STRIKING A BALANCE

MANAGING EL NIÑO AND LA NIÑA IN PHILIPPINES’ AGRICULTURE

William R. Sutton, Jitendra P. Srivastava, Mark Rosegrant, Rowena Valmonte-Santos, and Maximillian Ashwill
Striking a Balance

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<th>Full Form</th>
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<tr>
<td>AFS</td>
<td>Agriculture food system</td>
</tr>
<tr>
<td>AMRIS</td>
<td>Angat-Magat River Irrigation System</td>
</tr>
<tr>
<td>AWD</td>
<td>Alternate wet and dry</td>
</tr>
<tr>
<td>BFAR</td>
<td>Bureau of Fisheries and Aquatic Resources</td>
</tr>
<tr>
<td>BSWM</td>
<td>Bureau of Soils and Water Management</td>
</tr>
<tr>
<td>CFW</td>
<td>Cash-for-Work</td>
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<tr>
<td>CGE</td>
<td>Computable general equilibrium</td>
</tr>
<tr>
<td>CGCM</td>
<td>Coupled Ocean-Atmosphere General Circulation Models</td>
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<tr>
<td>CRA</td>
<td>Climate-resilient agriculture</td>
</tr>
<tr>
<td>DA</td>
<td>Department of Agriculture</td>
</tr>
<tr>
<td>DILG</td>
<td>Department of Interior and Local Government</td>
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<tr>
<td>DSWD</td>
<td>Department of Social Welfare and Development</td>
</tr>
<tr>
<td>ENSO</td>
<td>El Niño–Southern Oscillation</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>ha</td>
<td>Hectare</td>
</tr>
<tr>
<td>IRRI</td>
<td>International Rice Research Institute</td>
</tr>
<tr>
<td>LGUs</td>
<td>Local government units</td>
</tr>
<tr>
<td>mt</td>
<td>Metric tons</td>
</tr>
<tr>
<td>NAP-Ag</td>
<td>Integrating Agriculture in National Adaptation Plans</td>
</tr>
<tr>
<td>NDRRMC</td>
<td>National Disaster Risk Reduction and Management Council</td>
</tr>
<tr>
<td>NEDA</td>
<td>National Economic and Development Authority</td>
</tr>
<tr>
<td>NFA</td>
<td>National Food Authority</td>
</tr>
<tr>
<td>NGO</td>
<td>Nongovernment organization</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>PAGASA</td>
<td>Philippine Atmospheric Geophysical and Astronomical Services Administration</td>
</tr>
<tr>
<td>PCIC</td>
<td>Philippine Crop Insurance Corporation</td>
</tr>
<tr>
<td>PDRRM</td>
<td>Philippine Disaster Risk Reduction and Management</td>
</tr>
<tr>
<td>PhilRice</td>
<td>Philippine Rice Research Institute</td>
</tr>
<tr>
<td>PRISM</td>
<td>Philippine Rice Information System</td>
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<tr>
<td>QRF</td>
<td>Quick Response Fund</td>
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</tbody>
</table>
Striking a Balance: Managing El Niño and La Niña in Philippines' Agriculture

RAIN   Roadmap to Address the Impact of El Niño
SAM    Social Accounting Matrix
SST    Sea surface temperature
THI    Temperature Humidity Index
UNDP   United Nations Development Programme
$      United States dollar
Foreword

In a world of climate change and headline grabbing cyclones, El Niño is one of the most unspoken climate risks in East Asia and the Pacific. It is a cyclical event that consistently ravages the region’s economies and agricultural sectors with droughts and water scarcity. In turn, La Niña, the cool phase which typically occurs the year after an El Niño event, often brings extensive damage from floods and heavy rainfall. El Niño has occurred eight times since 1980, with the most recent event, from 2014 to 2016, being the most severe, causing billions of dollars in damage to the region. Experts forecast another El Niño event, predicted to affect East Asia and the Pacific in the winter of 2018–2019.

Given the cyclical nature of the El Niño–Southern Oscillation (ENSO) events, it is critical that governments have plans in place to face the threat. The research presented here is the first to carry out in-depth economic modeling to calculate changes in agricultural production, gross domestic product, household welfare, and poverty levels from both El Niño and La Niña in East Asia and the Pacific. It also estimates how certain policy interventions could mitigate these impacts. As such, the Striking a Balance reports could be important tools for policy makers in Cambodia, Lao PDR, Myanmar, the Philippines, and Vietnam—the five countries examined in the series.

The reports’ findings are concerning: the authors estimate El Niño produces GDP, consumption, and income losses for all households, in all countries, regardless of income level, urban-rural location, or gender. El Niño threatens to raise food prices, with women and poor people set to suffer the most because they spend more of their income on food. Because of this, El Niño could threaten the region’s poverty reduction and food security advances from the past decade. Fortunately, the reports also find there may be opportunities to harness the heavier rainfall which occurs during La Niña to achieve some GDP, consumption, and poverty reduction gains.

Regional governments have made inroads in preparing for climate events like floods and other natural disasters, but more could be done to prepare for ENSO specifically. This includes building resilience and preparedness by investing in early warning systems, developing national action plans, and cooperating with other East Asia–Pacific
countries on ENSO-related challenges, which are regional in nature. Striking a balance among these various policy options, and between El Niño and La Niña management, demands concerted effort. It is our hope that this report will catalyze collective action and help governments and other national and subnational stakeholders achieve that balance.

Juergen Voegele
Senior Director
Food and Agriculture Global Practice
The World Bank
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Overview

The purpose of this report is to improve the Philippines’ preparedness for the El Niño–Southern Oscillation (ENSO) by informing stakeholders of ENSO’s agricultural and economic impacts. The report finds that ENSO has detrimental impacts on the Philippine people, economy, poverty levels, and agricultural sector. The country has taken actions and enacted policies to respond to ENSO events, but these have not adequately mitigated the costs of ENSO impacts. That said, there are further actions the country can take to better prepare for these impacts. This is important because of the Philippines’ high exposure to climate shocks, the rural population’s climate vulnerability, and the prominence of the agricultural sector in the national economy. There is also some urgency as recent forecasts suggest another El Niño will likely occur in winter 2018–2019.1

ENSO has important impacts on the Philippines’ climate, agriculture, economy, and society

The Philippines is highly exposed to ENSO-related climate and agricultural shocks. ENSO describes naturally occurring ocean and atmospheric temperature fluctuations, which have major implications on global weather patterns. Since 1980 there were seven severe ENSO events, which include both El Niño, ENSO’s warm phase, and La Niña, ENSO’s cold phase. In 1982–1983, El Niño–related droughts affected 450,000 hectares of farmland in the Philippines. The most severe El Niño occurred in 1997–1998, when rainfall fell to half of historical levels, causing drought in two-thirds of the country. This led to forest fires that destroyed almost 10,000 hectares of natural forests.2 In 2015–2016, dry El Niño conditions lasted for 18 months and affected about a third of the country. In total, six cities, 16 provinces, and 65 municipalities declared a state of calamity. By May 2016, over 400,000 farmers and 550,000 hectares were directly affected by El Niño–induced drought. Later, La Niña caused flooding in low-lying farm areas causing increases in crop pests and diseases.3 Overall, the most recent El Niño event in 2015–2016 caused $327 million in agricultural production losses.

1NOAA (2018); http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensso_advisory/ensodisc.shtml
2OCHA (2015).
3PAGASA (2015a).
ENSO’s most notable effect is on average rainfall, which declines during El Niño and rises during La Niña. These average rainfall variations are most pronounced during the driest six months of the year, December to May. During El Niño in the Philippines, average rainfall decreased by 14 percent in Luzon, the northern island chain; 21 percent in Visayas, the central island chain; and 35 percent in Mindanao, the southern-most island chain. During La Niña, by contrast, rainfall increased by 31 percent in Luzon, 41 percent in Visayas, and 19 percent in Mindanao (see Figure A for El Niño’s rainfall patterns and El Niño–affected areas in the Philippines).

ENSO affects crop production because it disrupts normal weather patterns. More specifically, El Niño creates water shortages and La Niña creates water abundance, including flooding. Water shortages reduce crop planting areas, delay planting seasons, and generally lower crop yields. One study\(^4\) found that a one degree increase in sea surface temperatures during July–September is associated with a 3.7 percent decline in irrigated dry season production and a 13.7 percent decline in rainfed dry season production in Luzon. In both irrigated and rainfed systems, the decline was larger for harvested areas (9 percent decline) than for yields (5 percent decline).\(^5\)

\(^4\)Roberts and others (2009).
\(^5\)Roberts and others (2009).
Another study\textsuperscript{6} estimated substantial yield losses for wet season crops, showing rice yield losses during El Niño events in 1973, 1983, and 1990. Simulations carried out for this report show La Niña crop yield gains can partially make up for El Niño yield losses.

\textbf{There is some evidence that ENSO events affect the livestock and fisheries sectors, though this link is inconclusive.} A report by the Philippine Bureau of Fisheries and Aquatic Resources shows El Niño may reduce annual fish catches by 20 percent in open waters and by 23 percent in waters within 15 kilometers of the shoreline. Despite this, national production data also show fish production, from 1980 to 2015, has consistently risen in the Philippines despite numerous ENSO events, seemingly contradicting the ENSO-fisheries link. ENSO’s links with livestock declines is also poorly established. That said, La Niña increases annual “hot” days by 25,\textsuperscript{7} which can cause increased heat stress on livestock and related cost increases for producers.\textsuperscript{8}

\textbf{ENSO’s impacts on agriculture have economy-wide implications.} Over 7 million hectares of the Philippines’ 30 million hectares are devoted to agriculture.\textsuperscript{9} Agriculture was only 12.5 percent of total gross domestic product (GDP) in 2011. But, when downstream agricultural processing, input production, and agriculture-related trading and transporting are included, the contribution of the entire agriculture food system (AFS) was over 30 percent of GDP. Agriculture also employs over a quarter of the country’s workforce.\textsuperscript{10} As such, any shocks to agriculture lead to reverberations across the entire economy, with serious implications on welfare, food security, and national poverty levels.

\textbf{Strong El Niño events lead to GDP losses, while strong La Niña events lead to smaller GDP gains.} Simulations for this report show that national GDP losses during a strong El Niño event are $3.3 billion, while national GDP gains during La Niña are $0.5 billion. Percentage losses are larger in agriculture, where GDP falls by nearly 7 percent. Subnationally, GDP losses vary across regions within the Philippines: agricultural GDP falls by 1.9 percent in Luzon during a strong El Niño, but by 1.4 percent in Mindanao. Moderate La Niña events saw some gains in Luzon and Visayas, but small losses in Mindanao. Overall, most of El Niño’s economic losses occur outside

\textsuperscript{6}Lansigan and others (2000).
\textsuperscript{7}Kalnay and others (1996).
\textsuperscript{8}West (2003).
\textsuperscript{9}PSA CountryStat (2017).
\textsuperscript{10}WB-WDI (2018).
of agriculture, while La Niña’s agricultural impacts cause slightly greater economic benefits in agriculture than the wider economy.

**Net food consuming households, usually in wealthier urban areas, suffer greater welfare losses during a strong El Niño.** Simulations show consumption, or welfare, levels fall for all households across the income distribution. Urban household consumption is affected more negatively than rural household consumption, especially farming households, during strong El Niño events because urban households are more likely to be net consumers of food products. Net consumers, who can also frequently be non-farming rural households, are hurt by higher food prices, but unlike net producers, do not benefit from higher farm incomes. However, net producers in rural areas tend not to be poor. The rural poor, which is two-thirds of the poor population, typically do not own the land on which they work and may not benefit when farm prices rise. Therefore, when El Niño lowers crop yields, it reduces wages and farm labor demand, causing some laborers to search for non-farm work to smooth income. ENSO also causes greater food insecurity by raising household food expenditures.\(^{11}\) This can cause greater malnutrition\(^{12}\) and consumption poverty for the poor, since poor families spend more of their total income on food. The World Bank estimates\(^ {13}\) that much of the increase in poverty, from 25 percent in 1997 to 28 percent in 1998, was attributable to the impact of an El Niño shock on the agricultural sector.

**Women are heavily involved in the Philippines’ agriculture sector and face different vulnerabilities to ENSO than men.** Women’s extensive involvement in farming and other agricultural-related activities is well documented in the Philippines.\(^ {14}\) Women also have fewer assets than men that they can use to adapt to ENSO events. Men generally hold more agricultural assets, including land and irrigation systems, which allows them to offset agricultural losses during ENSO events. Women’s assets are lower in value but generally have higher liquidity—and are thus more easily sold during times of crisis. As such, when coping with a natural disaster, households tend to sell women’s assets first. Women also have lower access to agricultural technologies and climate information that support ENSO preparedness. Simulations indicate female-headed households are slightly less affected by strong El Niño events than male-headed households. This is mainly because female-headed households tend to

\(^{11}\)Dawe and others (2009).
\(^{12}\)Alderman and others (2006).
\(^{13}\)World Bank (2001).
\(^{14}\)Mendoza (2018 forthcoming).
be poorer than male-headed households, and, as reported above, poorer households are slightly less affected than higher income households. That said, women also spend more of their earnings on food consumption and tend to be landless laborers, so production shocks disproportionately affect them.

