soil management, best agriculture practices, animal vaccination, and so forth), and compensatory payments for income loss when risk events occurred (emergency fund, index insurance, and so forth).

What is the impact of technological innovation in the mitigation of risks in the economy of family farms? If we consider the 240,000 producers with less than 20 hectares (defined as family farmers) accounted by the census of 2008, 203,000, 194,000, and 170,000 of them planted cassava, beans, and maize respectively. Furthermore, the three crops are present in most farms, and it can be assumed that the mitigated event, say a severe drought, would allow for farmer losses to be reduced from $955 to $265, at least. Therefore, family farms would have a benefit of $730/farm (($169 million–$45 million)/170,000) during drought years in a scenario with technological innovation in relation to the current situation of low technology—all this, considering only those crops that on aggregate represent 76 percent of total VBP.

The simultaneous implementation of both mechanisms, technological innovation and income compensation, could result in an forgone loss of an important share of family income when risks such as severe droughts occur. It has been estimated that the forgone losses could reach 41 percent of gross farmer family income.

In summary, although the focus is the management of risks, the ultimate objective is to reduce poverty through income stabilization of family farms, placing them in a more advantageous place to be able to plan and invest on their farms and on their human capital.

CHAPTER THREE
AGRICULTURE RISK MANAGEMENT STRATEGY

FULL PROPOSAL

The proposed strategy intends to tackle in an integrated way the causes of agriculture and livestock risk. The risks that have been realized have important impacts in economic growth, public finances, the economy of supply chain actors and food security of the most vulnerable sectors. With respect to weather risks, mainly drought, actions are proposed in various dimensions, and other risks have their own actions. Proposed actions for family farming have an impact for all production and market risks they face.

Therefore, risk mitigation at the level of the most vulnerable sectors (family farming), is proposed to be addressed through the development of a more efficient and coordinated Agriculture Innovation System, in order to address the technology and market problems that places family farming in an extremely vulnerable situation with respect to production risks.

It is expected that the optimization of agriculture insurance will have positive effects for family farming and other agriculture segments. The improvement of the information and monitoring systems, as well as the development of risk transfer and absorption mechanisms for family farming (contingency fund and index insurance) are especially considered.

With respect to animal health risks, the strategy includes measures to protect export markets but also improve local sanitary conditions and food safety. For livestock, risks that have become a great threat for producers of all sizes and for the economy as a whole, a series of measures are proposed with SEN-ACSA at its center, addressing FMD and other important diseases for meat exports and national production. The strategy, however, does not end at the requirement of the external sector, but also at the consequences of a deficient food safety situation for the health of Paraguayans (slaughterhouses for internal consumption with no sanitary regulations for example), proposing a series of actions throughout the livestock supply chains and involving several levels of government.

The strategy proposes the development of an agriculture commodity to, among other things, mitigate and eventually transfer market risks. Price volatility was fund as an important risk which is not easy to mitigate both for large and medium size producers of soy and of other commercial crops (maize, wheat, and rice), as well as for family farmers, for which price volatility (international prices and exchange rate) can determine their survival (cotton, for example). This action requires strong institutions in order to have more transparent markets and price hedging mechanisms, and can be addressed by the development of an agriculture commodity exchange in Paraguay.

The proposed measures are not of easy implementation and require a concerted effort between public and private sectors. It is worth highlighting, however, that the annual cost for this strategy is significantly lower ($223 million over five years) when compared to the actual annual losses of non-mitigated risks—an average of $237 million (see table 3.1). Although it is not to be expected that the entire $237 million of annual expected losses will disappear with the proposed investment, it is estimated that the economic return of the investment in better agriculture risk management be significant (additional studies for the cost-benefit analysis would be needed for each of the proposed interventions). In the last chapter, a relatively detailed action plan is presented, indicating responsible entities, required timeframes, necessary resources, and a basic cost estimate.

SOLUTIONS FOR ANIMAL HEALTH AND FOOD SAFETY OF LIVESTOCK SUPPLY CHAINS

Paraguay has consolidated its position as an important meat (and meat processor) exporter,[32] but it is important to ensure its sustainability. The responsible agency for animal health that has allowed for this performance is the National Animal Health and Quality Service (SENACSA). SENACSA was created in 2004 as an autonomous and autarkic entity under the supervision of MAG. According to the OIE evaluations, SENACSA has an acceptable performance level (OIE/PVS average performance of 65.5 percent in 2009). However, a series of gaps were identified which are necessary to address in order to ensure the sustainability of the achievements and so that past losses due to sanitary risks are not repeated.

I EXOTIC DISEASES: FMD, MAD COW AND AVIAN FLU

In 2005, Paraguay reached the status of free of FMD with vaccination, which was interrupted by an FMD outbreak in 2011 and 2012. These outbreaks were controlled with the collaboration of the Panamerican Center for FMD (PANAFTOSA) and CVP, and the country recuperated the free of FMD status in November 2013. However, the OIE gap analysis report established that given the inability to determine the exact focus of the FMD outbreak, it could be possible that there could be some endemic areas in the country where the virus persists. The OIE certificate for free of FMD with vaccination requires having a permanent surveillance, prevention, and contention program that ensures the absence of viral activity, which in turn guarantees the same status for the countries who buy Paraguayan meat and their products.

Paraguay is certified by the OIE with "Insignificant Risk" for mad cow disease (EEB),[33] but there is still a transmission risk. It has the certificate based on the documentation presented which includes a risk analysis and due to the fact that they have an active surveillance system with sampling and a contention and response program. Even though they risk is insignificant, the epidemiological characteristics of the disease showing long incubation periods, the possibility of transmission through feeding and the human health risks, makes it a risk that must be addressed. In order to mitigate this risk, Paraguay must have a good detection and early warning system and prevention and response measures in order to battle eventual cases.

To date there has been no outbreak of exotic avian flu from the Asiatic strand H5N1 in the

[32] Paraguay went from exporting 27,000 tons of meat in 1994 to 211,000 tons in 2010. In monetary terms this represented an increase from $55 million in exports per year to $920 million.

[33] EEB has impacted mainly the UK and other European countries, Japan, Greece, and Israel. In LAC cases reported to the OIE have been in Canada (2002–11), United States (2005, 2006, and 2012), and Brazil (2010).

Americas,[34] but a prevention and contention system is needed for epidemiological surveillance and elimination of possible outbreaks. The risk of occurrence of outbreaks from other highly pathogenic strands exists, causing potential similar impacts than H5N1. In order to counteract this risk, the majority of countries including Paraguay, and in collaboration with the OMS/Panamerican Health Organization (OPS), OIE and Food and Agriculture Organization (FAO), have elaborated and implemented a good detection and early warning system and prevention and response measures to counteract the eventual presence of outbreaks. The major emphasis is epidemiological surveillance and undertaking simulations to test contingency plans.

The PVS/OIE gap analysis of SENACSA identifies the main gaps from mitigating the risks of outbreaks of these diseases which can be summarized as follows: an incomplete traceability system, the need to strengthen quarantine activities, the improvement in the sending of information to the World Zoonotic Database OIE/(WAHID), and the consolidation and assurance of the sustainability of the animal health services in the medium to long term. The impacts of these gaps can be potentially very dire. For example, SENACSA has estimated the FMD outbreak of 2011–12 at a direct cost of $300 million, on top of export market losses. The economic consequences of an EEB outbreak (if it happens) can be devastating for the sector and country's economy. For example, the outbreak in the United States in December 2003 had an estimated cost of $3,200 to $4,700 million due to export losses in 2004, representing a reduction of 82 percent with respect to the previous year (2003) (Coffey et al., 2005).

II PREVALENT DISEASES OF ECONOMIC AND HUMAN HEALTH IMPORTANCE: BOVINE BRUCELLOSIS, BOVINE TUBERCULOSIS, CLASSIC SWINE DISEASE (PPC), BOVINE RABIES, NEWCASTLE DISEASES (ENC), EQUINE INFECTIOUS ANEMIA

Bovine brucellosis, bovine tuberculosis, classic swine disease (PPC), bovine rabies, Newcastle diseases (ENC), equine infectious anemia are present at varied prevalence rates. In the case of brucellosis and tuberculosis the rates are estimated at 4 percent and 7 percent respectively. They produce significant losses by abortion, fertility reduction, milk contamination, and the discarding of carcasses in the case of tuberculosis. But most importantly is the issue with public health, given that humans can be contaminated by these diseases.

The absence of a specific updated program to control and eradicate these diseases is the main gap. The major impact of these risks is for farmers and the population at large. If they are not controlled and eradicated, these diseases can bring market restrictions in the future for meat exports and dairy products. As for PPC, given its sporadic appearance, the requirements could be met in the short term in order to obtain the free of PPC certificate from OIE. The same applies for ENC that given the low rates of appearance can lead to achieving the free of ENC status in the short term.

III LACK OF FOOD SAFETY FOR MEAT PRODUCTS DUE TO DEFICIENCIES IN THE NATIONAL AND LOCAL SLAUGHTER HOUSE INSPECTION SYSTEM

The risk related to food safety for meat products is a public health problem that can impact the Paraguayan population at large. Currently, the possible presence of bacteria such as Escherichia coli 0157:H7, Salmonella sp. and Campilobacter sp. can be present in meat due to gaps in inspection and control, and can lead to severe outbreaks of the disease transmitted through food.