The Philippines acted to support ENSO preparedness, but there is room for improvement

The Philippines developed the Roadmap to Address the Impact of El Niño (RAIN), which directly addresses ENSO. RAIN directly responded to El Niño in 67 provinces and was successful in stabilizing food prices and food supplies by supporting crop production in unaffected or mildly affected regions at times when other areas were broadly impacted by drought. RAIN accomplished this through several components, including Cash-for-Work, food distribution, public information, water system improvements, and seeds and fertilizer distribution. During the most recent El Niño in 2015–2016, the National Economic and Development Authority (NEDA), which leads the Philippines’ El Niño Task Force, allotted $422 million for El Niño,15 $83 million to manage water supplies, $29 million to provide food stamps, and another $40 million to support affected urban households.16

Most of the Philippines’ climate-related efforts were intended for non-ENSO events, but indirectly supported ENSO preparedness. These efforts include several climate change and disaster risk reduction programs, including: the National Action Plan to Combat Desertification 2010–2020; the Adaptation and Mitigation Initiative in Agriculture; the Nationwide Operational Assessment of Hazards, and the piloting of Weather Index–Based Insurance. Moreover, two national development programs have major implications on ENSO preparedness in the Philippines. These include the national rice self-sufficiency policy and the Pantawid Pamilya conditional cash transfer program. Under the rice self-sufficiency policy, the National Food Authority controls rice trade by implementing import tariffs and establishing other import restrictions, such as curbing the private sector’s ability to import. These actions reorient domestic

16NEDA (2016).
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rice demand to domestic producers; however, they can also create harmful market distortions, especially for foreign trading partners. The Pantawid Pamilya cash transfer program, by contrast, reduces losses for poor families during ENSO by providing them cash resources in return for them meeting a set of conditions. NEDA also relies on international support, including from the World Bank, to enhance ENSO preparedness.17

These important efforts also demonstrated several areas to improve the Philippines’ ability to prepare for ENSO events. These areas include the following:

Government areas to strengthen

• Government agencies and systems could be better adapted to slow onset disasters, like El Niño–related water scarcity.
• Drought aid delivery could be timelier and more efficient.
• More detailed forecasting systems would be more helpful to local farmers.
• There have been various budget and financing delays and shortfalls around ENSO relief and preparedness.

General areas to strengthen

• Gender issues have generally not been integrated into ENSO-related response and preparedness activities.18
• There is no ENSO financing mechanism fitted to the Philippines’ context.
• Local stakeholders and governments could be better prepared for ENSO and better able to access hard-to-reach locations.

Policy interventions do not neutralize ENSO-related losses

Policy interventions and investments do not fully offset GDP losses from strong El Niño events. In-depth modeling carried out under this study estimated the effects from seven ENSO-related policy interventions, including introducing drought-tolerant crop varieties, expanding irrigation, applying food import subsidies, storing grains, removing rice quotas, providing cash transfers to poor households, and applying all these policy interventions simultaneously. These models show that GDP losses during

18Mendoza (2018 forthcoming); Benson (2009).
El Niño of $3.3 billion with no interventions, are reduced to $1.4 billion with all six interventions. In other words, even with an ambitious policy framework, a strong El Niño still causes $1.9 billion in GDP losses. When interventions are implemented in isolation, which is more likely to be the case, losses are much higher. For example, the simulation shows food import subsidies and cash transfers are the least effective in mitigating El Niño losses. The reason is that food import subsidies do not increase local agricultural production and cash transfers require tax increases for higher income households to offset transfer costs. Therefore, food subsidy gains are limited and cash transfers may actually increase overall GDP losses. Removing rice import quotas is the most effective in mitigating GDP losses. Increased rice imports offset domestic production shortfalls for downstream processing and ease upward pressure on consumer food prices.

**Simulated policy interventions are effective in reducing welfare losses and limiting poverty increases caused by El Niño.** As with GDP during El Niño, expanding irrigation use, depleting grain stores, and removing rice import quotas are effective in reducing household consumption losses, particularly for poorer households. Simulations show that cash transfers reduce losses for poorer households but increase losses overall. When all policy scenarios are implemented, total consumption losses drop considerably and become consumption gains for the poorest households. Simulations also show that 5.1 million Filipinos fall into poverty during a strong El Niño event, but irrigation, cash transfers, and removing rice import quotas can mitigate this. In the most ambitious scenario, where all interventions are implemented together, the poverty headcount would actually decrease during a strong El Niño. This shows there is tremendous potential to implementing national policies related to ENSO.

**Urban households benefit the most from simulated policy interventions.** While removing rice quotas offsets consumption losses for rural households, no policy scenarios completely offset El Niño’s consumption losses on urban households. That said, it is also true that urban households benefit more from interventions than rural households. The one exception is cash transfers, which are financed through taxes on higher income households, most of whom reside in urban areas. Cash transfers are also the most likely policy intervention to benefit female-headed households, but this is because cash transfers target lower income households. Lifting rice import quotas is the only simulated intervention that completely negates consumption losses from strong El Niño events.
The government can take additional actions to improve ENSO preparedness in the Philippines

There are many opportunities to improve ENSO preparedness and resilience. In Table A, recommendations are divided into two groups: preparedness and resilience. Preparedness are measures specifically geared toward ENSO and should, ideally, be in place before the next ENSO event occurs. These actions will significantly empower people to cope, respond, and recover from damaging ENSO events. Resilience, by contrast, are measures that are not specifically tailored to ENSO, but that will build individuals’ and organizations’ ability to adapt to multiple forms of risks and shocks without compromising long-term development. Recommendations in blue are a high priority, recommendations in tan are a moderate priority. The last two columns denote which actions are short-term (S), or should be completed within a year, and which actions are medium- to long-term (M/L), or would not be achievable in less than a year.

**TABLE A:** Summary of Recommendations and Proposed Actions.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Actions</th>
<th>S</th>
<th>M/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare response measures for when ENSO-related events occur</td>
<td>Develop local drought and flood contingency plans.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ensure emergency response inputs, supplies, and contingency budgets are available.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Correct inefficiencies within the Roadmap to Address the Impact of El Niño (RAIN) and the El Niño Task Force</td>
<td>Create a coordinating committee to communicate strategies and share information.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establish a trigger mechanism to reconvene the Task Force when there is a forecasted El Niño.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Prioritize likely hotspots prior to the onset of ENSO.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjust RAIN to focus more on long-term slow onset challenges, like water scarcity.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harness La Niña’s rebound</td>
<td>Charge the El Niño Task Force with exploring agricultural strategies for La Niña.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make plans to improve water use efficiency and reduce flood risk.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Assess ENSO-related slow onset disasters and government responses</td>
<td>Develop a system of ex ante and ex post assessment and reporting for slow onset disasters.</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Document the chronology of actions taken in the affected areas before, during, and after El Niño.</td>
<td>X</td>
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<td></td>
<td>Identify more cost-effective interventions and adapt them to the Philippines’ context.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Actions</td>
<td>S</td>
<td>M/L</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---</td>
<td>-----</td>
</tr>
<tr>
<td>Prepare detailed ENSO risk and vulnerability maps</td>
<td>Use historical data sources to describe the spatial distribution of crops and potential impacts.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Make maps “smart” by recommending actions for farmers or businesses.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Develop maps with a range of stakeholders.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Improve ENSO forecasting and dissemination</td>
<td>Develop phase-specific scenarios and response protocols to guide agencies to respond to possible rice supply volatility.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Augment drought outlooks with historical climate analysis and recorded market responses.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Make forecasts more detailed and expand dissemination channels.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Strengthen the early warning capacity of government agencies</td>
<td>Identify capacity constraints.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Expand meteorological station coverage.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Make forecasts more user friendly and timelier.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Strengthen Local Government Units’ (LGUs) capacity to deliver aid and services and prepare for El Niño events</td>
<td>Fully implement current preparedness and capacity development projects.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Collaborate with international partners to increase local capacity building measures.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Provide assistance to LGUs to deliver aid and expand preparedness measures.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Provide contingency and preparedness funding for ENSO events</td>
<td>Include these funds in regular programing and at the subnational level.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Trigger funds with early warning systems to avoid undue delays and political issues.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Improve procedures that constrain federal fund dispersal in times of crisis.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Create a separate budget line for slow onset weather events like those associated with El Niño.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Develop a database of ENSO-related initiatives</td>
<td>Include all initiatives in a geo-referenced database.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify priority areas and categorize projects.</td>
<td></td>
<td></td>
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<tr>
<td>Remove rice import quotas</td>
<td>Remove current quotas and consider additional policies.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Adopt drought- and flood-tolerant crop varieties (and fishery practices)</td>
<td>Using site-specific seasonal climate forecasts, recommend stress-tolerant crop varieties.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Carry out additional research and establish links between farmers and research institutions.</td>
<td></td>
<td>X</td>
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<tr>
<td></td>
<td>Scale up the dissemination and farmer awareness through improved extension services.</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

(continued)
TABLE A: Continued.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Actions</th>
<th>S</th>
<th>M/L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparedness</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Improve grain storage</td>
<td>Before a predicted El Niño event, stock grain stores for more than the current 22-day reserve.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>capacity</td>
<td>Purchase additional storage silos.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Apply safeguards to protect producers.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Expand and adjust</td>
<td>Assess constraints to expanding current SSNs.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>social safety nets</td>
<td>Target poor, rural areas and adjust programs to make them more responsive to droughts.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>(SSNs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide emergency</td>
<td>As was done during typhoon Yolanda, wave cash transfer conditionalities during ENSO events.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>cash transfers</td>
<td>Consider activating additional transfers for ENSO preparedness.</td>
<td></td>
<td></td>
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<tr>
<td>during El Niño events.</td>
<td></td>
<td></td>
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<tr>
<td><strong>Resilience</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustain and scale up</td>
<td>Identify Philippine best practices on ENSO-related themes.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>good practices.</td>
<td>Increase human and resource capacity to scale up.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Invest in rural</td>
<td>Assess rural transportation systems and irrigation and water harvesting systems.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>infrastructure</td>
<td>When feasible, expand irrigation and water harvesting systems to improve water use efficiency.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Develop plans to improve and climatize rural roads.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Target women</td>
<td>Develop a strategy targeting women who are vulnerable to ENSO.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Empower women in leadership positions in local- or national-level efforts to combat ENSO impacts.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Target women in SSNs.</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
CHAPTER 1

Introduction

The purpose of this report is to improve the Philippines’ preparedness for the El Niño–Southern Oscillation (ENSO) by informing stakeholders of ENSO’s agricultural and economic impacts. The report finds that ENSO has detrimental impacts on the Philippines’ people, economy, poverty levels, and agricultural sector. The country has taken actions and enacted policies to respond to ENSO events, but these could be improved to more adequately mitigate the costs of ENSO impacts. Being proactive is important because of the Philippines’ high exposure to climate shocks, the rural population’s climate vulnerability, and the prominence of the agricultural sector in the national economy.

The Philippines is highly exposed to ENSO-related climate and agricultural shocks. Since 1980 there were seven severe ENSO events, which include both El Niño and La Niña events. In 1982–1983, El Niño–related droughts affected 450,000 hectares of farmland. The most severe El Niño occurred in 1997–1998 when rainfall fell to half of historical levels, causing drought in two-thirds (68 percent) of the country. This led to forest fires that destroyed almost 10,000 hectares of natural forests.\(^\text{19}\) In 2015–2016, dry El Niño conditions lasted for 18 months and affected about a third of the country. In total, six cities, 16 provinces, and 65 municipalities declared a state of calamity. By May 2016, over 400,000 farmers and 550,000 hectares were directly affected by El Niño–induced drought. Later, La Niña caused flooding in low-lying farm areas causing increases in crop pests and diseases.\(^\text{20}\) Overall, the most recent El Niño event in 2015–2016 caused $327 million in agricultural production losses.

\(^{19}\)OCHA (2015).

\(^{20}\)PAGASA (2015a).
The national economy is highly sensitive to ENSO-related agricultural shocks. Almost a third of the Philippines’ 30 million hectares is devoted to agriculture. The agriculture sector’s share of the country’s gross domestic product (GDP) declined from 25 percent in 1980 to 10 percent in 2016. Agriculture accounts for 30 percent of GDP when the entire agriculture food system (AFS) is included. The AFS includes downstream agricultural processing, input production, and agriculture-related trading. Agriculture still employs over a quarter of the country’s workforce (28 percent in 2017), making it an important source of household income. The prominence of the agricultural sector means that severe ENSO events are estimated to cause a 1.57 percent decrease in GDP, which is equivalent to $3.4 billion in lost value.

The rural population is particularly vulnerable to these climate shocks. Half of the Philippines’ population and two-thirds of all poor people live in rural areas. The overwhelming majority work in agriculture. Poverty reduction has been relatively slow, declining by less than 4 percent from 2012 to 2015. The World Bank estimates that poverty increases from 1997 to 1998 were more attributable to El Niño agricultural shocks than the concurrent Asian financial crisis, which primarily affected higher wage earners. ENSO has also contributed to greater food prices and food insecurity, which lead to greater malnutrition and consumption poverty, since poor families spend more of their total income on food. Poor families also have fewer resources to protect themselves from these ENSO-related price and climate shocks.

The scarcity of research on ENSO in the Philippines and the high likelihood of another El Niño in the near term makes this report well timed. It is difficult to disentangle ENSO’s impacts from those of other climate shocks, natural disasters, and economic cycles. This complicates the design of policies and response mechanisms that help mitigate ENSO-related welfare losses and economic damages. There is a growing body of empirical evidence measuring the effects of climate change and variability on the Philippines’ agricultural and national economies. Few studies, however, focus on the specific impacts of ENSO events, and no studies measure economy-wide outcomes. Moreover, while there is a growing literature on how disasters are managed in the Philippines, there are few quantitative assessments of these policies and how

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23 In 2011 values.
26 Dawe and others (2009).
27 Alderman and others (2006).
Introduction

they can mitigate ENSO-related losses. At the time of writing, forecasts predict there is a 70 percent chance there will be another El Niño event by winter 2018–2019.28

Roadmap

This report looks at some of El Niño and La Niña’s impacts on agriculture—particularly crops, livestock, and fisheries—and how these have implications on the economy and household poverty levels. It will then look at some of the actions the Philippine government has taken to mitigate the losses associated with ENSO events. These actions include some targeted directly at ENSO and others not designed for ENSO but that provide co-benefits. Next, the report simulates how well certain policy options mitigate ENSO-related GDP, poverty, and consumption losses. It concludes by offering recommended actions to continue to build the Philippines preparedness for ENSO. Box 1 provides a brief description of the research’s methodology.

BOX 1: Methodology.

The report synthesizes available evidence and presents new analyses on ENSO’s impacts on the Philippines’ weather, agricultural production, poverty levels, and the broader economy. The evidence comes from a secondary literature review, an analysis of historical data, and a series of simulations. Simulations were carried out using two models. The first is the Decision Support System for Agrotechnology Transfer (DSSAT) model, which is widely used by agricultural researchers to understand crop production system dynamics and simulate different farm management and environmental changes, including climate variability associated with ENSO. The second is a Computable General Equilibrium (CGE) model (refer to Annex 1 for more details).

The models simulate: (i) potential agricultural productivity under various conditions, including water scarcity, different planting months, and low or high fertilizer use; (ii) the indicative impacts of ENSO on livestock using the Temperature Humidity Index (THI); (iii) economic outcomes associated with these productivity losses (usually during El Niño) and gains (usually during La Niña); (iv) economic outcomes, including spillover effects associated with certain policy changes, such as providing drought-resistant crop varieties, increasing irrigated land, providing food import subsidies, removing rice import quotas, increasing grain storage and distribution, providing short-term cash transfers, and a combination of these; and (v) poverty impacts on rural households with male and female household heads. Put simply, the model simulates the impact of historical ENSO events if they were to reoccur today and affect the current economy. This is valuable given the lack of systematic historical analyses of ENSO’s impacts on poverty and broader economic growth. The models do not simulate water supply constraints because of a lack of useable data. For more specifics on the methodology, please refer to Annex 1.

(continued)

BOX 1: Continued.

Figure 1 depicts this report’s analytical framework.

**FIGURE 1: Integrated Analytical Framework.**

- **Weather and climate**
  - Rainfall; temperature (max, min)

- **Crop management**
  - Seed varieties; chemical fertilizer; irrigation; crop calendar

- **Livestock & fisheries**
  - Animal deaths; heat stress; ocean capture stocks

- **Infrastructure**
  - Roads and ports; agricultural capital

- **Policies**
  - Trade policies; price policies (subsidies, taxes); social safety nets

- **Crop yield impacts**
  - Spatial crop models (DSSAT)

**Biophysical outcomes**
- Yields by crop and region

**Economy-wide impacts**
- Dynamic spatial CGE and microsimulation model

**Economy outcomes**
- GDP, poverty, etc.
ENSO, or the El Niño–Southern Oscillation, describes naturally occurring ocean and atmospheric temperature fluctuations across the east-central Equatorial Pacific Ocean. These temperature fluctuations are considered ENSO when they are greater than 1 degree Celsius. El Niño is ENSO’s warm phase and La Niña is ENSO’s cold phase. ENSO events recur, on average, every four years and typically last nine to twelve months or longer. These slight ocean temperature deviations can have large-scale impacts on global weather patterns.

ENSO’s most notable effect is on rainfall; El Niño tends to depress it and La Niña tends to enhance it. These rainfall variations are most pronounced during the driest six months of the year, December to May. During El Niño in the Philippines, rainfall decreased by 14 percent in Luzon, the northern island chain; 21 percent in Visayas, the central island chain; and 35 percent in Mindanao, the southern-most island chain. During La Niña, by contrast, rainfall increased by 31 percent in Luzon, 41 percent in Visayas, and 19 percent in Mindanao (Figure 2).

The Philippines has four distinct climates that are affected differently by ENSO. The interplay of southwest and northeast monsoons leads to the Philippine’s four pervasive climate types, ranging from the very wet eastern coast to the drier western coast. Type I has two pronounced seasons, the dry season from November to April and the wet season from May to October, and is mostly in the western-most regions. Type II has a distinct wet season from November to April, but no dry season and is mainly along the eastern coast. Type III has no distinctive season, with only a slightly drier period from November to April, and is in the central-western region. Type IV has an almost equal distribution of rainfall throughout the year, and is most common in the...
Striking a Balance: Managing El Niño and La Niña in Philippines’ Agriculture

central-eastern region. Figure 3 shows these regional climate patterns. The eastern climate types (II and IV) are the most severely impacted by El Niño from December to March, however damage from El Niño is mitigated by larger groundwater reserves. The western climate types (I and III) are more severely impacted by El Niño from May to September. With some variance, these areas also tend to suffer the most damage, as can be seen in Figure 4.

**FIGURE 2:** Monthly Regional Rainfall (mm) Patterns During El Niño, La Niña, and non-ENSO Years.

![Monthly Regional Rainfall Patterns](image)

ENSO events, and their severity, are difficult to predict with accuracy, especially over the long term. Future ENSO events are predicted using Coupled Ocean-Atmosphere General Circulation Models (CGCMs). These models simulate the complex interactions between oceans and climate systems, based on historical sea surface temperature (SST) trends. There are still many technical and scientific challenges to modeling these complex oceanic and atmospheric processes. Moreover, ENSO forecasting is an actively researched area, and understanding is not complete. For example, it is not known why some ENSO-related weather events are more extreme than others.

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Such was the case for the 2016 La Niña, which was originally projected to have serious rainfall impacts on the country. However, the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) reported there was “near to above normal rainfall” in southern Luzon, Western and Central Visayas, and Northern and Western Mindanao, while there was “near to below normal rainfall” in the rest of the country. This is the opposite of the heavy rainfall that was expected from La Niña. In fact, any ENSO predictions longer than four months in advance are largely unreliable. The United States’ National Oceanic and Atmospheric Administration (NOAA) assessed its ENSO forecast accuracy with different lead times. They concluded that ENSO forecasting was highly accurate one month in advance (correlation coefficient = 0.89), but much less accurate four months or longer in advance (correlation coefficient = 0.60).

30 Pazzibugan (2016).
31 Pazzibugan (2016).
32 Barnston (2014).
CHAPTER 3

ENSO Affects Agriculture

Agriculture, although declining, is a diverse and important part of the Philippine economy. Almost a third of the country’s 30 million hectares was devoted to agriculture in 2015.33 As in other Asian countries, the share of agriculture in GDP declined with economic development—from 25 percent of GDP in 1980 to 10 percent in 2016. Despite this, agricultural GDP per capita has steadily increased, and agricultural GDP growth generally remains positive, although it varies significantly year to year (Figure 5). One reason for the consistent growth is the sector’s diversity of crops, livestock, and fisheries—major crops, based on harvested land area, include rice, coconuts, maize, and


FIGURE 5: Growth and Variability of Agricultural GDP in the Philippines.
and vegetables; major livestock includes pigs, chicken, and cattle; and coastal and inland fisheries include a variety of fish for consumption.

**Crops**

**ENSO affects crop production because it disrupts normal weather patterns.** More specifically, El Niño creates water shortages and La Niña creates water abundance, including flooding. Water shortages reduce crop planting areas, delay planting seasons, and generally lower crop yields. One study found that a one degree increase in sea surface temperatures during July–September is associated with a 3.7 percent decline in irrigated dry season production and a 13.7 percent decline in rainfed dry season production in Luzon. In both irrigated and rainfed systems, the decline was larger for harvested areas (9 percent decline) than for yields (5 percent decline). Another study estimated substantial yield losses for wet season crops, showing rice yield losses during El Niño events in 1973, 1983, and 1990.

**Estimated crop damages from specific ENSO events are substantial.** During the 1982–1983 El Niño, droughts caused $14 million worth of damage to rice and maize production. During the 1992–1993 El Niño, drought caused $156 million worth of damage to agriculture, including 478,000 million tons of maize production losses. The 1997–1998 ENSO, resulted in $240 million worth of agriculture damage, including a 27 percent decline in rice production and a 44 percent decline in maize production. The 2015–2016 El Niño caused $327 million in total agriculture damage (Table 1). It also triggered 1.48 million metric tons of estimated production losses to rice, maize, cassava, and high value crops like rubber and banana. The Department of Agriculture (DA) and the National Economic and Development Authority (NEDA) quantified the agricultural losses from various El Niño events and the results are summarized in Table 1.

**El Niño depletes water reservoirs, leading to crop losses.** The Angat Dam, which supplies water for metro Manila and the Angat-Magat River Irrigation System (AMRIS), has experienced severe shortages during El Niño events. During a relatively minor El Niño from November 1989 to April 1990, water in the auxiliary canal, which supplies Manila, exceeded that of the main canal, which supplies AMRIS. This led to over a 50 percent decrease in areas irrigated by AMRIS during the 1990 dry season.

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34Roberts and others (2009).
35Roberts and others (2009).
36Lansigan and others (2000).
37NEDA (2017).
### TABLE 1: Agriculture Losses Caused by ENSO from 1994 to 2016.38

<table>
<thead>
<tr>
<th>Year</th>
<th>Total*</th>
<th>Rice</th>
<th>Maize</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total area affected (ha)</td>
<td>Production loss</td>
<td>Total area affected (ha)</td>
</tr>
<tr>
<td></td>
<td>Volume (mt)</td>
<td>Value (US$ million)</td>
<td>Volume (mt)</td>
</tr>
<tr>
<td>1994–1995</td>
<td>183,572</td>
<td>405,775</td>
<td>2.69</td>
</tr>
<tr>
<td>(Aug–Apr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997–1998</td>
<td>677,441</td>
<td>1,056,743</td>
<td>87.26</td>
</tr>
<tr>
<td>(Apr–May)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002–2003</td>
<td>159,043</td>
<td>340,938</td>
<td>25.33</td>
</tr>
<tr>
<td>(Apr–Mar)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004–2005</td>
<td>204,688</td>
<td>349,762</td>
<td>44.45</td>
</tr>
<tr>
<td>(Jun–Feb)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug–Feb</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2009–2010</td>
<td>555,102</td>
<td>1,180,000</td>
<td>375.90</td>
</tr>
<tr>
<td>(Jun–May)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>556,721</td>
<td>1,480,672</td>
<td>326.90</td>
</tr>
<tr>
<td>(Feb–July)</td>
<td></td>
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</table>

*Totals include losses to vegetables, other crops, livestock, and fisheries.*


and a 28 percent crop yields decline.39 During the 1997–1998 El Niño, the Angat Dam reached critically low levels. This led to officials cutting off irrigation for 27,000 hectares of rice and maize, affecting 15,000 farm households and reducing rice production by an estimated 100,000 metric tons.40 This also led to reduced water provision for Manila.