The main gaps can be summarized as follows: There is no national food safety policy nor mechanisms for inter-institutional coordination; inspection and control by SENACSA over national and local slaughterhouses is incipient; and the surveillance done by the National Institute of Food and Nutrition (INAN) and the Epidemiological Directorate of MSPBS in the processing, distribution, and consumption stages is limited. This situation leads to food products without quality assurance for national consumers and risks for public health through transmission of zoonotic diseases and transmitted through food.

[34] Other strands of avian flu had outbreaks in Mexico and other LAC countries.

IV SANITARY AND PRODUCTION RISKS DUE TO LACK OF INTEGRATED SUPPORT TO LIVESTOCK PRODUCERS FROM FAMILY FARMS

Small livestock producers only provide 16 percent of total production, but they account for 83 percent of the total number of producers in the country, and they are a very vulnerable sector to sanitary risks. Given their low technological level and low levels of capital, small livestock producers are highly exposed to drought, floods, and frosts, as well as sanitary risks. The FMD program reaches these producers with sanitary prevention actions, but not with the necessary technical assistance to reduce production risks. If these needs are not addressed, the sanitary programs for eradication of FMD and other diseases could fail. The main problem is the lack of integrated attention by the public services providing technical assistance and livestock extension.

V SANITARY RISK MITIGATION STRATEGY FOR THE LIVESTOCK SECTOR

The objective of this strategy is to improve agriculture sector risk management, including sanitary risks for livestock.[35] This improvement requires the consolidation and sustainability of animal and food safety services, which will also contribute to increase national production of quality livestock products for national consumption and exports, improve public health, and protect the environment.

Specifically it is proposed to:

- Maintain the free of FMD with vaccination status
- Move forward in the eradication of prevalent diseases of economic and human health importance like bovine brucellosis and tuberculosis
- Reach the free of PPC and free of Newcastle status
- Extend the control and inspection of slaughterhouses for national consumption
- Be part of an integrated system that can offer efficient technical assistance to family farmers
- Consolidate the management and administration of animal health and food safety services

[35] In order to address the gaps and to achieve sanitary risk absorption, it will be necessary to comply with the recommendations of the PVS gap analysis of SENACSA undertaken by OIE in 2013. Also, the orientations of the Institutional Strategic Plan of SENACSA 2013–18 must be taken into account.

For complying with these objectives of improving livestock sanitary risk management, the following strategic lines of action are proposed and which are detailed in the action plan:

1. Consolidate the compliance and sustainability of sanitary requirement for the export of livestock products according to national and international norms, which not only will contribute to reduce disease risk, but will ensure that Paraguayan meat be seen as of high sanitary quality worldwide, will improve competitiveness of meat products and subproducts, and will maintain and consolidate the free of FMD status with vaccination, and of insignificant risk of EEB.
2. Achieve an integrated approach to animal health services in order to cover all diseases of economic and public health importance. For this it would be important to expand coverage of sanitary programs to other diseases such as bovine brucellosis and tuberculosis, PPC, and Newcastle, and the strengthening of basic surveillance, quarantine, and laboratory services.
3. Expand meat inspection services in order to cover the slaughterhouses for domestic consumption. According to the gap analysis, the processing plants under inspection are limited to a few (11 slaughterhouses for export, 51 slaughterhouses for national consumption), but there are 350 local slaughterhouses that are not inspected. In order to reduce human health risks in Paraguay, it is necessary to extend the control and inspection of slaughterhouses for national consumption; strengthen the ex ante and ex post inspection of feed plants for export markets; extend the waste program to be applied in all products of animal sources, both for exports and local consumption; have total and effective control over medicines and biological products of veterinary use; promote the functioning of an integral food safety program throughout the food supply chain; and improve the coordination between the Public Health Ministry and Human Welfare and other institutions related to the livestock supply chain.
4. Improve the quality of laboratories, increase their functional capacity and strengthen and increase the laboratory network. SENACSA's Laboratory

Directorate is composed of the Disease Program Directorate and the Veterinary Diagnostic and Food Control Directorate. It has qualified human resources, updated facilities, and modern equipment. The laboratory complex has a laboratory with a biosafety level NSB3A. The laboratories need to complete the ISO certification and have the capacity to attend a larger number of samples from disease control programs other than FMD and from national slaughterhouses.

5. Consolidate the management and sustainability of animal health services and food safety in the framework of the program for ensuring the guidelines and quality standards of the reference organizations, OIE and Codex Alimentarius. This implies actions such as the adaptation of the legal framework, improving SENACSA's performance according to the PVS/OIE evaluation, and the availability of sufficient resources.
6. Optimize the provision of technical assistance for sanitary and livestock production for small and medium size farmers. Given that livestock for small and medium size farmers is often complementary to agriculture, at times for autoconsumption, it is necessary that the technical assistance and extension services incorporate technological packages that address risks in an integrated fashion, including livestock. It is important to strengthen the communication and education regarding sanitary measures to ensure the active participation of farmers in the sanitary programs.

These actions presume the institutional strengthening of SENACSA in aspects related to its legislations, to its program, human resources, financial resources, communications, and sanitary education and management capacity. Also, it is necessary to establish a national food safety policy that defines the responsibility of all actors in the livestock supply chains, establishing coordination mechanisms. Finally, the partnership with livestock producers must be maintained, in particular the Rural Association of Paraguay, and expanded to other producers like the swine and poultry associations.

The cost analysis of the FMD outbreaks shows the financial benefits of undertaking a sanitary risk management strategy for the livestock sector. The management measures proposed for sanitary risks and food safety for the livestock supply chains have an estimated cost of $198.1 million between 2014 and 2018, or an annual average of $66 million. According to estimates from SENACSA, the FMD outbreak of 2011–12 had a direct cost of $300 million, with additional costs associated with the loss of markets, loss of animals, eradication costs, and cost for recovering the free of FMD with vaccination status. Another example is the FMD outbreaks in Uruguay and Argentina in 2011, which had an estimated cost of $178 million and $440 million due to commercial losses respectively. In the event of an outbreak, costs can be larger for just one year compared to the five years of risk management costs.

STRENGTHENING OF THE AGRICULTURE INNOVATION SYSTEM (SIA) FOR MITIGATING FAMILY FARMING RISKS

I FAMILY FARMING RISKS

Family farming presents a high and increasing exposure to production risks. Family farms are more than 90 percent of total censused farms in 2008 (241,000 in total) although they have only 6 percent of the land. Traditionally, the main crops produced by family farms are white maize, beans, habilla, and cassava, as autoconsumption products, and cotton, sesame, sugar cane, soy, and cassava (sold fresh or to the starch industry) as cash crops. Also, banana and pineapple are the main permanent crops. Regarding livestock, large animals dominate as reserve value and from the productive standpoint, milk production. Only recently have vegetables been gaining in importance as cash crops for many family farms.

Contrary to soy and other crops of commercial farms, the area planted by family farms has remained constant or decreased in some products during the last decade. Yields, on the other hand, have not had a good performance. The analysis of the evolution of cassava yields, the main autoconsumption crop along with beans, shows a decreasing trend from the 1991–2012 period. Cotton and sesame, both cash crops for family farms, show varied yields in the short term at the national level and a clear, decreasing trend in the long run. In summary, family farming is stagnant or shrinking, both in area as in yields, with a very significant lack of public agriculture services (mainly technological innovation) impacting small scale agriculture. This situation is critical for the design of institutional strategies for agriculture risk mitigation that can reduce non-mitigated risks and losses by farmers and supply chains.

The most important risks of family farms identified during the diagnosis are production risks, in particular weather variation. Most of the main family farming crops, like sesame, cotton, maize, sugar cane, and vegetables, suffer from severe droughts. Cassava is relatively tolerant to lack of water and is only affected with very severe droughts.

II THERE ARE TECHNOLOGICAL OPTIONS THAT CAN MITIGATE WEATHER AND BIOTIC RISKS

There are a set of techniques and technological practices that reduce the vulnerability to weather variation. The following stand out, as their implementation would allow farmers to mitigate risks associated with weather variability:

- » Diversify crops
- » Increase soil capacity to store water, requiring improving and conserving soils, vegetative cover, and adequate soil management
- » Use cultivars and/or drought resistant varieties
- » Use greenhouses and half-shade vegetable crops
- » Introduce irrigation where feasible and with appropriate techniques
- » Improve efficiency of water management

The following options were identified to mitigate pest and disease risk: pest monitoring and early warning for a timely control.

It is important to have a research agenda that includes adaptive technologies to local context. Although almost all techniques and technological practices mentioned can be adopted without major difficulties by family farmers (taking into account that some of them require investments), it is also true that the statement is very general and that in many cases a higher level of detail will be needed in terms of the techniques and the agriculture research background to adapt them to the local conditions of family farms. IPTA should develop a specific research agenda for the generation of technological innovations adapted to family farming, in particular to mitigate risks and achieve greater resilience.

III ADVANCES AND DEFICIENCIES IN THE SIA

The GOP has various ongoing programs and projects that have activities related to the management of some of the risks identified in the diagnostic. Aside from the UGR mentioned above in this report, other institutional responses are presented, that although not as specific as the UGR in tackling risks, do address production risks of family farmers.