**El Niño can cause local yield declines that do not occur in the entire country.** Simulations show crop yield declines would vary widely during El Niño events, from roughly 20 percent in some regions to 70 percent in others. However, these declines may not affect the entire country. For example, CGE simulations also show that during a strong El Niño event, only about 7 percent of the country’s agricultural areas would be affected, but crop yield declines in these areas could reach 70 percent. Assuming yields for the other 93 percent of agricultural areas are similar to these affected regions, this local 70 percent decline in yields would equal to only about a 5 percent decline nationally.41

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38This report’s literature review revealed there is much more available information on rice and maize production impacts than on other crops or livestock and fisheries production impacts.


40Jegillos (2000).

4170 percent loss of crops in 7 percent of crop area equals a 4.9 percent loss in 100 percent of crop areas.
Rice production tends to fall during El Niño, but the relationship is inconclusive. FAOSTAT data shows rice production falls in five out of seven ENSO phases. This relationship is more pronounced during strong El Niño phases, which are more likely to extend into the rainy season and delay rice planting, diminish irrigation, and reduce harvestable areas. A weaker, shorter-lived El Niño may affect a smaller area and only a single growing season, not multiple. One study showed this relationship in a statistical analysis for 1970–2005. It estimated 0.2 percent rice production declines during weak El Niño events, 6 percent during moderate El Niño events, but 22 percent during strong El Niño events. Moreover, Figure 6 shows that strong El Niños in 1982–1983 and 1997–1998 led to major losses in rice productions. It also shows that a mild El Niño, such as in 2004 and 2006–2007, may have an overall positive effect because it still provides just enough water, but can lead to less overcast skies and more sunlight for plant growth. Figure 7 shows the most likely time to see production declines from ENSO events is during the ENSO’s second year. This is because by the second year, droughts are likely to have reduced harvested areas. Figure 7 also shows there is no discernable pattern. Sometimes area contraction sees increased yields (as in 1992); sometimes it reinforces yield declines (as in 1998 and 2016); and sometimes it has no impacts on yields (as in 2010; albeit with a decline from a few years previous).

Studies show maize production will decline from El Niño. A simulation analysis of El Niño impacts on yellow maize in Isabela Province, which is the largest maize producing province, estimated a 70 percent decline in the 2010 dry season and a 68 percent decline

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42FAOSTAT and National Oceanic Atmospheric Administration (NOAA) Climate Prediction Center.
43Delos Reyes and David (2009).
44Weak, moderate, and strong El Niño events relate to the strength of rainfall variation.
FIGURE 7: Countrywide Rice Statistics Overlapping with Several El Niño Episodes.

Source: FAOSTAT (2017) and National Oceanic Atmospheric Administration (NOAA) Climate Prediction Center.

in the 1998 dry season.45 Smaller reductions of 19 and 18 percent were estimated for the 1987 and 2014 dry seasons. The study also showed 19 percent yield reductions during the 2007 wet season. Generally, only 15 percent of maize production is generated during the dry season. Data46 for maize show a less discernable relationship with ENSO events. Half of all El Niño events since 1990 are associated with lower maize production, with production increases or no effects for the other events. Maize production impacts from El Niño at the national level are mainly driven by changes in land area. During La Niña events, the analysis shows up to 20 percent maize yield increases.47

Unlike other crops, national coconut production responds negatively to La Niña. The seven leading crops by harvested area in the Philippines are rice, coconuts, maize, vegetables, bananas, sugarcane, and cassava. All of these would likely see production increases during La Niña that do not produce damaging floods, except coconuts. Coconut production declines are less attributable to declines in harvested areas, like

45Tongson and others (2017).
46From National level statistics from FAOSTAT (2017) and the National Oceanic Atmospheric Administration (NOAA) Climate Prediction Center.
47Tongson and others (2017).
for rice and maize, because coconut harvesting areas change slowly. Furthermore, coconut yield declines do not occur after El Niño events that lack a La Niña event afterwards. This suggests coconut declines are caused by La Niña and not a delayed effect from El Niño.48

There is no clear association between ENSO and banana, cassava, or sugarcane production. Banana production does not show much modulation. Sugarcane yields see some increases during La Niña, but sugarcane yields, production, and harvested areas all vary widely, which obscures any simple relationship to ENSO. Evidence suggests cassava is as likely to have yield increases as yield decreases during an El Niño event.49

Simulations show La Niña crop yield gains can partially make up for El Niño yield losses. Figure 8 generally demonstrates this trend. It shows maize, usually grown in relatively dry conditions, had large simulated yield reductions, especially in Visayas, under both moderate and strong El Niño conditions. For rice, yield reductions were insignificant under moderate El Niño scenarios, especially during the wet season, but highly significant during strong El Niño scenarios. Strong El Niño conditions predict major yield losses in Mindanao (22 percent), Visayas (13 percent), and Luzon (7 percent). When moderate El Niño conditions were combined with water shortages for rice yields, Figure 8 shows only minimal yield losses. This reinforces the earlier finding that rice yields are more impacted by losses in harvestable lands than by dry conditions. The simulation also shows that La Niña’s wetter conditions would increase rice and maize yields. However, the simulations did not account for the possibility of flooding, which tends to be the largest threat to crops during La Niña. Finally, tomatoes, which generally favor dry season conditions—including higher temperature, solar radiation, low humidity, adequate irrigated water supplies, and low disease pressures—see yield increases during dry El Niño conditions and yield losses during wetter La Niña conditions.

Pests and typhoons cause major damages in the Philippines, but these are not likely caused by ENSO. One study50 shows that from January to May 2016 there were $185 million in agricultural damage, with pest infestation accounting for $35 million of those damages. This pest damage coincided with an El Niño event, but the relationship between the two is weak. Overall, over 200,000 farmers were negatively affected by drought and pest infestation during this period. However, evidence51 suggests this is

48Information for this paragraph is taken from FAOSTAT’s national data from 1990–2016.
50Cordero (2016).
51Gregory and others (2009).
more a consequence of long-term climate change than shorter term El Niño events. A forthcoming report\(^52\) shows floods, droughts, and typhoons from 2000 to 2013 caused annual damages of $12 million to facilities and $22 million to irrigation systems. However, the majority of these types of structural damages are caused by typhoons not droughts and floods, but typhoons have no discernable correlation with ENSO events.

**Livestock**

There is very little evidence suggesting that ENSO affects livestock production. The 2015–2016 El Niño caused an estimated livestock value loss of only about $9,000: a negligible loss.\(^53\) Aggregate national production data also show little or no

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\(^{52}\)Ravago and others (2018, forthcoming).

\(^{53}\)NEDA (2017).
Striking a Balance: Managing El Niño and La Niña in Philippines’ Agriculture

The Philippine Statistics Authority reported\textsuperscript{54} that livestock and poultry production increased by 3.25 percent and 8.76 percent during the third quarter of 2015, despite the intense heat brought about by El Niño. Figure 9 shows livestock production expanded from 1 million tons in 1980 to 5 million tons in 2016, with strong production growth for hogs and chicken but almost no production growth for cattle and carabao. Figure 9 also shows there was no direct association between livestock production and ENSO events in the Philippines. That said, the slight decline in hog and chicken production in 1985 coincides with a La Niña event, and the slight decline in hog production in 2004 coincides with an El Niño event. However, a lack of other associations makes causality weak.

\textbf{FIGURE 9:} Livestock Production (’000 mt) and ENSO Events, 1980–2016.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure9.png}
\caption{Livestock Production (’000 metric tons) and ENSO Events, 1980–2016.}
\end{figure}

\textit{Source:} PSA CountrySTAT.

ENSO causes more high Temperature Humidity Index (THI) days, which may cause increased stress on livestock and related cost increases for producers. THI measures heat stress based on temperature and humidity. Whereas El Niño and non-ENSO years do not increase the number of high THI days, La Niña, because of higher humidity, increases the number of moderate-to-severe THI days by 25.\textsuperscript{55} Once daily THI exceeds 75, cattle begin to experience ill effects from heat stress.\textsuperscript{56} This can cause declines in milk productivity ranging from 0.20 to 0.88 kilograms per additional unit of THI increase.

\textsuperscript{54}PSA (2015).
\textsuperscript{55}Kalnay and others (1996).
\textsuperscript{56}West (2003).
Swine and poultry dominate the Philippine livestock sector and are generally less heat tolerant than cattle. Cattle and carabao are significant in the Philippines livestock sector, but less so than swine and poultry. Overall, swine is less heat tolerant than poultry, which is less heat tolerant than cattle.\(^{57}\) Swine begins to see negative outcomes, including in reproductive performance, when temperatures reach 70 degrees Fahrenheit.\(^{58}\) A THI of about 80 degrees Fahrenheit causes declines in poultry egg size, feed intake, and egg quality.\(^{59}\) Temperatures in the Philippines are regularly sub-optimally hot for swine and poultry production, but La Niña only makes this more the case. As such, it is possible that producers are already familiar with dealing with heat stress, so the ultimate consequences from La Niña’s added high THI days are muted.

**Fisheries**

**ENSO can have negative impacts on fishing, but the evidence is inconclusive.** A report by the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) shows that surface and subsurface water temperature rises in the Pacific Ocean during El Niño may reduce annual fish catches by 20 percent (447,000 metric tons) in open waters and by 23 percent (279,000 metric tons) in waters within 15 kilometers of the shoreline, or “municipal waters.”\(^{60}\) Moreover, the model estimates that fish production falls by 3.6 percent during El Niño events.\(^{61}\) Another study\(^{62}\) found that fish production in municipal waters decreased during the 1997–1998 El Niño when small pelagic fish moved from warm shallow waters to cooler deep waters. Furthermore, the tuna catch declined by 58 percent in the Cagayan Valley in Luzon and Zamboanga in Mindanao.\(^{63}\) Such declines can have considerable impacts on the food security and livelihood conditions of fishing communities.

**Aquaculture production declined during ENSO events.** Aquaculture was the most affected fisheries subsector during the 2002–2003 ENSO with seaweed mariculture, brackish water ponds, and cage operations all incurring heavy losses.\(^{64}\) In Bolinao, Pangasinan, in Luzon, a massive milkfish kill occurred in maricultures from algal blooms from January to February 2002. Algal blooms happen when high temperatures

\(^{57}\)Xin and Harmon (1998); Myer and Bucklin (2001).
\(^{58}\)Wegner and others (2016).
\(^{59}\)Lara and Rostango (2013).
\(^{60}\)Domingo (2016).
\(^{61}\)Damatac and Santos (2016).
\(^{63}\)Vera and Hipolito (2006).
\(^{64}\)Azanza and others (2005).
increase water nutrient levels. In 2016, El Niño’s hot sea water temperatures diminished the production of milkfish (−2.4 percent), tilapia (−4.5 percent), roundscad (−11.8 percent), tigerprawns (−5.3 percent), skipjack (−14.1 percent), and yellowfin tuna (−12.8 percent). This led to a 7 percent reduction in the value of commercial fisheries and a 2.5 percent decline in the value of municipal fisheries. In April and May 2016, El Niño led to seaweed production declines of 16 percent.

Much of the evidence suggests that ENSO has little impact on fisheries and may even be beneficial. National production data show fish production from 1980 to 2015 has consistently risen in the Philippines despite numerous ENSO events (Figure 10). Total fish production grew from 1.8 million metric tons in 1980 to 4.7 million metric tons in 2015 because of a rapid increase in aquaculture production during those years. Moreover, some studies link ENSO to higher fish production. For example, the sardine fishery in Zamboanga had its highest catch rates during the El Niño events of 2003, 2005, and 2007. This can be attributed to ENSO-caused upwelling—the process where deep, cold, nutrient-rich water rises toward the surface—which benefits pelagic plankton feeding species such as sardines.

FIGURE 10: Fisheries Production (million mt) and ENSO Events, 1980–2015.

Source: PSA CountrySTAT.

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65 Damatac and Santos (2016).
66 PSA (2016a).
67 PSA (2016a). The decline in municipal fisheries was because of less fishing activity in coastal areas during hot weather conditions.
68 PSA (2016b).
70 Guerrero (2009).
71 Villanoy and others (2011).
The effects of ENSO can be felt throughout the Philippine economy. As discussed above, ENSO has major implications on the agricultural sector. By extension, the agricultural sector is a major source of production and employment for the national economy, although, as discussed above, its share of national GDP declined over the years and the sector still trails both manufacturing and services (Table 2). Employment in agriculture declined a bit more slowly—from 50 percent in 1987 to 28 percent in 1997.

<table>
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<tbody>
<tr>
<td>Share of total (%)</td>
</tr>
<tr>
<td>All sectors</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Crops and livestock</td>
</tr>
<tr>
<td>Luzon</td>
</tr>
<tr>
<td>Visayas</td>
</tr>
<tr>
<td>Mindanao</td>
</tr>
<tr>
<td>Forestry &amp; fishing</td>
</tr>
<tr>
<td>Industry</td>
</tr>
<tr>
<td>Mining</td>
</tr>
<tr>
<td>Manufacturing</td>
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<tr>
<td>Agro-processing</td>
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<tr>
<td>Other manufactures</td>
</tr>
<tr>
<td>Other industry</td>
</tr>
<tr>
<td>Services</td>
</tr>
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</table>

Source: Philippines CGE model and 2011 SAM.
Note: GDP is gross domestic product; employment is workers in primary jobs.
2017—underscoring the sector’s importance for household incomes.\footnote{World Bank (2018).} It is also the case that agriculture is a source of significantly less trade (fewer imports and exports), though even small shares of overall trade can strongly impact workers in downstream sectors and consumers purchasing foods in local and national markets. However, using a detailed social accounting matrix (SAM)\footnote{The SAM separates the Philippines economy into 65 producer sectors and 30 consumer household groups in Luzon, Visayas, and Mindanao. Together these groups capture the entire consumer and producer population across rural and urban areas and per capita expenditure levels.}, it is possible to estimate the size of the Philippine’s broader agriculture food system (AFS). Table 3 shows agriculture was only 12.5 percent of total GDP in 2011. But, when downstream agricultural processing, input production, and agriculture-related trading and transporting are included, the contribution of AFS rises to over 30 percent of GDP. This is 2.5 times the size of agriculture’s direct GDP share. ENSO-related shocks to agriculture can, therefore, have important economy-wide implications.

<table>
<thead>
<tr>
<th>TABLE 3: Agriculture Food System GDP and Employment, 2011.</th>
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<tbody>
<tr>
<td><strong>Share of national total (%)</strong></td>
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<tr>
<td></td>
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<tr>
<td>National economy                                  100</td>
</tr>
<tr>
<td>Agriculture food system                           30.3</td>
</tr>
<tr>
<td><strong>Direct production</strong></td>
</tr>
<tr>
<td>Agriculture                                       12.5</td>
</tr>
<tr>
<td>Agro-processing                                   9.6</td>
</tr>
<tr>
<td><strong>Input production</strong></td>
</tr>
<tr>
<td>Agriculture                                       0.7</td>
</tr>
<tr>
<td>Agro-processing                                   2.6</td>
</tr>
<tr>
<td><strong>Trade and transport</strong></td>
</tr>
<tr>
<td>Agriculture                                       1.4</td>
</tr>
<tr>
<td>Agro-processing                                   3.5</td>
</tr>
</tbody>
</table>

Source: Philippines CGE model and 2011 SAM.
Note: GDP is gross domestic product; employment is workers in primary jobs.

The CGE model predicts modest economic losses during moderate El Niño years (Table 4). Modeling shows national GDP falls by only 0.29 percent during moderate El Niño years compared to non-ENSO years. However, even small percentage reductions in national GDP can imply substantial monetary losses. For example, a 0.29 percent drop in national GDP is equal to about $620 million in lost value-added (measured in...
ENSO Contributes to Economic Impacts

2011 prices). Agricultural GDP falls by much more. Nationally, the model predicts a 1.73 percent decline in agricultural GDP, and in Luzon, it predicts a 1.85 percent decline in crop and livestock GDP, a subsection of agricultural GDP. The model suggests that agricultural productivity losses during strong El Niño events reduce national GDP by much more: 1.57 percent, equivalent to $3.32 billion. The model predicts much larger losses in crops and livestock GDP: 8 percent nationally and 9.3 percent in the Luzon region. Crops and livestock excludes forestry and fisheries GDP. Box 2 explains how these losses can be compounded by external factors.

La Niña events, particularly stronger events, are predicted to benefit the economy. All GDP categories in all regions see predicted gains during strong La Niña events (Table 4). Moderate La Niña events saw some gains also, particularly in Luzon and Visayas, though generally, moderate La Niña events see modest losses. Mindanao’s crop and livestock GDP declined by 1.21 percent. Despite these predicted gains, it is important to note that La Niña gains ($0.51 billion) do not offset El Niño losses ($3.32 billion).

Overall, the CGE model estimates that El Niño’s impacts on agriculture cause substantial damages outside of agriculture. Figure 11 summarizes simulated GDP losses in different economic sectors during strong El Niño years. It shows percentage GDP losses are largest in agriculture, particularly for crops and livestock, but much lower for the broader AFS and the national economy. In other words, a strong El Niño affects a larger portion of the agriculture sector than other sectors. However, absolute (dollar value) losses are larger in the broader economy (–$3.3 billion) than in the agriculture sector (–$1.8 billion). This is because of negative spillovers from agriculture into other sectors. For example, lower agricultural production reduces the supply of

BOX 2: External Factors Can Exacerbate ENSO’s Impacts.

ENSO’s agricultural-related social and economic impacts can be exacerbated by external factors. As such, it is not possible to completely disassociate damages caused by ENSO events and damages caused by other events. The 1997–1998 ENSO, which actually persisted through early 2001, merits special consideration. The strong warm phase began in May 1997 and then switched to a persistent cold phase in July 1998 that did not dissipate for nearly three years. This extended ENSO overlapped with the Asian Financial Crisis. During this period, ENSO phases led to 25 percent production losses, which accounts for 13 percent of maize production losses and 8 percent of rice production losses, among other losses. These losses compounded the human and economic consequences from the financial crisis. Fortunately, this is an extreme example and not all ENSO events are exacerbated to this extent.
raw materials for agriculture-related processing and trade. As a result, GDP losses in the AFS are larger (~$2.7 billion) than direct losses in agriculture. Similarly, when agricultural incomes fall, so too does production in nonagricultural sectors, which relies on the demand this income generates. National GDP losses are therefore even larger than losses for the AFS.
The CGE model also estimates that La Niña creates slightly greater benefits in agriculture than the wider economy. Figure 12 shows that agricultural GDP dollar gains are higher in agriculture than for the AFS or national economy. This is because higher agricultural productivity during La Niña draws in labor from nonagricultural sectors such that GDP gains are larger in agriculture than elsewhere in the economy, including the AFS. As could be expected, these dollar gains reflect a greater GDP percentage gain in agriculture as well, especially for crops and livestock which benefit directly from La Niña conditions.
CHAPTER 5

ENSO Contributes to Social Impacts

Most poverty in the Philippines occurs in rural areas, and poverty reduction has been slow. The rural sector constitutes half the national population and continues to account for about two-thirds of all poor people. Over the past three decades, poverty reduction has been consistent but was slowed during the global financial crisis. After declining from 34 percent in 1991 to 27 percent in 2006, the national poverty headcount dropped only 2 percent from 2006 to 2012 (to 25 percent). In 2015, poverty sat at just under 22 percent. Table 5 uses CGE modeling to show the average Filipino consumes $1,743 of goods and services per year on average. This is six times higher than what a poor rural Filipino consumes. Hence, despite rapid urbanization in recent years, poverty in the Philippines is a significantly rural phenomenon.

ENSO has differential implications on poorer income groups. The poorest households, even in rural areas, tend to not own land and are more likely engaged in landless farm labor or off-farm labor. Table 5 reinforces this, showing nearly three-quarters of rural poor income comes from labor remuneration (71.7 percent) and not crop land returns. The rural poor typically do not own the land on which they work so do not earn income from cropland returns or capital profits like the rural non-poor. Therefore, when ENSO reduces harvestable land or causes lower yields, it has major impacts on farm labor demand and income. The World Bank estimates that much of the increase in poverty, from 25 percent in 1997 to 28 percent in 1998, was attributable to the impact of an El Niño shock on the agricultural sector, rather than to the effects of the concurrent Asian financial crisis, which primarily affected relatively better-off wage earners.

74 PSA CountrySTAT (2017).
75 At market exchange rates unadjusted for purchasing power parity.
76 World Bank (2001).
El Niño leads to higher food prices. Historical data\textsuperscript{77} show there were several large increases in Philippine rice prices in the aftermath of El Niño events. This outcome was avoided in the severe El Niño of 1997–1998 through appropriate management of stocks and imports.\textsuperscript{78} The Organisation for Economic Co-operation and Development (OECD)\textsuperscript{79} simulated that a 10 percent national production decline and a 4 percent global production decline for rice and maize and a 2 percent global production decline in wheat, would lead to a 7 percent price increase for wheat, a 10 percent price increase for maize, and a 15 percent price increase for rice. The CGE model (Figure 13) reinforces that ENSO, particularly El Niño, raises food prices. For example, cereal prices, which include rice and maize prices, increase by 43 percent during a strong El Niño event, and, together with shocks to other crops and livestock, cause

\textsuperscript{77}Dawe and others (2009).
\textsuperscript{78}Roberts and others (2009).
\textsuperscript{79}OECD (2017).

### TABLE 5: Household Income and Consumption, 2011.

<table>
<thead>
<tr>
<th></th>
<th>National</th>
<th>Rural</th>
<th>Rural poor</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (millions)</td>
<td>94.5</td>
<td>47.8</td>
<td>19.3</td>
<td>46.7</td>
</tr>
<tr>
<td>Consumption per capita (US$)</td>
<td>1,743</td>
<td>679</td>
<td>287</td>
<td>2,832</td>
</tr>
<tr>
<td>Food consumption share (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cereals and roots</td>
<td>20.6</td>
<td>27.8</td>
<td>42.3</td>
<td>18.2</td>
</tr>
<tr>
<td>Vegetables</td>
<td>6.5</td>
<td>4.6</td>
<td>2.2</td>
<td>7.1</td>
</tr>
<tr>
<td>Fruits</td>
<td>1.4</td>
<td>1.1</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Meat, fish, and eggs</td>
<td>32.5</td>
<td>30.7</td>
<td>24.9</td>
<td>33.1</td>
</tr>
<tr>
<td>Milk and dairy</td>
<td>5.7</td>
<td>6.0</td>
<td>3.1</td>
<td>5.6</td>
</tr>
<tr>
<td>Pulses and oilseeds</td>
<td>1.3</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Other foods</td>
<td>32.0</td>
<td>28.6</td>
<td>25.3</td>
<td>33.1</td>
</tr>
<tr>
<td>Food consumption share (%)</td>
<td>40.4</td>
<td>50.8</td>
<td>61.4</td>
<td>37.9</td>
</tr>
<tr>
<td>Processed food share (%)</td>
<td>90.2</td>
<td>88.2</td>
<td>79.5</td>
<td>90.9</td>
</tr>
<tr>
<td>Total household income (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cropland returns</td>
<td>3.3</td>
<td>16.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Labor remuneration</td>
<td>35.1</td>
<td>52.5</td>
<td>71.7</td>
<td>30.5</td>
</tr>
<tr>
<td>Capital profits</td>
<td>50.4</td>
<td>10.4</td>
<td>0.0</td>
<td>60.8</td>
</tr>
<tr>
<td>Other sources</td>
<td>11.2</td>
<td>21.0</td>
<td>28.3</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Source: Philippines CGE model and 2011 SAM.
Note: Food consumption excludes meals prepared outside the household. Processed foods exclude products processed and consumed within the household. Other income sources include social and foreign remittances.
agricultural prices to rise by 23 percent. La Niña, by contrast, generally reduces food prices: cereal prices fall by 23 percent during a strong La Niña event causing agricultural prices to drop by 9 percent.

**Higher food prices hurt the poor.** Table 5 shows poor rural households in the Philippines spend more of their earnings on food consumption—about 20 percent more than the average Filipino household. Poor urban households also spend more of their incomes on food. So production declines disproportionately impact poor consumers by raising food prices. This leads to greater food insecurity and explains why poverty rises and real consumption falls for both rural and urban households in the CGE model.

**El Niño events are likely to impact health, though evidence is anecdotal.** In a global context, even short-term shocks, such as droughts, during children’s early years, can have long-term negative effects on individuals’ nutritional status.\(^{80}\) When such events reduce food consumption levels, it leads to long-term reductions in height and school achievement. However, the broader socioeconomic impacts of disasters and shocks are rarely substantiated with hard data in the Philippines.\(^{81}\) This limited information partly reflects measurement problems relating to the annual

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\(^{80}\) Alderman and others (2006).

\(^{81}\) Benson (2009).
occurrence of disasters: disasters are so common in the Philippines that the benefits of a disaster-free year cannot be directly measured.

**Hunger, child wasting, and undernourishment remain persistent challenges in the Philippines.** In 2015, the hunger rate was the lowest since 2004. Subnationally, Mindanao’s hunger rate declined by 9 percent. Despite this, national hunger was still at 13 percent in 2015.\(^82\) The proportion of undernourished people in the Philippines also dropped from 26 percent in 1990–1992 to 14 percent in 2014–2016, but this still leaves nearly 14 million undernourished people.\(^83\) By contrast, wasting, or a low weight-for-height ratios for children under 5 years old, has not improved, increasing from 6 percent in 1982 to 8 percent in 2013.\(^84\) It is unclear how much ENSO events impact these indicators, but since ENSO affects food security, it likely would affect hunger, wasting, and undernourishment as well.