Linked to MAG, there are a series of programs and projects that in many ways support family farming and its development. However, program and projects without a single hierarchical structure have resulted in a dispersion of investments and initiatives. Programs and projects with external funding depend on the National Project Coordination and Administration Directorate (DINCAP), with the exception of the 2KR program financed by Japan which depends directly on the General Administration and Finance Directorate. The programs and projects financed by the public budget depend on the Viceministry of Agriculture. The most important ones are PPA, PRODERS, Paraguay Inclusivo, PRONAFOPE, and the National Soil Management, Conservation and Recovery Program (PNMCRS). The majority of these programs and projects transfer resources to beneficiaries, calling them "donation resources," others "non-reimbursable investments," and others "supports."

Assuming that these programs and projects do not overlap in terms of beneficiaries, they would be supporting 220,000 farmers, or 90 percent of farmers below 20 hectares. If one adds the farmers supported by DEAg (minimum 20,000), one would be reaching the totality of family farms. This would represent a great achievement in terms of technical assistance provided to family farms: In the last census (CAN 2008) only 12.4 percent of farms with less than 20 hectares were receiving technical assistance.

The problem, however, is that the quality of the technical assistance being offered by these projects and programs, and the existing coordination among their actions. The quality of technical assistance refers to its content of the technological packages being disseminated as well as its methods and methodologies used to provide technical assistance. The coordination refers not only to what is needed from the set of institutions that provide the technical assistance (DEAg and project executing units), but also to what should exist with other institutions that make up the SIA in Paraguay, basically IPTA and SENAVE. There seems to be large deficiencies in both fronts, quality of technical assistance and coordination of actions, given that no change is perceived at the productive level in family farming: As was shown before, its production volumes and yields show no increase in the past years, but to the contrary.

An innovation system oriented toward family farming is in need of development. In order to achieve a better management of agriculture risks in family farming, what is needed is a strategy that would focus on improving efficiency and coordination of the SIA, providing a hierarchy to manage risks associated with weather faced by family farmers, strengthening their capacity to adapt to weather variations; but taking also into account pests and disease risk for some crops.

IV THE SIA AS A PRODUCTION RISK MANAGEMENT STRATEGY FOR FAMILY FARMING

The main components of the SIA are the institutions responsible for generating knowledge, the institutions responsible for transferring this knowledge to final users, and the institutions that determine the policy framework for the appropriate functioning of the system. Technical assistance received by family farmers depends almost exclusively from the public sector. Therefore, it is the public extension and agriculture technology transfer system that must fulfill, to a great extent, this function of transferring the available technological knowledge to family farmers, transmitting their demands back to research institutions. Therefore, the institutions involved in the SIA are IPTA, SENAVE, SENACSA, the public agriculture extension and agriculture technology transfer system, and the Viceministries of MAG, DINCAP, and DGP.

This set of institutions and their relationships do not make up a real system at present, not even the most basic definition of system. In order for them to become a real system, there is a need to improve the efficiency and institutional coordination so that they can make the techniques and practices available to family farmers, as well as the pests and diseases control measures that would allow them to better manage production risks. The Integrated System for Agriculture and Rural Development (SIGEST)[36] of MAG should be the forum for the development of the SIA. It must be said, however, that SIGEST has not been able to move forward very much in the establishment of formal coordination mechanisms within the agriculture sector and therefore its actions should be strongly supported by MAG.

V STRENGTHENING OF THE COORDINATION AMONG THE SIA INSTITUTIONS FOR AGRICULTURE RISK MANAGEMENT OF FAMILY FARMING

The weak coordination mechanisms between the institutions that would make up the SIA would require short and medium term measures for its strengthening. In several cases, it was evident that the achievement of joint activities would involve informal coordination rather than formal coordination mechanisms. Therefore, it is absolutely necessary to establish and/or strengthen the inster-institutional coordination mechanisms.

A first measure could be the establishment of a working group with representatives of the different institutions. Resolution No. 356 of MAG of 14 October 2008 ruled the operation of SIGEST, allowing the creation of working groups, "which would be integrated by the entities that are formally involved" (MAG 2008a). It is therefore proposed that a working group be established as a short term measure, composed of IPTA, SENAVE, SENACSA, Viceministries of MAG, and

[36] SIGEST was created in 2008 as an inter-institutional entity for supervising, coordinating, and evaluating the sectoral operations, a "management mechanism that integrates, is participatory and rationalizes the institutional effort of the government over a territorial approach, efficient organization and sustainability" (MAG 2008(a)).

DINCAP, which would have as an objective the coordination of these institutions in order to undertake actions of generation and dissemination of technological knowledge that would allow family farmers to improve risk management. The Viceministry of Agriculture, a component of SIGEST, could represent DEAg, PNMCR, and PPA at the working group, or would delegate on them the participation. Also, it is important to ensure the participation of projects and programs with external funding, which would be represented by DINCAP. This working group would need to approve the action plan below as a first step and detail the chronogram of activities. The compliance would be monitored by the Technical Group of SIGEST.

With regards to the technical assistance services, the coordination between DEAg and PPA is also to be done in the proposed working group. It is important to coordinate projects and programs with external funding as they also target risk management for family farms, like PRODERS. This would also be a function of the working group.

At the territorial level, the SIGEST started in 2012 with an experience creating the Interinstitutional Departmental Coordinating Table for Agriculture and Rural Development (MECIDDAR). The experience has been successful, but up to now only four departments have implemented these Tables. The proposal is to implement these tables in the rest of the departments, at least in the Eastern Region, and to strengthen them.

Furthermore, the experience by SIGEST has shown that the absence of a hierarchy between MAG and the autonomous agencies (for example IPTA) limits the possibilities of consolidating priorities in a more efficient way for the development of technical assistance programs. In order to improve the institutional performance of the agriculture public sector, MAG needs to play a leadership role based on legal and regulatory attributions, and place itself in a strategic position to lead the agriculture and rural development strategy. In order to do this, a law is required: The autonomous agencies are a set of institutions which different laws of origin, and therefore it is important to pass a law that puts them in direct relationship with MAG.

VI IMPROVE THE EFFICIENCY OF SIA FOR AGRICULTURE RISK MANAGEMENT OF FAMILY FARMING

Beyond improving the inter-institutional coordination, an increase in efficiency is required for providing public technical services in research, extension, and technical assistance, and the plant health control.

IPTA. Agriculture research has not received a budgetary allocation according to the importance of the agriculture sector of Paraguay. The general picture is very scarce in terms of technology generation, and even more in family farming. IPTA should develop a specific research agenda for the generation of technology innovations adapted to family farming and that contributes to production risk management.

Improving IPTA's efficiency to support risk management in family farming requires the strengthening of the institution, in particular reaching the research-extension complex. The proposed strategy for improving the efficiency of IPTA involves several actions that should be faced jointly:

- Determine a research agenda for generating technologies adapted to family farming, contributing to the management of production risks
- Strengthen human resource by training existing researchers and hiring new young researchers and train them at the highest level
- Supply the Research Center in Cacupe and the Experimental Field of Chore with infrastructure and equipment so that they can generate technological information for family farming crops (intensive crops in the former and extensive crops in the latter)
- Improve information and communication technology services and establish a system for capturing technology demands to improve internal and external connectivity

The public agriculture technology extension and transfer system is composed of DEAg, PPA, and PNMCRS. Starting in the 1990s, a process of decay of DEAg begun, which was due to several reasons: lack of resources for field operations, drain of technicians to the private sector and universities, constant reduction in training actions, and update of technical staff. On the other hand, there is no evaluation of the efficiency of actions by PPA. The approaches for the technical assistance supplied do not seem to be very different from the ones used by DEAg.

Recently, several documents were prepared with recommendation for the strengthening of the public extension services and technical assistance, comprising of the following activities in relation to DEAg and PPA:

- » Establish a program with periodic events for the training and update of extension agents
- » Undertake training in areas of higher management for the heads of CDAs and ALATs in order to achieve better service management
- » Establish a public career path for extension agents
- » Improve the budget allocation in order to guarantee mobility in the field by extension agents
- » Use new models of training of technicians and farmers, promoting the training of trainers, waterfall training, and the methodology of farmer to farmer technology transfer
- » Adapt the methods and means for rural extension to the particular situation of users, upscaling the use of new technologies like information and communication technologies (ICTs) as a way of reducing costs
- » Experiment with different extension methods and methodologies in order to better address the farmers' demands and adapt to changing situations

The PNMCRS is a transversal program that should play a fundamental role in the training of technical staff from different programs and projects in soil management and conservation. It has, therefore, strategic relevance for agriculture risk management in family farming. The role that PNMCRS has had in the dissemination of conservation practices and training has been very important and recognized, and has been limited by the lack of human and material resources. Its strengthening is necessary and fundamental within the risk management strategy.