**ENSO has made communities prone to disease.** During the 1997–1998 ENSO, the lack of drinking water and the prevalence of unsanitary hygiene conditions made communities prone to communicable diseases.\(^85\) Outbreaks of malaria, dengue or H-fever, diarrhea, and cholera were reported by early 1998. The UN reported\(^86\) that droughts associated with the 2015–2016 El Niño reduced the ability of lactating mothers to breastfeed by 70 percent from before the drought. It also reported that the drought reduced the ability of lactating women to consume three meals a day by 42 percent. Despite this, NEDA\(^87\) reported that the lack of water led to “no reported breakout of diseases and epidemics,” though they also acknowledge health may have been negatively affected in some areas.

**Women are less involved in agricultural work in the Philippines than other East Asian-Pacific countries, but remain vulnerable to ENSO nonetheless.** Philippine women are more involved in agricultural production further along the value chain because gender norms dictate women should be more involved in non-farm labor.\(^88\) In 2016, 17 percent of employed females worked in agriculture, compared to 33 percent

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\(^82\)NEDA (2016).  
\(^83\)FAO, IFAD, and WFP (2015).  
\(^84\)WB-WDI database.  
\(^85\)Jegillos (2000).  
\(^86\)UN-ESCAP (2016).  
\(^87\)NEDA (2016 April).  
\(^88\)Chandra and others (2017); Estudillo and others (2001); gender.cgiar.org/wp-content/uploads/2018/05/FISH-Gender-Norm-Study-Philippines-Bangladesh-Report_FA.pdf
of employed males.\textsuperscript{89} By contrast, 73 percent of employed women work in the service industry, compared to 44 percent of employed men.\textsuperscript{90} In fisheries, women are involved in pre- and post-fishing—especially processing and marketing—but their participation is usually part-time and unpaid.\textsuperscript{91} Women have less access to land and other productive assets compared to men,\textsuperscript{92} making them vulnerable to extreme climate events in agrarian communities. This vulnerability can lead to migration, resource poverty, food insecurity, increased discrimination, and the loss of customary land rights.\textsuperscript{93}

\begin{itemize}
  \item \textsuperscript{89}Word Bank Gender Data Portal.
  \item \textsuperscript{90}Word Bank Gender Data Portal.
  \item \textsuperscript{91}D’Agnes and others (2005).
  \item \textsuperscript{92}Chandra and others (2017); FAO (2015).
  \item \textsuperscript{93}Chandra and others (2017).
\end{itemize}
CHAPTER 6

The Philippines Has Taken Many Actions That Directly and Indirectly Support ENSO Preparedness

Domestic actions

The National Economic and Development Authority (NEDA) leads the Philippines’ El Niño Task Force, which developed a Roadmap to Address the Impact of El Niño (RAIN). The president appointed NEDA to lead the interagency Task Force during the 2015–2016 El Niño. NEDA’s appointment shows the government views ENSO as an economic development issue, not just an agriculture issue. As such, the Task Force developed RAIN, which focuses on 67 provinces affected by El Niño. RAIN has several components, or responses to El Niño, including cloud seeding, Cash-for-Work, food distribution, public information, water system improvements, and seeds and fertilizer distribution. NEDA says RAIN stabilized food prices and food supplies by supporting crop production in unaffected or mildly affected regions at times when other areas were broadly impacted by drought. During the most recent El Niño, NEDA recommended allotting $165 million for 2015 and $257 million for 2016.

95 Other members of the El Niño Task Force include: Bureau of Animal Industry, BFAR, Bureau of Soils and Water Management (BSWM), National Disaster Risk Reduction and Management Council (NDRRMC), Mindanao Rural Development Program, Philippine Carabao Center, Philippine Center for Postharvest Development and Mechanization, Philippine Crop Insurance Corporation (PCIC), Philippine Rice Research Institute (PhilRice), and Sugar Regulatory Board.
96 NEDA (2016).
to prepare for El Niño.\textsuperscript{97} Allocations included $83 million to manage water supplies, $20 million to provide food stamps, and another $40 million to support affected urban households.

The Department of Agriculture is the Philippines’ lead agency for managing drought risks on agriculture. The DA activated the National El Niño Task Force in mid-2014 in coordination with regional and provincial El Niño Task Force offices.\textsuperscript{98} For instance, South Cotabato’s provincial government formed a provincial task force composed of the Provincial Agriculture Office and other stakeholders.\textsuperscript{99} These sub-national task forces monitor drought incidence and direct farmers to the DA’s support programs.\textsuperscript{100} One such program pays claims to farmers whose rice and maize fields were damaged by drought. Table 6 shows the number of farmers that received payments and how much. Almost 40,000 claims were paid during the 2015 El Niño, of which 26,000 supported rice farmers. While helpful, this represents a small fraction of the country’s 2.4 million rice farmers.

The National Disaster Risk Reduction and Management Council (NDRRMC) leads disaster preparedness and rehabilitation programs. The NDRRMC emphasizes the government’s policy shift from emergency response to disaster preparedness and is responsible for risk reduction, prevention and mitigation, rehabilitation and recovery, and financial protection from natural disasters, including drought and flooding.\textsuperscript{101} For example, in preparation for the 2016 La Niña, the government, under the Department

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<tbody>
<tr>
<td><strong>Particulars</strong></td>
<td>2014</td>
<td>2015</td>
<td>2016</td>
<td>2017</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rice</td>
<td>Maize</td>
<td>Rice</td>
<td>Maize</td>
<td>Rice</td>
</tr>
<tr>
<td>Number of farmers</td>
<td>4,362</td>
<td>4,462</td>
<td>26,545</td>
<td>13,039</td>
<td>12,596</td>
</tr>
<tr>
<td>Claims paid (US$ million)</td>
<td>0.30</td>
<td>1.34</td>
<td>2.22</td>
<td>0.49</td>
<td>6.38</td>
</tr>
<tr>
<td>Claim per farmer (US$)</td>
<td>191.44</td>
<td>250.18</td>
<td>209.82</td>
<td>210.94</td>
<td>243.60</td>
</tr>
</tbody>
</table>

\textit{Source: DA, Field Programs Operational Planning Division through WB-Philippine office.}

\textsuperscript{98}Diega (2015).
\textsuperscript{99}United Nations (2016).
\textsuperscript{101}RA 10121 (n.d.).
The Philippines Has Taken Many Actions That Directly and Indirectly Support ENSO Preparedness

of Budget and Management, apportioned $2.7 million for disaster risk reduction programs, including flood control and relief.\textsuperscript{102} Also, the NDRRMC coordinates the government’s disaster risk management with the private sector\textsuperscript{103} and focuses on building local capacity as described in the NDRMMC’s National Disaster Preparedness Plan.\textsuperscript{104}

The Department of Interior and Local Government (DILG) leads the government’s efforts to build local capacity. DILG has a leading role in building the capacity of local governments. These duties include: trainings, drills and exercises, contingency planning, pre-positioning and stockpiling, capacitating and organizing responders, and disaster risk reduction research. DILG strengthens disaster preparedness by using a “whole-of-government” approach in its Disaster Preparedness Manual, or Operation Listo.\textsuperscript{105} In April 2016, DILG launched two additional components of Operation Listo. The first, the Listong Pamayanan, built preparedness capacity at the village level, the second, the Listong Pamilyang Pilipino, built preparedness capacity at the household level.

PAGASA’s subnational seasonal climate forecasts are reliable and improving. PAGASA analyzes and reports information on El Niño’s onset, spread, and decline. During the recent 2015–2016 El Niño season, PAGASA issued 13 monthly provincial-level drought outlooks that accurately predicted drought in all but two cases.\textsuperscript{106} This is comparable to the quality of predictions by NOAA, though PAGASA reports tend to be overly technical and their climate outputs are delayed by about a month.\textsuperscript{107} In May 2016, prior to La Niña, PAGASA issued a “La Niña Watch” that warned of potential flooding in low-lying agricultural lands, threats to farm lands and standing crops, increases in pests and disease, and coastal erosion from coastal flooding.\textsuperscript{108}

Since 2010, the government has been engaged in several initiatives that directly reduce ENSO risk, but were not intended for ENSO. These include the following:

- The National Action Plan (NAP) to Combat Desertification 2010–2020. The NAP addresses drought, land degradation, and desertification by improving rainwater harvesting and small-scale irrigation systems, establishing agrometeorological

\textsuperscript{102}Acosta and others. (2016).
\textsuperscript{103}PreventionWeb (n.d.).
\textsuperscript{104}NDRMMC (2011).
\textsuperscript{105}PreventionWeb (2016).
\textsuperscript{106}PAGASA (2015b); PAGASA (2016).
\textsuperscript{107}PAGASA (2015b); PAGASA (2016); NOAA (2015).
\textsuperscript{108}GMA (2016).
stations and early warning systems, and launching information and communication campaigns.\textsuperscript{109}

- **The Adaptation and Mitigation Initiative in Agriculture (AMIA).** Launched in 2014, AMIA aims to strengthen the capacity of vulnerable agriculture and fishing communities to pursue sustainable livelihoods while effectively managing the impacts of climate change and other climate-related risks by 2022.\textsuperscript{110} Under the AMIA project, 17 pilot sites carried out community-level research and tested various climate-resilient agricultural (CRA) technologies across the country.

- **The Nationwide Operational Assessment of Hazards (NOAH).** Also launched in 2014, NOAH provides climate information to improve farmer productivity. This information includes seven-day weather forecasts, crop assessments, and drought vulnerability maps for important crops. This helps farmers understand what, where, and when to plant.\textsuperscript{111}

- **The Philippines is piloting Weather Index–Based Insurance (WIBI).** WIBI is standardized, transparent, and less costly to administer than traditional forms of insurance. As such, it is a viable option to adjust for ENSO scenarios. Nevertheless, given that WIBI coverage is based on a predetermined index of damages, losses could be higher or lower than the household’s coverage. As a result, WIBI often requires subsidies to be sustainable. Moreover, WIBI has been beset with operational issues and challenges, such as the difficulty in eliminating subsidies, creating climate-based risk profiles, and developing location- and crop-specific indexes.

- **The Philippine government frequently assists farmers and fishers with subsidies to cope with climate-related impacts.**\textsuperscript{112} These subsidy programs, mainly for rice, are implemented by the Department of Social Welfare and Development (DSWD), National Food Authority (NFA), and the National Nutrition Council and Department of Interior and Local Government (DILG).\textsuperscript{113} Other forms of subsidies include those for fertilizer, seeds and fingerlings, and livestock and fishery feed.\textsuperscript{114}

- **The Philippines stores grain in public and private stocks to smooth supply shocks, which can be associated with ENSO events.** FAO Food Balance Sheets show Philippine stocks were depleted by approximately 1.1 million tons in 2008 and by 0.7 million tons in 2009 to manage supply shocks.

\textsuperscript{109}Bureau of Soils and Water Management and others (2015).
\textsuperscript{110}CIAT (2017).
\textsuperscript{111}DOST (2014).
\textsuperscript{112}Oxfam (2016).
\textsuperscript{113}Jegillos (2000).
\textsuperscript{114}Quilang (2011); Domingo (2016).
The Philippine government implements other programs and policies, not related to ENSO, that indirectly influence ENSO preparedness.115 Two prominent examples worth mentioning are the Philippines’ national rice self-sufficiency policy and the national conditional cash transfer program.

- The Philippine’s key agricultural policy is to achieve national self-sufficiency in rice. This policy is implemented by the NFA under the Department of Agriculture. Under this policy, the NFA controls rice trade by implementing import tariffs and establishing other import restrictions, such as curbing the private sector’s ability to import. These actions reorient domestic rice demand to domestic producers. However, as we will see, the policy also creates inadequate supply and raises domestic rice prices to twice that of world prices.116 High rice prices can exacerbate GDP and consumption losses during El Niño, as demonstrated below.

- The Pantawid Pamilya is the Philippines’ national conditional cash transfer program. The program provides cash resources to poor households in return for these households meeting a set of conditions. These conditions include pregnant women being attended during childbirth, development sessions on health and parenting, child health checkups and deworming, and grade school enrollment. As we will see below, such programs help reduce losses for poor families during ENSO. In 2013, the government adjusted the program to a crisis scenario. In the three months following typhoon Yolanda, the government released $12.5 million to existing beneficiaries but waived conditionality requirements. This was done so beneficiaries could receive immediate relief during the crisis.117 Overall, the government’s various social protection and pension schemes transfer, on average, $23 per month to a typical family, which includes $11 per household plus $12 for two children.

International support

NEDA recognized the role of the international community in enhancing ENSO preparedness.118 Development partners provide the government and national stakeholders with information and technical capacity. Alternatively, relief agencies like the International Committee of the Red Cross act as extensions of federal and provincial governments by providing relief in hard-to-reach areas.119 Below are a number of development agencies and brief descriptions of their ENSO-related work programs in the Philippines.

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115Oxfam (2016); Jegillos (2000); Quilang (2011); Domingo (2016).
119IFRC (2016).
The World Bank supports the Philippines in climate and disaster risk management. Three notable projects demonstrate this support. First, the Risk Resiliency and Sustainability Program improves climate risk management through better adapted and more resilient ecosystems, and improved infrastructure and livelihoods in vulnerable coastal, forest, and peri-urban areas. Second, the Reducing Vulnerability to Natural Disasters project builds resilience by strengthening preparedness, recovery, and reconstruction, and financing risk insurance programs. And third, the Philippines Climate Resilience and Sustainability project helps build government capacity to implement the Risk Resiliency and Sustainability program.

The Food and Agriculture Organization (FAO) has led or collaborated on several initiatives supporting ENSO preparedness. The DA cooperated with FAO to frame the Philippines’ first Strategic Plan of Action for Disaster Risk Reduction in Agriculture and Fisheries in 2015, and opened the first Disaster Risk Reduction and Management Operations Center for agriculture in 2016. FAO also assists the Philippines in integrating agriculture into its National Adaptation Plan (NAP-Ag). During the 2015–2016 El Niño, FAO conducted various activities to help the Philippines in combating drought effects. These included damage assessments in Mindanao; rice and vegetable seeds and fertilizer provision to over 60,000 farming households in Mindanao and Central Luzon; technical assistance to minimize drought losses and damage; and disaster risk reduction and climate-smart training. FAO with the DA also began implementing drone technology to support disaster reduction.

The United Nations Development Program (UNDP) supports agricultural and land management programs in the Philippines. Together with FAO, UNDP works on the NAP-Ag program. UNDP also launched a sustainable land management program in August 2015 to promote local and national integrated landscape management across sectors. The project mainstreams local governments’ sustainable land management policies and programs across agencies.

The U.S. Agency for International Development (USAID) supports the Philippines’ weather bureau, PAGASA. The USAID Water Security for Resilient Economic Growth and Stability (Be Secure) project was implemented to improve PAGASA’s

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120 DENR (2016).
121 FAO (2016).
122 FAO (2016).
123 FAO (2017).
124 ReliefWeb (April 2016).
125 UNDP (August 2015).
126 UNDP (December 2015).
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weather and climate forecasting ability. With the help of the U.S. National Center for Atmospheric Research, a series of technical trainings were held for PAGASA on cluster management, weather forecasting, radar engineering, tropical cyclone forecasting, hydrometeorological capabilities, and thunderstorm identification, tracking, and analysis. In March 2015, the Be Secure project launched Payong PAGASA, a program to help the public better understand and use PAGASA’s weather and climate-related forecasting by simplifying concepts and translating warnings and forecasts into five local languages, Waray, Bisaya, Tagalog, Chabacano, and Hiligaynon.

The International Rice Research Institute (IRRI) implemented the Philippine Rice Information System (PRISM) and the Green Super Rice initiative. The PRISM system is executed in collaboration with the DA and aims to improve disaster preparedness through a combination of satellite and local-level data. It uses remote sensing, crop modeling, cloud computing, and smartphone-based surveys to provide information on rice areas, rice production, planting dates, yield estimates, drought and flood areas, and pest damages. IRRI also introduced alternate wetting and drying (AWD) technology during the 2015–2016 ENSO. Alternate wetting and drying, the process of alternately flooding and unflooding a field, conserves water resources and minimizes greenhouse gas emissions in paddy fields. During the 2015–2016 El Niño, IRRI, along with PhilRice, promoted and distributed Green Super Rice, which combines the superior traits of 250 rice varieties adapted to growing under difficult drought conditions with less fertilizer and no pesticide.

128 IRRI (2016).
129 PhilRice (2016).
Despite These Successes, There Are Still Areas to Improve

Government agencies and systems could be better adapted to slow onset disasters like El Niño–related water scarcity. The programs and systems outlined above are overwhelmingly geared toward providing relief for rapid onset disasters such as floods, storms, or droughts when they become an emergency. However, El Niño–related challenges, like water scarcity, often evolve over the course of a year or longer with conditions progressively getting worse. According to conversations with government officials, task forces and working committees are temporary and do not meet frequently enough to address slow onset challenges. They also say that government response and budgeting systems are geared for providing critical relief, not building preparedness or long-term resilience. Also, there is no clear protocol that triggers government responses for ENSO or reconvenes the El Niño Task Force, which tends to become inactive until an El Niño has reached a crisis stage.

Delays in drought aid delivery were blamed for violence in Kidapawan. For five days in 2016, 6,000 drought-affected agricultural workers rallied in Kidapawan, the capital of Cotabato province in Mindanao, to ask for government aid in response to El Niño–related droughts. The demonstration led to three deaths and over a hundred injuries. The incident, known as “the Kidapawan Tragedy,” revealed inefficiencies in the country’s ability to move rice aid to affected areas. In an example not related to Kidapawan, a seed distribution program, implemented by the DA to replace crops damaged by the dry spell, also faced delays. This was because the program required that

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131Panahon (2016).
damaged crops were validated so farmers could not game the system. RAIN implementation was also delayed because of inadequate roads and transportation facilities in remote upland and hinterland areas.

**Forecasting systems are not detailed enough to fully benefit local farmers.** Stakeholder engagements reveal that the current system is too coarse and unsteady to be fully operationally useful. Forecasts do not provide information precise enough to forecast down to the municipal level with accuracy. This lack of precision has implications for farm planning and monitoring and evaluation efforts.

**Gender issues have generally not been integrated in ENSO-related response and preparedness activities, though there has been some progress.** In 2009, the Philippine government introduced legislation granting women and men equal rights to own land. This act requires the Department of Agriculture to include rural women’s groups in policy making and promote new technology for female farmers. As such, the Philippine Commission on Women helped craft the National Framework Strategy for Climate Change and the subsequent National Climate Change Action Plan (NCCAP). Still, women’s participation in the implementation of this and other initiatives has not been realized. In Filipino society, women are consistently neglected in local agricultural planning and decision making despite involvement in agricultural activities, especially nonfarm work.

**There have been various budget and financing inefficiencies around ENSO relief and preparedness.** In September 2015, the DA requested $42 million for fast-track El Niño responses, but, the Senate did not support the funding, and instead proposed realigning the DA’s $363 million in unused funds. In April 2016, the Chair of the Senate Committees on Finance and Climate Change said there were many unused resources in the National Disaster Risk Reduction and Management (NDRRM) Fund ($1 billion), DSWD ($49 million), and the DA Quick Response Fund ($11 million). Also, election rules prohibited, or slowed, El Niño response fund disbursement.

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134 Mendoza (2018 forthcoming); Benson (2009).
136 Ibid.
137 Sombilla and Rosegrant (2018 forthcoming).
Despite These Successes, There Are Still Areas to Improve

Federal law prohibits the release, disbursement, or expenditure of public funds from 30 days before to 45 days after national elections. As such, there was a ban on releasing public funds from March 25 to May 8, 2016. The ban prevented government agencies from directly implementing aid projects just as droughts and dry spells were on the rise (see Figure 14). The election funding ban also prevented LGUs from directly providing aid to affected communities.

There is no ENSO financing mechanism fitted to the Philippines context. Stakeholder discussions revealed that neither general or pooled government funds, such as the Quick Response fund (QRF), or line budget items in the DA, are sufficiently limber or adequate to be effective. Moreover, since ENSO is not an annual event, it has been difficult to dedicate funding for the phenomenon within the context of annual planning and budgeting. Similarly, the annual budget process is also not fully suited to slow onset disasters like ENSO-related drought. Also, the budget process is hampered by the lack of precision of the current forecasting and early warning system.


Source: OCHA (2016).

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Local stakeholders and governments are not sufficiently prepared for ENSO and have not been able to access hard-to-reach locations. The federal government relies on Local Government Units (LGUs) to deliver services, identify beneficiaries, and monitor project results but have been inefficient or slow in carrying out these responsibilities. The fact that LGUs are also used to deliver aid in times of crisis makes their role crucial during El Niño years. In terms of planning, the Climate Change Act of 2009 requires LGUs to draft and implement local climate change action plans (LCCAP). However, as of July 2016 only 160 LGUs, less than 10 percent of all LGUs, have their own LCCAPs.

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142NEDA (2016).
Simulated policy interventions do not fully negate GDP losses from strong El Niño events. Table 7 reports GDP losses in absolute and percentage terms, with and without the benefits of policy interventions. The effects of policy interventions can be estimated using the CGE model (see Box 3). Table 7 shows that combining and implementing all interventions concurrently mitigates GDP losses by $1.42 billion. In other words, even with the most active and ambitious policy framework, a strong El Niño will still cause $1.90 billion in GDP losses. When interventions are implemented in isolation, which is more likely to be the case, losses are much higher. For example, the simulation shows food import subsidies and cash transfers are the least effective in mitigating El Niño losses. The reason is that food import subsidies do not increase local agricultural production at all, and cash transfers require tax increases for higher income households to offset transfer costs. Therefore, food subsidy gains are limited and cash transfers may

**TABLE 7: GDP Changes During Strong El Niño Events and Intervention Scenarios.**

<table>
<thead>
<tr>
<th></th>
<th>Without interventions</th>
<th>With interventions</th>
<th>Remove rice quotas</th>
<th>All combined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drought-tolerant</td>
<td>Additional</td>
<td>Food import</td>
<td>Grain storage</td>
</tr>
<tr>
<td>National</td>
<td>–1.57</td>
<td>–1.45</td>
<td>–1.42</td>
<td>–1.52</td>
</tr>
<tr>
<td>Absolute change in GDP (US$ billion)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AFS</td>
<td>–2.67</td>
<td>–2.45</td>
<td>–2.42</td>
<td>–2.63</td>
</tr>
<tr>
<td>Agriculture</td>
<td>–1.84</td>
<td>–1.71</td>
<td>–1.70</td>
<td>–1.82</td>
</tr>
</tbody>
</table>

*bSource:* Simulation results from the Philippines CGE model.
actually increase overall GDP losses. Removing rice import quotas is more effective in mitigating GDP losses. Grain storage and irrigation are also effective. Increased rice imports and replenished grain stocks offset domestic production shortfalls on downstream processing and ease upward pressure on consumer food prices. This policy intervention was implemented in 2015 when the government imported 750,000 metric tons of rice to serve as a buffer stock in case El Niño intensified and reduced domestic production.\textsuperscript{144} Irrigation, by contrast, makes production more resilient to El Niño–related droughts.

**All households experience falling welfare during strong El Niño events.** Welfare, or consumption percentage losses, are larger than GDP percentage losses. This is because ENSO’s effects on agriculture and food production and prices are more important for household consumption than for national investment or government spending. Moreover, welfare impacts vary across regions and household income groups. Figure 15 shows all households experience welfare losses during a strong El Niño, but losses are

\textsuperscript{144}World Bank (2016).
slightly larger for nonpoor households. Nonpoor households are more likely to be net consumers of foods so are particularly hurt by rising food prices during strong El Niño events. Farming households are also hurt by rising prices, but they are more likely to be producers of foods. Welfare losses for food producers are smaller because their incomes rise when food prices rise. However, these income gains are smaller than consumption losses even for rural farmers. Note that while lower income (rural) households may be less affected by El Niño, their ability to smooth consumption by selling assets is more limited than for higher income (urban) households. In the absence of supporting evidence, the modeling analysis presented here does not include the short-term benefits and longer term costs of selling household assets.

Policy interventions are effective in reducing household welfare losses. As with GDP, expanding irrigation use, depleting grain stores, and removing rice import quotas reduce consumption losses, particularly for poorer households. Figure 15 shows that cash transfers reduce losses for poorer households because the transfers specifically target these households for support. However, cash transfers increase welfare losses overall because higher income groups, which comprise most of the national tax base, pay more taxes to finance the transfers. This also explains why a cash transfer scenario does not mitigate GDP losses during El Niño events. When all policy scenarios are implemented, total consumption losses drop considerably, and become consumption gains for the poorest households (Figure 16).
Policy can be effective in avoiding increases in poverty during strong ENSO events. The immediate impact of severe El Niño events on poor households can be measured by changes in the national poverty headcount rate, or the population share living below the official poverty line. Figure 17 shows the national poverty rate increases by 5.4 percentage points without interventions to mitigate El Niño’s impacts. This is equivalent to 5.1 million additional people living below the poverty line. Again, the most effective policies include irrigation, cash transfers, and removing rice import quotas.

**FIGURE 17:** Changes in National Poverty Headcount Rate and Number of Poor People During Strong El Niño Events and Intervention Scenarios (percentage points and millions of people).