The strategy to improve the efficiency of PNMCRS includes:

- » Incorporate low-scale equipment and machinery for family farming that can be made available to municipalities
- » Supply the program with computer equipment for the mapping of soils, GPS, samplers, topographic equipment, and so forth
- » Supply inputs for demonstrative plots
- » Develop a training and update program for PNMCRS staff and DEAg and PPA extension agents

SENAVE is the institution in charge of protecting, maintaining, and improving the phytosanitary condition and quality of food products of vegetable origin, and the dissemination of best agriculture practices. It is also in charge of controlling the use of agriculture inputs subject to regulations. The strategy for strengthening SENAVE for the management of risks for family farming is based on the strengthening of its pest and disease prevention, control, and eradication services, and the compliance with phytosanitary and quality norms of fruits and vegetables entering the country, as well as the shipments for export. It involves the following activities:

- » Structure and implement a training program for the levels of directors, managers, and technical staff
- » Strengthen the laboratory services for prevention, control, and protection of plant health and quality
- » Establish an joint action program with institutions linked to SENAVE to improve its institutional mandate, focusing on family farming

The cost of developing a strategy to mitigate family farming risks is very low considering the potential benefits. It has been estimated that the cost of the proposed measures for the strengthening of the SIA is $23.4 million in total, or an annual average of $4.7 million between 2014 and 2018.

PRICE RISK AND THE DEVELOPMENT OF AN AGRICULTURE COMMODITY EXCHANGE

I THE PRICE VOLATILITY PROBLEM OF AGRICULTURE COMMODITIES

The price variations are a normal characteristic of agriculture markets; however, when these are significant and unpredictable, they can negatively impact food security, the economy of rural

producers, and even the overall economy of a country. Since 2007, international prices of agriculture commodities have been experiencing drastic variations, impacting mainly basic staples with a high correlation with international markets. The factors that have caused these variations since 2007–08 are structural (changes in demand and supply) as well as temporary. One of the main causes of this increase in price volatility of agriculture products in international markets has been the increase in production in zones more vulnerable to weather variations (in particular the Black Sea Region).

Nevertheless, the concern for mitigating the increase in volatility of agriculture prices is not new. The creation of the CBOT in 1848 and the launch of the term contracts in 1851 was the consequence of the same logic, trying to implement tools to mitigate price risk. Since then, numerous agriculture commodity exchanges were created in South America and the rest of the world. Derivatives became an efficient instrument to hedge against price volatility, and the exchange being the place to trade them.

Price volatility both for commercial and family farming was identified as one of the most important risks. All of the market risks are summarized in table 3.1.

In general, price hedging in institutional markets does not exist at the level of producers. For the management of these risks, currently, forward contract are only done for soy where farmers can fix their price at any moment. Prices are set taking the CBOT reference price, from which a discount is deducted (differential) which is informed daily by the multinational firms operating the market. For wheat and maize, the contracts are spot. Furthermore, family farmers make the sale spot in situ. On the other hand, the multinational firms and the intermediaries do use these market to hedge their exposure to price volatility. Therefore, in Paraguay there is no installed capacity for managing market risks in that there is a lack of information on international and local prices and volumes on supply and demand.

In terms of the legal base, in order to move forward in establishing formal and universal

TABLE 3.1. SUMMARY OF MAIN RISKS

Product	Summary of Commercial Farming Risks
Soy, maize, and wheat	Export price volatility is a relevant risk for the soy cluster as well as variations in exchange rates.
Soy	Seasonal and interannual variability of differentials (discounts in relation to Chicago) are a risk for soy.
Maize	The variability of the price in Brazil is transmitted directly to Paraguayan farmers.
Product	**Summary of Risks to Family Farming**
Sesame	Sesame is an export product subject to international price variation. There has been strong variation in producer prices during the period 2003–04 to 2008–09, and then annual prices became relatively stable. The drop in prices is translated to producers.
Cassava (autoconsumption—70 percent; sold as fresh—20 percent; and for industry—10 percent)	The price reference in the medium term is the international market. but the short term variations are impacted by local supply and demand of fresh cassava. It is a risk for the industry that needs to supply itself locally when the price of fresh cassava is high. The reduction in the availability in the local market due to sales to Brazil, taking advantage of price differentials, impacts the industry and increases the price for consumers.
Soy	Given the high level of prices, variability is not a big problem for large scale producers, but can have a significant impact on family farms and cooperatives. The variation in the exchange rate can also amplify these risks—the appreciation of the exchange rate between the purchasing of inputs and the sale of the product.
Cotton	Price volatility: The industry transfers price variations to producers. Variations in the exchange rate impact mainly producers.

mechanisms for hedging agriculture price volatility, Law 1.163 establishes the regulation over commodity exchanges. However, for now, there is no action take for the development of an agriculture commodity exchange. The formal name of the stock exchange, "Stock and Commodity Exchange of Asunción SA." Although the word "commodity" appears in the name of the exchange, there has never been an operation on commodities nor the current bylaws of the exchange allow for it. The Stock Exchange's strategy is only to assess the possibility of agriculture derivatives after the successful launch of the exchange rate derivative which is currently being under analysis. The launching of an exchange rate derivative would benefit the agriculture sector as exchange rate risk was observed as a risk for certain agriculture commodities.

II JUSTIFICATION FOR A PRICE RISK MANAGEMENT STRATEGY

The price risk management strategy to be adopted would involve the supply of tools to farmers to transfer risks for those who are not able or willing to absorb them. This is complementary to the proposals put forward in previous section regarding the mitigation of production risks. Therefore, the strategy would be composed of the following pillars:

- » Provide market transparency to reduce transaction costs and the impact of risks (both production and market risks) in particular for those with less market power, family farmers
- » Establish the necessary instruments to transfer price risk volatility to market operators willing to take on the risk
- » Ensure the existence of installed capacity in order to generate and use market information in order to operate price risk transfer instruments

The strategy proposes the development of an agriculture commodity exchange (see box 3.1). The commodity exchanges (cash markets) are institutions where contracts are negotiated for the physical trade of goods. In other words, what is traded is the right to access a certain product on a predetermined date (immediate or future). These types of contracts are not standardized. This is why any agriculture commodity could be traded at the exchange.

BOX 3.1. FUNCTIONS OF A CASH EXCHANGE VS. A DERIVATIVES EXCHANGE (BOTH CONSIDERED COMMODITY EXCHANGES)

A cash exchange: The main functions are to bring physical spaces for the negotiating and trading of commodities; supply a transparent and legal framework for the parties to operate; provide price, fees, quality, and quantity information services; have the authority to resolve differences between parties; organize and dispose of the functioning of laboratory services to certify quality of the samples of the merchandise being traded; intervene in representation of its members.

Derivatives exchange: It is better known as Futures and Options Market, and is a private entity whose objective is to organize, register, guarantee, and liquidate the negotiation of futures and options contracts. A futures and options exchange arises to improve the trading practices of its members throughout the supply chain. These exchanges make it possible to negotiate contracts with different type of objectives: risk coverage, arbitrage, speculation. The fundamental purpose of the derivatives exchange is to guarantee all parties the fulfillment of the obligation, therefore eliminating the counterparty risk.

The functions and economic benefits of the derivatives exchange for the agriculture and financial sector (as well as for the parties operating them) are: risk hedging (operators that own or will own an asset which has a great deal of volatility); risk profitability (searched by those who want to obtain a financial difference); risk transfer from those operators who want to cover themselves; price formation; power balance between actors; dissemination of market information, promoting competition.

Although the cash exchange does not take on counterparty risk, the derivatives exchange does. Therefore, the latter must incorporate within its institutional structure an office or unit that is in charge of the clearing and administration of guarantees with the goal of ensuring that all registered contracts can be paid in full. This can be done by an internal unit within the exchange or through an independent institution known as a clearinghouse.

It is common to see an erroneous concept of agriculture commodity exchanges. Generally, there is a misunderstanding that agriculture commodity exchanges are only for large farmers, excluding the small producers who do not have access to them due to the small volumes. An agriculture commodity exchange serves the commercial interests as significant volumes could be traded at once, but it can also be a place were small producers from family farming reduce their risks as it is shown by the cooperatives in Brazil and Argentina participating in them. The access mechanisms for small farmers are through their producer associations in order to reach scale and training to be able to follow the norms and requirements. These cooperatives can then negotiate and trade at the exchange on behalf of their members. This is how the exchange facilitates the sale or hedge to farmers. This is why alongside with the establishment of the exchange it is important to put in place a capacity building program to transfer knowledge to these farmer associations and cooperatives so that they can trade at the exchange in representation of its members.

III STRATEGIC PROPOSAL FOR THE ESTABLISHMENT OF AN AGRICULTURE COMMODITY EXCHANGE (CASH AND DERIVATE EXCHANGE)

The process for the development and implementation of an agriculture commodity exchange should start with a feasibility analysis about which commodities and instruments could be introduced for the launching of operations, including planning of necessary actions for the start-up. The launch of an exchange with series of products and successful instruments is very important to generate the trust in the market and thus attract further commodities and actors. This then allows the development of more instruments (cash or financial). Here below are a series of actions that could be undertaken:

1. Develop an integrated proposal for the establishment of an agriculture commodity exchange (cash and derivative). The proposal can contemplate at minimum the following work: examine the current legal framework to identify the existence of regulation; analyze which products and type of contracts could be negotiated; design the model for the commodity exchange that is most appropriate for Paraguay; determine the level of investment required to launch it; and estimate the financial viability of the exchange
2. Establish a working group composed of the public and private sectors. This would have as an objective the design and implementation of a business plan as well as the design of the bylaws and internal regulations. The working groups should be composed of members that can support the work needed for its establishment.
3. Design a business plan. The business plan should contain at a minimum: a work program with precise objectives; a strategic plan to define the commercial aspects linked to the project; and an organogram with functions.
4. Establish the projected cash flow.
5. Develop the bylaws and operating regulations. The working group should write the bylaws and operating regulations for the functioning of the exchange, and the organization and operation of each contract. The bylaws should regulate the different bodies and authorities; the requirements and activities, restrictions and responsibilities of traders; and audit and control systems, among others.
6. Finally, the launch. It is recommended that detailed activities be established in order for the exchange to active from day one. An international seminar could be used to share experiences with the functioning and launch of new contracts and exchanges and for allowing local stakeholders to clarify doubts before the launch.

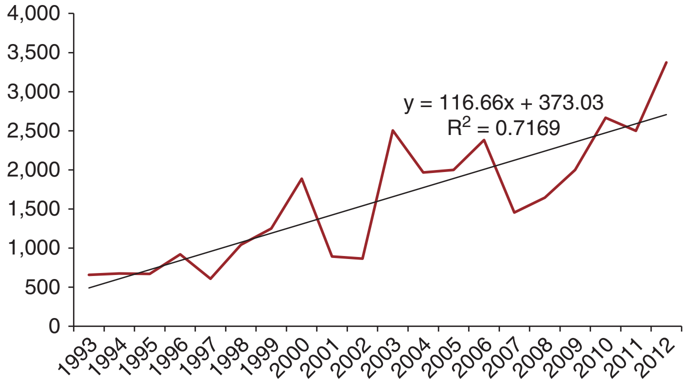
The cost for the establishment of an agriculture commodity exchange can be considered low given the high volatility of agriculture prices in Paraguay.[37] Graphs 3.1 and 3.2 show the price behavior of white and red maize in the Asunción Market. The coefficients of variation in both series is relatively high, 51 percent and 63 percent respectively, indicating a high level of volatility, resulting in losses to producers of both commercial and family farming. The estimated cost of the above proposed measures is $128,000.

FINANCING STRATEGY FOR AGRICULTURE RISKS

Volatility of Agriculture GDP in Paraguay is related to the overall economic volatility (see graph 3.3). The determinant factors of this volatility in

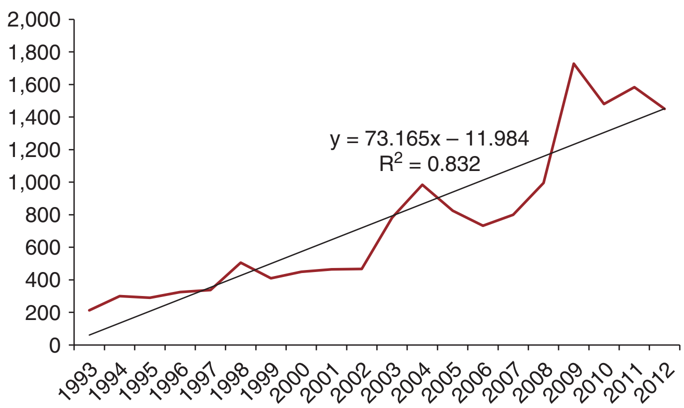
[37] See volume 1.

GRAPH 3.1. PRICE OF WHITE MAIZE IN JUNE, ASUNCIÓN



Source: DAMA and MAG.

GRAPH 3.2. PRICE OF RED MAIZE IN JUNE, ASUNCIÓN

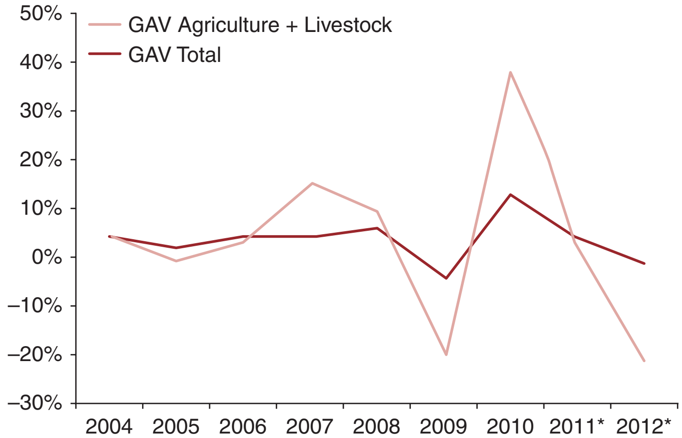


Source: DAMA and MAG.

the agriculture sector are the risks related to weather variables (mainly drought) and the animal health risks (FMD).

The tax base related to agriculture production and trade is small in Paraguay, but the government incurs significant expenditures in order to respond to sector emergencies. According to data from 1999 to 2012, the GOP has spent at least $200 million on emergency assistance programs supporting family farmers (debt forgiveness, freezing of interest rates, and refinancing of loans, distribution of production kits, Agronomic Certificates, and so on). This is why the GOP has the opportunity to improve the efficiency of public expenditures and reduce the agriculture sector volatility through a better financial structure for public expenditures to respond to sector risks, in particular catastrophic events that have a negative impact in the most vulnerable population.

GRAPH 3.3. ANNUAL VARIATION IN THE GROSS AGRICULTURE VALUE



Source: DAMA and MAG.

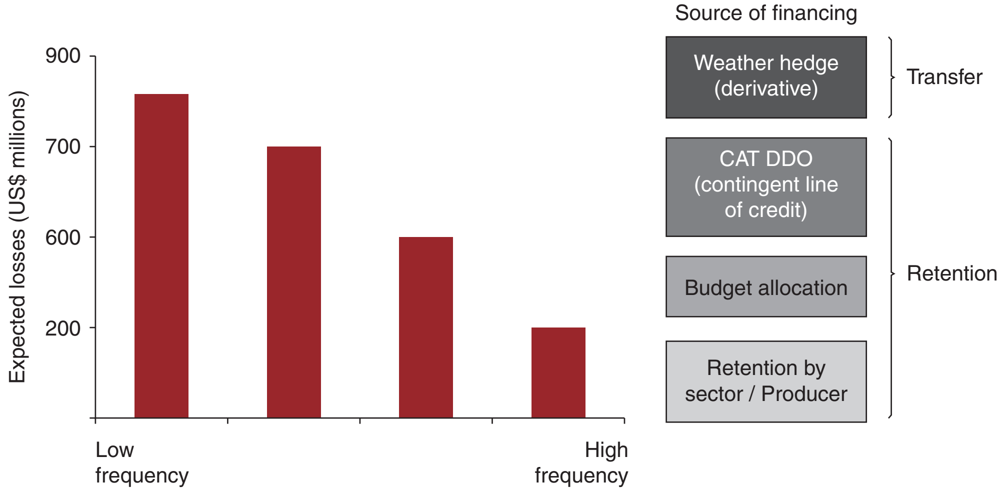
I A RISK FINANCING STRATEGY FOR FAMILY FARMING BASED ON RISK LAYERING

There are no formal and integrated mechanisms for financing public sector assistance to family farmers facing extreme weather events such as severe droughts. On the contrary, faced with these events and pressured by demands from impacted households, MAG has tended to put in place reactive measures that have not been planned to provide support to those affected farmers. These compensatory actions tend to be very costly for public finances as the resources are often taken from other programs in implementation, reducing the impact of the programs that are cut. Furthermore, the measure does not identify the eligible population in an ex ante fashion, so the assistance arrives late, in an insufficient quantity, and subject to political pressures.

The best way to finance agriculture risks is through a financing structure based on simultaneous instruments, designed to cover more efficiently the various risk layers according to their frequency and severity. This risk financing methodology allows them to establish integrated coverage and maximize the financial efficiency, as well as providing transparency to the public administration and achieving a higher degree of effectiveness in terms of ex-post emergency assistance.

For example, the establishment of an emergency contingency fund can be combined with the

GRAPH 3.4. DROUGHT RISK FINANCING IN PARAGUAY



Source: Authors' estimates.

implementation of a weather coverage and other tools. For example: Frequent events (frequency less than 1 in 5 years) should not be financed by such fund (risk absorption layer). For the next layer (events between 1 in 5 to 1 in 10 years) losses could be supported by the Fund and/or contingency credit. Finally, for severe events (more than 1 in 25 years), risk transfer instruments could be used. For this last layer, severe droughts could be covered, taking into account that drought has also an important impact in family farms, the agriculture sector, and the economy as a whole.

The lower risk layers could be (as they are at present) financed by resources from farmers and budget allocation that the GOP could do based on annual budgets. For the middle risk layers, the GOP could absorb the cost and risk, but ideally through contingency lines of credits (such as the Catastrophe Deferred Drawdown Option [CAT DDO]). Contingent credit lines allow a quick financial response after the event occurs, without having to wait for the approval of extraordinary budget resources. Finally, for the most catastrophic events, risks can be transferred to international markets through derivatives or insurance. (See graph 3.4.) All the financing instruments (weather derivatives, CAT DDOs, and budget support) are available from the World Bank.

For systemic events such as drought, one could think about the need to distribute payments in a quick fashion to compensate farmers and enable them to get back on their feet. One instrument that could be used is an index-based instrument, where premiums are linked to the frequency and severity of the event. But in case where the insurance contract is not cost-effective for the government, the indexes could continue to be used, while the government absorbs the risk as the option of not doing anything would be too costly as well.

Various factors have played against the establishment of an integrated risk financing system as described above. Among the more common ones are: (i) UGR, as specialized public entity in agriculture risk management, has a very limited capacity in terms of human technical resources (only four staff); (ii) there is low availability of public sector budget, impeding the improvement of the generation and transmission of data and identification of potential beneficiaries in priority areas; (iii) the hydro meteorological equipment is very limited at the national level (146 points for a surface of 406,752 km^2); and (iv) a low level of inter- and intra-institutional coordination.

II STRATEGIC PROPOSAL

The proposal is to have an integrated risk financing structure that is sustainable for transferring and absorbing agriculture risks that impact public finances, as described in point I. A PPP scheme would be applied and the financial structure would be transparent, creative, and in constant innovation. The beneficiaries will be family farmers registered in the National Family Farm Registry. The strategic lines would be as follows:

TABLE 3.2. POLICY ACTIONS FOR MANAGING AGRICULTURE SECTOR RISKS

Policy actions	Legal Evidence	Indicator
Animal Health and Food Safety		
Expand the inspection and control of slaughterhouses for local consumption	Law/decree defining the responsibility of the different supply chain actors for the control and inspection of slaughterhouses and the coordination mechanisms between the Health Ministry and SENACSA	Increase the control and inspections at slaughterhouses for internal consumption
Agriculture Innovation System for Family Farming		
Establish a coordinating entity for family farming risks	Decree creating the working group on family farming risks at SIGEST.	Meetings and inter-institutional agreement from the participants of SIGEST's working group.
Approve the budget of SIGEST's institutions in a coordinated fashion with MAG's participation	Resolution of the Ministry of Finance mandating the approval of the budget of SIGEST institutions under consensus	Minutes of meetings of SIGEST approving the budget of its members
Strengthen regional risk coordination for family farming	Decree formalizing the Departmental Coordination Tables	Minutes from the Departmental Tables of SIGEST
Price Volatility		
Approve a new regulatory framework for agriculture commodity exchanges differentiating between cash and derivative markets	Law/decree establishing the differences between the different exchanges	Increase in the volumes trade in the cash market at the exchange.
Approve incentives for the actors of the sector to trade at the exchange	Law/decree providing fiscal incentives, linkage to credit and public purchases at the exchange	Increase in the volumes trade in the cash market at the exchange.
Risk Financing		
Establish a contingency risk financing mechanism for family farming against catastrophic weather events (such as drought)	Law/decree approving an institutional contingency risk financing structure for multiannual, multilayer support to family farming (insurance, derivatives, contingent credit lines, and ex-ante budget transfers)	Number of family farmers covered against catastrophic weather events (such as drought)
Ensure that agroclimatic information is shared among institutions that gather the data and users	Inter-institutional agreements to share agroclimatic information among private and public networks	Number of signed agreements and data shared

1. Increase the knowledge of the public and private sector technical staff in the area of risk management in order to promote the necessary qualifications and the incorporation of risk issues in the institutional working agendas.
2. Achieve access to historical data and required information for the analysis and quantification of risks.
3. Design and implement an integrated risk financing strategy for the agriculture sector through a PPP to face the impact of risks in an efficient way, in particular for family farms.

Institutional measures and policies for agriculture risk management: Proposal

Table 3.2 shows some recommendations in terms of policies needed for sustaining the proposals contained in previous sections.

CHAPTER FOUR
ACTION PLAN

The activities in this action plan are presented by strategic line (first table) and per institution (second table), and the costs are disaggregated per year.

TABLE 4.1. SHORT-TERM PLAN PER STRATEGIC LINE

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Sanitary and Food Safety Risk Solutions for Livestock Supply Chains					
A. Strengthen international trade capacity	A.1 Update and strengthen the quarantine system completing the border posts	SENACSA and ARP	2014–16	Personnel, equipment (scanner, computer hub)	10,600,000
	A.2 Review, update, and complete the traceability system for cattle and other species	SENACSA and ARP	2014–18	Consultants, seasonal workers, equipment and materials	11,960,000
	A.3 Integrate a traceability plan for meat and milk products	SENACSA and ARP	2014–18	Consultants, seasonal workers, equipment, and materials	2,350,000
	A.4 Improve the transparency of reports to OIE and interested parties	SENACSA	2014–15	Studies	150,000
	A.5 Maintain and expand the sanitary agreements for the export of meat products	SENACSA	2014–18	Meetings, studies, and trips	200,000
	A.6 Comply with requirements for the recognition of free border areas	SENACSA	2014–18	Studies	150,000
	A.7 Continue with the active surveillance of FMD, EEB, and IAAP.	SENACSA	2014–18	Sampling	3,000,000
	A.8 Consider the building of quarantine stations	SENACSA	2017–18	Studies	100,000
B. Expand and strengthen the animal health capacity	B.1 Review and update action plans for control and eradication of bovine brucellosis and tuberculosis, PPC, and Newcastle	SENACA and ARP	2015	Consultants and studies	150,000
	B.2 Review and strengthen the field network and distribute and integrate human resources according to regional and local needs assessed: Minimum of two veterinarians and four professionals per Unit Zone.	SENACSA	2015–18	Staff, trips, materials	69,850,000
	B.3 Supply Unit Zones with equipment and materials	SENACSA and ARP	2015–18		10,000,000
	B.4 Improve passive and active surveillance for diseases of economic and human health importance, expanding the participant network, and including inspection data before and after in packing houses and slaughterhouses	SENACSA, local commissions	2015–18	Trips, materials, and communication and education	750,000

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Sanitary and Food Safety Risk Solutions for Livestock Supply Chains					
	B.5 Implement specific programs and systematize control and eradication of bovine brucellosis and tuberculosis	SENACSA, ARP and local commissions	2015–18	Travel, materials training, and communication and sanitary education	500,000
	B.6 Implement a specific and updated program for the control and eradication of PPC to achieve free of disease status	SENACSA and swine producer associations	2015–18	Travel, materials training, and communication and sanitary education	500,000
	B.7 Implement a specific and updated program for the control and eradication of Newcastle to achieve free of disease status	SENACSA and poultry farmer associations	2014–15	Travel, materials training, and communication and sanitary education	500,000
	B.8 Update the contingency plans for exotic diseases posing a risk to the country	SENACSA	2015–16	Consultants, simulation exercises	450,000
	B.9 Strengthen animal welfare aspects	SENACSA and ARP		Consultant, studies	100,000
C. Strengthen public sector competencies for addressing inspections of local slaughterhouses	C1. Undertake a study on the situation and registry of slaughterhouses for national consumption and define the strategies and human and financial resources needed to expand control and inspection services.	SENACSA	2015	Consultant, study	100,000
	C.2 Implement the program of continuous training of staff responsible for the inspection of slaughterhouses	SENACSA and University of Veterinary Sciences	2015–18	Courses, scholarships, and workshops	500,000
	C.3 Expand the inspection and control of local slaughterhouses	SENASCA, Departments and municipalities	2015–18	Staff, equipment, trips	30,250,000
	C.4 Delegate inspection activities to private professionals		2015–18	Courses, workshops, meetings	100,000
	C.5 Complete the registry and the post-registry activities for all medicines and biological material of veterinary use	SENACSA	2015–18	Legislation, courses, workshops	150,000
	C.6 Expand the waste disposal plan for all products of animal origin, including for local consumption	SENACSA and Laboratory Network	2016–18	Sample, temporary staff, materials, reagents	1,000,000
	C.7 Develop and use informatics modules to collect and analyze all data as part of the central information system of SENACSA	SENACSA	2014–18	Consultant, training	200,000

(Continued)

TABLE 4.1. SHORT-TERM PLAN PER STRATEGIC LINE (*Continued*)

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Sanitary and Food Safety Risk Solutions for Livestock Supply Chains					
	C.8 Promote the establishment of a national policy and the coordination mechanisms for all entities in the meat supply chain	SENACSA, MSSS	2015–18	Meetings, workshops, consultants	150,000
D. Strengthen competencies for veterinary laboratories	D.1 Increase the number of samples processed for other diseases	SENACSA	2014–18	Staff, material, reagents, trips	9,750,000
	D.2 Input information into the SIGOR III information system	SENACSA	2015–18	Consultant, equipment	250,000
	D.3 Implement the laboratory accreditation system	SENACSA	2016–18	Study, consultant, training	100,000
	D.4 Expand capacity of the Waste Laboratory to undertake relevant studies	SENACSA	2016–18	Equipment, material, reagents, training	8,750,000
	D.5 Strengthen and expand the policy on the quality management and method validation for the laboratory	SENACSA	2014–18	Consultant, studies	250,000
	D.6 Update the laboratory network	SENACSA	2015–18	Study, meetings, workshops	150,000
	D.7 Scientific publications in an official and continuous manner	SENACSA	2014–18	Digital subscriptions	75,000
E. Strengthen competencies on animal health management	E.1 Elaborate and update program and investment plan 2014–18	SENACSA	2014	Consultants, workshops	250,000
	E.2 Review the legal framework to achieve rights and responsibilities including the allocation of financial resources	SENACSA	2014	Consultants, workshops	150,000
	E.3 Prepare an organizational restructuring and strengthening program for system process management (ISO 9000)	SENACSA	2015–16	Consultants, studies	100,000
	E.4 Organize a transversal program for continuous staff training	SENACSA and University of Veterinary Sciences	2015–18	National courses, international scholarships, workshops, professors	750,000
	E.5 Establish a transversal system for integrated information covering SENACSA to collect, analyze and generate data for action	SENACSA	2015–18	Consultants, equipment, training	250,000

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Sanitary and Food Safety Risk Solutions for Livestock Supply Chains					
	E.6 Develop a transversal program on communication and sanitary education for farmers and other actors of the meat supply chain and expand the information center of SENACSA	SENACSA	2015–18	Consultants, equipment, materials, radio, and tv spots	500,000
	E.7 Review and update the administrative and accounting systems	SENACSA	2015–18	Consultant, training	100,000
	E.8 Improve the physical infrastructure and equipment including the strengthening of ICTs	SENACSA	2015–18	Land, construction, designs, equipment, material	1,250,000
	E.9 Managing and administering the institution	SENACSA	2015–16	Staff, trips, materials, and equipment	31,000,000
	Undertake a PVS evaluation and gap analysis after the five-year period	OIE, SENACSA	2018	Consultant, meetings, workshops	150,000
F. Optimize sanitary and production technical assistance for small and medium size farmers Note: The activities in this strategic line are coordinated with the component on agriculture innovation system. Note: Other strategic lines are financed in A and B above.	F.1 Support the establishment of a public-private coordination with farmer organizations to promote their organization	MAG, SENACSA, ARP	2014–15	Meeting, studies, consultants, trips	100,000
	F.2 Support the establishment of partnership with public institutions (departments, municipalities, others)	MAG, SENACSA, ARP	2014–18	Meetings, workshops, trips	100,000
	F.3 Maintain sanitary coverage of small and medium size farmers	MAG, SENACSA, ARP	2014–18	Travel, meetings, materials, radio, TV, courses	100,000
	F.4 Provide technical assistance on animal health as part of an integrated production system, including water storage and feed production in case of drought or floods.	MAG, SENACSA, ARP	2014–18	Financial resources for projects	Accounted in agriculture innovation systems

(Continued)

TABLE 4.1. SHORT-TERM PLAN PER STRATEGIC LINE (*Continued*)

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
	Sanitary and Food Safety Risk Solutions for Livestock Supply Chains				
	F.5 Train producers about animal health and productivity based on demand	MAG, SENACSA, ARP	2014–18	Courses, meetings, dissemination material, demonstrative plots, field days, social networks	100,000
	F.6 Undertake communication programs and sanitary education	MAG, SENACSA, ARP	2014–18	Consultant, materials, radio, TV, social networks	100,000
	F.7 Develop livestock production projects at the request of small and medium size farmers to be presented to financial institution for obtaining resources for its implementation	MAG, SENACSA, ARP	2014–18	Financial resources for projects	Available in the agriculture innovation system budget
Aggregate costs per year	Total: $198,085,000 2014: $19,883,667 2015: $51,296,166 2016–2018: $126,905,167 *Source:* This action plan and its budget is based on the Gap Analysis PVS undertaken by the OIE in 2012 and which covers all annual costs of SENACSA over five years				
	Strengthening of The Agriculture Innovation System for Mitigating Family Farming Risks				
A. Improve the coordination of the agriculture innovation system for family farming	A.1 Establish a working group with representatives from IPTA, SENAVE, SENACSA, Viceministries of MAG, and DINCAP	SIGEST/MAG	2014	Consultancy to determine the roles and responsibilities of the working group and its operation	8,000
	A.2 Implement MECID-DAR in the rest of the country	SIGEST/MAG	2015–18	Consultant for the strengthening of the tables in relation to their experience	100,000
	A.3 Formalize the existence of an agriculture innovation system	SIGEST/MAG	2015	Consultancy to determine the roles and responsibilities of the working group and its operation	10,000
	A.4 Reengineer MAG and institutional adjustment of the sector institutions	SIGEST/MAG	2015–17	Consultants to adapt legislation and redesign functions and linkages among institutions	30,000

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Strengthening of The Agriculture Innovation System for Mitigating Family Farming Risks					
B. Improve the efficiency of the agriculture innovation system for the management of agriculture risks by family farmers—strengthening of IPTA	B.1 Determine the research agenda to generate technologies adapted to family farming	IPTA	2014	Consultancy for determining the research agenda	10,000
	B.2 Strengthen human resources (training and hiring of researches)	IPTA	2014–18	Capacity building plan, training events, hiring of technical staff	400,000
	B.3 Improve infrastructure and equipment of the Research Center in Caacupe and of the Experimental Field of Chore	IPTA	2015–16	Building infrastructure, laboratory equipment, and ICT	2,000,000 2,700,000 450,000
	B.4 Improve the ICT services	IPTA	2015–16	Internal and external information system for communicating with other institutions of the agriculture innovation system	200,000
C. Improve the efficiency of the agriculture innovation system for managing family farmer risks—strengthening of the Agriculture Technology Extension and Transfer System	C.1 Establish and implement a program for the training an updating of extension agents	DEAg/Viceministry of Agriculture (VMA)	2015–19	Training and updated program for extension agents	150,000
	C.2 Undertake training for upper management of CDAs and ALATs.	DEAg/VMA	2015–17	Training programs for upper management	30,000
	C.3 Establish a public career path for extension agents	DEAg/VMA	2014	Consultancy to establish criteria and targets to evaluate performance	7,000

(*Continued*)

TABLE 4.1. SHORT-TERM PLAN PER STRATEGIC LINE (*Continued*)

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Strengthening of The Agriculture Innovation System for Mitigating Family Farming Risks					
	C.4 Improve the allocation of resources to ensure the mobility of extension agents on the field	DEAg/VMA	2014	Budget allocation	--
	C.5 Use new models of training of technical staff and farmers	DEAg/VMA	2015–19	Consultancies to determine new models to be used, training events	10,000 120,000
	C.6 Scale up the use of ICTs in order to reduce costs	DEAg/VMA	2015–17	Hiring of a massive SMS system with a cell phone company, implement long-distance learning methods	150,000 100,000
	C.7 Try different extension models and approaches	DEAg/VMA	2015–16	Consultancy for preparing a proposal for pilot experiences in outsourcing extension services and technical assistance	10,000
D. Improve the efficiency of the agriculture innovation system for agriculture risk management of family farms—strengthening of PNMCRS	D.1 Introduce small scale equipment and machinery for family farmers available for municipalities	VMA	2015–17	Small scale equipment and machinery for family farming	800,000
	D.2 Supply PNMCRS with the necessary equipment for its work	VMA	2015	Computer systems for the mapping of soils, GPS, sampling, and so on	100,000
	D.3 Provide inputs to the program for demonstrative plots	VMA	2015–18	Inputs for the development of demonstration plots	130,000
	D.4 Implement a training and update program for technical staff of PNMCRS and extensionist form DEAg and PPA	VMA	2015–19	Training and update program for technical staff of the program	200,000

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Strengthening of The Agriculture Innovation System for Mitigating Family Farming Risks					
E. Improve the efficiency of the agriculture innovation system for agriculture risk management of family farms—strengthening of SENAVE	E.1 Structure and implement a training program for directors, management, and technical staff	SENAVE	2015–16	Training program	150,000
	E.2 Strengthen the laboratory services for the prevention, control, and protection of plant health and quality	SENAVE	2015–16	Laboratory equipment for prevention, control, and plant health and quality	500,000
	E.3 Establish a joint action program with partner institutions to achieve its objectives	SENAVE-SIGEST	2015	Consultancy to establish a joint action program.	8,000
F. Improve risk management for family farmers through on-farm investments	F.1 Obtain financing for the installment of greenhouses, half-shade and small irrigation systems	VMA/PRODERS	2014–18	Equipment and materials to install greenhouses, half shade, and small irrigation systems	15,000,000
	F.2 Financing for seeds, fertilizers, tools and small equipment	VMA/DINCAP/ SIGEST	2014–18	Existing resources in programs and projects	--
Total aggregate costs per year	Total: $23,373,000 2014: $3,105,000 2015: $6,726,600 2016–19: $13,541,500				
Price Risk and The Development of an Agriculture Commodity Exchange					
A. Establish an agriculture commodity exchange (cash only)	A.1 Develop an integrated proposal for the establishment of an exchange	MAG	2014	Consultant with experience in commodity exchanges	15,000
	A.2 Establish a working group	MAG	2014	Public and private sector entities	0
	A.3 Design a business plan	Working Group	2014	Consultant with experience in commodity exchanges	20,000

(*Continued*)

TABLE 4.1. SHORT-TERM PLAN PER STRATEGIC LINE (*Continued*)

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Price Risk and The Development of an Agriculture Commodity Exchange					
	A.4 Develop of bylaws and operating regulations	Working group	2015	Lawyer with experience in commodity exchanges	19,000
	A.5 Launch	MAG and exchange authorities	2015	Launch event	10,000
B. Establish of a derivatives market	B.1 Develop an integrated proposal for the establishment of derivatives market	MAG	2014	Consultant with experience in commodity exchanges	15,000
	B.2 Train the working group	MAG	2014	Public and private sector entities	0
	B.3 Design a business plan	Working group	2014	Consultant with experience in commodity exchanges	20,000
	B.4 Develop the bylaws and operating regulations	Working group	2015	Lawyer with experience in derivative markets	19,000
	B.5 Launch	MAG and authorities of the exchange	2015	Launch event	10,000
Total aggregate costs per year	Total: $128,000 2014: $70,000 2015: $58,000				
Agriculture Risk Financing Strategy					
A. Increase the knowledge of public and private sector officials on agriculture risk management approaches to integrate them within their respective institutions	A.1 Diagnose the agriculture risk management areas and themes that need to be reinforced through training	Risk Management Unit—MAG (UGR-MAG) with support from universities (UNA and UCNSA)	2014–16	Consultant and training	3,000 3,000
	A.2 Design flexible training adjusted to the availability of technical staff on forecasting, risk analysis, quantification, sector impacts, and risk financing.	Academic institutions (UNA and UCA) with support from the technical working committee	2014–16	Consultancy and training	65,000 65,000

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
	Agriculture Risk Financing Strategy				
	A.3 Implementation of exchange visits, courses, and workshops in the areas of risk management for agriculture sector institutions	UGR-MAG with support from the technical working committee	2014–16	Consultancy and training	25,000 8,000
	A.4 Establish collaboration agreements with local and international entities	UGR-MAG with support of the technical working committee	2014–16	Meeting expenses	1,000
	A.5 Access resources and cooperation agreements to: (i) support the development of risk financing policies; and (ii) support the implementation of a risk financing structure for the public sector	UGR-MAG with support from the technical working committee	2014–16	Equipment	7,500
B. Access historical data and required information for the analysis and quantification of risks	B.1 Strengthen the technical working committee to direct studies and analysis, and manage the coordination of actions focused on risk management	UGR-MAG	2014	Equipment	7,500
	B.2. Coordinate and establish working groups for the design and implementation of an information platform	UGR-MAG with support of the technical working committee	2014–18	Consultancy and training	10,800 6,300
	B.3 Undertake a needs assessment and priorities from an institutional mapping. The mapping should include: (i) system's hardware, software, and applications; (ii) information and available data generated by the institution; (iii) storage systems; (iv) analysis of missing values; and (v) financial resources for its implementation	UGR-MAG with support of the technical working committee	2014–18	Consultancy and meeting expenses	7,200 1,500
	B.4 Design and develop an information platform through the definition of a technological architecture and the definition of an information system model	UGR-MAG with support of the technical working committee	2015–17	Consultancy	60,000

(*Continued*)

TABLE 4.1. SHORT-TERM PLAN PER STRATEGIC LINE (*Continued*)

Strategic Line	Action	Responsible Institution	Period	Resources	Cost (US$)
Agriculture Risk Financing Strategy					
	B.5 Approve the protocol for the functioning of the information platform	UGR-MAG with support of the technical working committee	2014–16	Consultancy	1,800
	B.6 Strengthen the software and hardware platform	UGR-MAG with support of the technical working committee	2015–17	Consultancy and investments	600,000 585,000
	B.7 Execute a pilot of the functioning and operation of the platform	UGR-MAG with support of the technical working committee	2015	Consultancy and investments	80,000
	B.8 Design and deliver training for the use of the technological platform	UGR-MAG with support of the technical working committee	2016–18	Consultancy and training	15,000
C. Design and implement a financial structure for integrated risk management through a PPP to allow family farmers to be covered	C.1 Approve a strategic plan and design an operating plan for its implementation through the technical working committee	UGR-MAG with support of the technical working committee	2014	Consultancy	3,000
	C.2 Design and implement a financing structure for agriculture risk focusing on family farmers. The structure should include the identification of institutional, technical, operative, and regulatory limitations/strengths	UGR-MAG with support of the technical working committee	2015–17	Consultancy	450,000
Aggregated costs per year	Total: $2,064,850 2014: $123,400 2015: $874,300 2016–2018: $1,067,150				

TABLE 4.2. SHORT-TERM PLAN PER RESPONSIBLE INSTITUTION

	2014			2015			
Actions	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
Solutions for Sanitary and Food Safety Risks of Agriculture Value Chains							
A1 – SENACSA (Servicio Nacional de Sanidad de Alimentos)/ARP	X	X	X	X			
A2 – SENACSA/ARP			X	X	X	X	X
A3 – SENACSA/ARP							
A4 – SENACSA							
A5 – SENACSA			X	X	X	X	X
A6 – SENACSA	X	X	X				
A7 – SENACSA	X	X	X	X	X	X	X
A8 – SENACSA							
B1 – SENACSA/ARP			X	X	X		
B2 – SENACSA				X	X	X	X
B3 – SENACSA/ARP				X	X	X	X
B4 – SENACSA, local comissions				X	X	X	X
B5 – SENACSA, ARP, local comissions					X	X	X
B6 – SENACSA, pig producer associations				X	X	X	X
B7 – SENACSA, poultry producer associations					X	X	X
B8 – Agencia Nacional de Sanidad Animal (ANACSA)		X	X	X			
B9 – SENACSA/ARP				X	X	X	X
C1 – SENACSA					X	X	
C2 – SENACSA, Veterenary Science University				X	X	X	X
C3 – SENACSA, departments, and municipalities				X	X	X	X
C5 – SENACSA			X	X	X	X	
C6 – SENACSA, lab network				X	X	X	X
C7 – SENACSA			X	X	X		
C8 – SENACSA				X	X		
D1 – SENACSA				X	X	X	X
D2 – SENACSA		X	X	X	X	X	X
D3 – SENACSA					X	X	X
D4 – SENACSA				X	X	X	X
D5 – SENACSA		X	X	X	X	X	X
D6 – SENACSA				X	X	X	X
D7 – SENACSA			X	X	X		
E1 – SENACSA		X	X				

(Continued)

TABLE 4.2. SHORT-TERM PLAN PER RESPONSIBLE INSTITUTION (*Continued*)

	2014			2015			
Actions	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
E2 – SENACSA		X					
E3 – SENACSA				X	X		
E4 – SENACSA, Veterinary Science University				X	X	X	X
E5 – SENACSA				X	X	X	X
E6 – SENACSA			X	X	X	X	X
E7 – SENACSA				X	X	X	
E8 – SENACSA				X	X	X	X
E9 – SENACSA			X	X	X	X	X
E10 – OIE, SENACSA							
F1 – MAG, SENACSA, ARP			X	X	X		
F2 – MAG, SENACSA, ARP			X	X	X		
F3 – SENACSA, MAG, ARP	X	X	X	X	X	X	X
F4 – MAG, SENACSA, ARP				X	X	X	X
F5 – MAG, SENACSA, ARP	X	X	X	X	X	X	X
F6 – MAG, SENACSA, ARP		X	X	X	X	X	X
F7 – MAG, SENACSA, ARP				X	X	X	X
Strengthening of The Agriculture Innovation System for Mitigating Family Farming Risks							
A1 – SIGEST/MAG		X	X				
A2 – SIGEST/MAG				X	X	X	X
A3 – SIGEST/MAG				X	X		
A4 – SIGEST/MAG				X	X	X	X
B1 – IPTA		X	X				
B2 – IPTA			X	X	X	X	X
B3 – IPTA				X	X	X	X
B4 – IPTA				X	X	X	X
C1 – DEAg/VMA				X	X	X	X
C2 – DEAg/VMA				X	X	X	X
C3 – DEAg/VMA			X				
C4 – DEAg/VMA			X				
C5 – DEAg/VMA				X	X	X	X
C6 – DEAg/VMA				X	X	X	X
C7 – DEAg/VMA							X
D1 – PNMCRS/VMA				X	X	X	X
D2 – PNMCRS/VMA				X	X		
D3 – PNMCRS/VMA				X	X	X	X
D4 – PNMCRS/VMA				X	X	X	X
E1 – SENAVE				X	X	X	X
E2 – SENAVE				X	X	X	X
E3 – SENAVE				X			
F1 – Inversiones Prediales			X	X	X	X	X
F2 – Inversiones Prediales			X	X	X	X	X

TABLE 4.2. SHORT-TERM PLAN PER RESPONSIBLE INSTITUTION (*Continued*)

	2014			2015			
Actions	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
Price Risk Management and Developing an Agricultural Commodity Exchange							
A1 – MAG		X					
A2 – MAG			X				
A3 – Working group			X				
A4 – Working group				X			
A5 – MAG And authorities of the commodity exchange					X		
B1 – MAG		X					
B2 – MAG			X				
B3 – Working group			X				
B4 – Working group				X			
B5 – MAG and authorities of the commodity exchange					X		
Agriculture Risk Financing Strategy							
A1 – UGR-MAG	X						
A2 – Academic institutions	X						
A3 – UGR-MAG	X				X		
A4 – UGR-MAG	X						
A5 – UGR-MAG	X						
B1 – UGR-MAG			X				
B2 – UGR-MAG	X		X		X		X
B3 – UGR-MAG	X						
B4 – UGR-MAG					X		
B5 – UGR-MAG			X				
B6 – UGR-MAG					X		
B7 – UGR-MAG							X
B8 – UGR-MAG							
C1 – UGR-MAG			X				
C2 – UGR-MAG						X	

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