**FIGURE 16:** Household Consumption Losses by Expenditure Quintile and with/without All Interventions Combined (gains if negative).

**Source:** Simulation results from the Philippines CGE model.
Policy Interventions Do Not Neutralize ENSO-Related Losses

In the best scenario, where all interventions are implemented together, the poverty headcount would decrease even during a strong El Niño. All regions of the Philippines benefit from simulated policy interventions. Figure 18 shows that more people enter poverty in Luzon during a strong El Niño event than in the two other major regions. Luzon also benefits the least from the various policy scenarios. Mindanao benefits the most, showing a 3.6 percentage point reduction in its poverty headcount rate when implementing all intervention scenarios. As could be expected, cash transfers, which target the poorest households, are effective in mitigating poverty increases during a strong El Niño event. However, removing rice quotas is by far the most effective policy for minimizing poverty increases during El Niño. In Visayas, removing rice quotas almost negates any threats a strong El Niño event poses to the regional poverty headcount.

Simulations show urban households are more affected by strong El Niño events in total consumption losses, but they also benefit the most from policy interventions. The CGE model estimates differences in outcomes across rural and urban areas. Table 8 shows urban household consumption levels are affected more negatively by strong El Niño events. This is mainly because urban households are more likely to be net consumers of food products, so are hurt more by higher food prices. Many rural households can also be net food consumers, but are more likely to be net food producers if they are farming households. Removing rice import quotas limits food price increases during El Niño, which benefits urban consumers, or net consumers, more
than rural farmers, or net producers. However, there are no policy scenarios that fully offset El Niño’s impacts on urban households. Moreover, urban households are worse off with a cash transfer program because the higher taxes needed to finance transfers are more likely to be paid by the larger urban tax base. That said, poor urban households are better off because they pay fewer taxes than nonpoor urban households.

Results indicate female-headed households are slightly less affected by strong El Niño events. This is mainly because female-headed households tend to be poorer than male-headed households, and, as explained above, poorer households are slightly less affected than higher income households. Figure 19 shows the only policy intervention with significantly different gender outcomes are cash transfers, but this is because cash transfers target lower income households. Again, lifting rice import quotas is the only intervention that completely negates consumption losses from strong El Niño events. Figure 20 also shows that urban households are more vulnerable than rural households to poverty increases during a strong El Niño event.

### TABLE 8: Rural and Urban Household Consumption Changes During Strong El Niño Events and Intervention Scenarios (percentages).

<table>
<thead>
<tr>
<th></th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without interventions</td>
<td>−2.77</td>
<td>−15.40</td>
</tr>
<tr>
<td>Drought-tolerant varieties</td>
<td>−2.45</td>
<td>−14.67</td>
</tr>
<tr>
<td>Additional irrigation</td>
<td>−2.20</td>
<td>−14.37</td>
</tr>
<tr>
<td>Food import subsidies</td>
<td>−2.24</td>
<td>−14.63</td>
</tr>
<tr>
<td>Grain storage</td>
<td>−2.19</td>
<td>−14.44</td>
</tr>
<tr>
<td>Cash transfers</td>
<td>−2.02</td>
<td>−15.76</td>
</tr>
<tr>
<td>Removing rice quotas</td>
<td>2.10</td>
<td>−8.09</td>
</tr>
<tr>
<td>Combined</td>
<td>4.01</td>
<td>−4.89</td>
</tr>
</tbody>
</table>

Source: Simulation results from the Philippines CGE model.
**FIGURE 19:** Rural Household Consumption Losses by Gender of Household Head with and without Interventions (gains if negative).

<table>
<thead>
<tr>
<th>Without interventions</th>
<th>Drought-tolerant varieties</th>
<th>Additional irrigation</th>
<th>Food import subsidies</th>
<th>Grain storage</th>
<th>Cash transfers</th>
<th>Quota lifting</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2.97%</td>
<td>2.57%</td>
<td>2.46%</td>
<td>2.47%</td>
<td>2.43%</td>
<td>2.75%</td>
<td>-1.52%</td>
</tr>
<tr>
<td>Female</td>
<td>2.85%</td>
<td>2.51%</td>
<td>2.27%</td>
<td>2.34%</td>
<td>2.28%</td>
<td>2.06%</td>
<td>-1.90%</td>
</tr>
</tbody>
</table>

Source: Simulation results from the Philippines micro-simulation model.

**FIGURE 20:** Change in Poverty Headcount Rates During Strong El Niño Events under Intervention Scenarios by Location and Gender of the Household Head (percentage points).

<table>
<thead>
<tr>
<th>Without interventions</th>
<th>Drought-tolerant varieties</th>
<th>Additional irrigation</th>
<th>Food import subsidies</th>
<th>Distribute stored grains</th>
<th>Cash transfers</th>
<th>Remove rice quotas</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>5.7</td>
<td>5.3</td>
<td>5.0</td>
<td>5.2</td>
<td>5.3</td>
<td>5.0</td>
<td>-0.7</td>
</tr>
<tr>
<td>Female</td>
<td>4.4</td>
<td>4.0</td>
<td>3.8</td>
<td>3.9</td>
<td>4.0</td>
<td>3.9</td>
<td>-2.2</td>
</tr>
</tbody>
</table>

Source: Simulation results from the Philippines micro-simulation model.
The Government Can Take Additional Effective Actions to Protect the Philippines’ Food System and Improve ENSO Preparedness

There are many opportunities to improve ENSO preparedness and resilience. The Philippines is a regional leader in working toward ENSO preparedness, but there are still areas to improve. In the section below these opportunities are divided into two groups: preparedness and resilience. While there is some overlap between these two concepts, for the purposes of this report they are defined as the following. Preparedness are measures specifically geared toward ENSO and should, ideally, be in place before the next ENSO event occurs. These actions will significantly empower people to cope, respond, and recover from damaging ENSO events. Resilience, by contrast, are measures that are not specifically designed for ENSO, but that will build individuals’ and organizations’ ability to adapt to multiple forms of risks and shocks without compromising long-term development. Included in this section are various best practices from around the world that can be emulated. Table 9 outlines these recommendations and prescribes steps that should be taken for each.

Preparedness

Prepare response measures for when ENSO-related climate events occur. Response measures take place during an emergency and include actions to save lives and prevent further property damage. A proper response system requires several plans and actions that should be in place prior to an El Niño or La Niña event. These include,
first developing local drought and flood contingency plans that can be activated when ENSO-related climate events occur. Second, making sure contingency budgets or other ENSO-related budget lines can be accessed to provide humanitarian or relief support to affected areas and populations. Third, ensuring that emergency response inputs and supplies are available. This includes relief supplies, such as water and food, and agricultural inputs, such as seeds and fertilizers. Fourth, ensuring that infrastructure needed for emergency responses—main roads, water ports, and other connectivity-related infrastructure—is sufficiently climate proofed. These will safeguard “last mile” delivery capacity.

Harnessing the rebound from La Niña could help mitigate some of the damage from El Niño events. On the whole, La Niña gains do not cancel out El Niño losses. However, La Niña events increase rainfall, positively impacting agricultural production as long as it does not lead to destructive flooding. To date, the Filipino government has instituted measures to prepare for La Niña floods but has not tried to take advantage of the increased rainfall. This could be done by expanding planting and improving water catchment during La Niña. At the same time, if policies were enacted to mitigate El Niño’s negative impacts, harnessing La Niña’s rebound could bring ENSO’s positive and negative impacts into balance.

The DA should assess ENSO-related slow onset disasters and government responses to them. The DA should develop a comprehensive system of ex ante and ex post assessment and reporting for slow onset disasters. This should document the chronology of actions taken in the affected areas before, during, and after the El Niño event. The usual package of DA interventions includes: cloud seeding; input support, including providing resistant seed varieties; and water supply and irrigation support. This package has been implemented for decades without change. Moreover, no impact assessment has been made on the effectiveness of these measures. Such an assessment would allow policy makers to understand which interventions should continue or discontinue. The assessment could also identify more cost-effective interventions and adapt them to the Philippines’ climatic and institutional context. The proper projection and documentation of ENSO-related damage and responses would improve the DA’s approach in addressing future ENSO episodes.

The government should prepare detailed ENSO risk and vulnerability maps to better target interventions. Much of the information needed to create these maps is already available from historical data sources and PAGASA’s forecasting operations. Maps could describe the spatial distribution of crop types and potential impact levels for each province. They can incorporate a range of valuable information. This information
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can be on topography; hydrology; cropping systems; crop calendars; risks such as floods, drought, or saline intrusion; seasonal climate patterns and forecasts; infrastructure such as roads, dikes, canals, or sluices; and vulnerability including poverty and ethnic differentiation. Moreover, with current technology, maps can be “smart,” recommending actions for farmers or businesses, and resource deployment for affected areas. Best practice would be to develop these maps in cooperation with a range of stakeholders, but PAGASA would be the obvious choice to lead these efforts.

**PAGASA could be empowered to improve forecasting and disseminate actionable information to farmers.** PAGASA has demonstrated an ability to accurately forecast climate events. The agency could also develop a set of phase-specific scenarios and response protocols to guide agencies within DA in responding to possible rice supply volatility. They could do this by augmenting drought outlooks with historical climate analysis and recorded market responses. It would also be beneficial to make forecasts more detailed, less technical, and more relevant and user friendly for local farmers. Several studies argue that ENSO advisories could have avoided climate variability–related rice crises by determining when to adjust rice importation policies. Reliable forecasts of the ENSO phase, in particular, would allow farmers to select ideal crops or shifts between irrigated or rainfed cultivation as forecasted conditions dictate. Moreover, a clear set of early warning protocols are needed to trigger when the government mobilizes its ENSO response mechanisms. For example, the government could establish a severity or certainty threshold for a forecasted ENSO event to ensure the El Niño Task Force is reconstituted with sufficient lead time to enact response measures.

**Strengthen the early warning capacity of government agencies responsible for responding to natural disasters.** The capacity of government agencies involved in natural disaster preparedness could be improved, especially in early warning systems and communication. The National Action Plan to Combat Desertification already seeks to establish early warning systems. The early warning capacity of these agencies needs to be strengthened so that they can develop timely, precise, location-specific, and understandable advisories for local farmers and communities.

**Create a geo-referenced database to harmonize ENSO-related initiatives of civil society, the private sector, international organizations, and local and national governments.** The database could contain a list of programs and projects and help

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145For example, Reyes and others (2008); Reyes and Mina (2009).
identify priority areas. The database should categorize projects by scale, including local, provincial, or national; project type, such as livelihoods, climate data, technologies, or agricultural extension services; and target populations, including youth, women, farmers, local governments, or ethnic minorities. Box 4 discusses the U.S. NDIS drought information system.

Efforts could be made to strengthen LGUs’ capacity to deliver aid and services and prepare for El Niño events. As we have seen, LGUs have difficulties in efficiently delivering services in a timely way. Moreover, LGUs are frontline responders to disasters, but most do not have contingency plans for slow onset emergencies. Instead, LGU response plans are for extreme weather events such as typhoons. Exceptions are the few climate change adaptation plans that have been developed and the local El Niño task forces, but neither are widespread, and both suffer the same capacity and funding constraints as the LGUs themselves. Currently, both the NDRRMC and the DA, with UNDP support, are engaged in efforts to strengthen local government capacity, but resources have not been adequate.

**BOX 4: Access to Centralized Information on Drought in the United States.**

The U.S. National Integrated Drought Information System (NIDIS) is a one-stop information portal on drought across the United States. Through a mix of data, maps, and other visual tools, NIDIS provides a comprehensive overview of the U.S. drought situation by region and for each major U.S. river basin. The site aggregates information and research from public and private sector partners related to drought, including data on soil moisture, water supplies, and precipitation levels. The aggregated information is presented in a coordinated and user-friendly manner via the Drought Early Warning System, which also warns of natural hazards arising from drought events, such as wildfires and local water supply interruptions. NIDIS users are able to search for tailored drought information; by entering their zip code, they gain access to regional forecasts, drought outlook reports, local meteorological contact information, and information on the drought’s potential impacts. There are also links to educational material to raise awareness on drought preparedness and response. NIDIS ranks the drought’s severity, making it useful to a wide range of stakeholders in the affected areas.

*Taken from:* World Bank GFDRR 2017, “Toward Integrated Disaster Risk Management in Vietnam: Recommendations Based on the Drought and Saltwater Intrusion Crisis and the Case for Investing in Longer-Term Resilience.”

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Funding for contingency and preparedness measures should be included in the DA's regular programming. Many of the approved budget allocations have been for reactive measures not pre-planned and targeted. Contingency and preparedness funds could be triggered by early warnings to avoid undue delays and the political bickering over budget allocations that happened during the 2016 drought response. Moreover, election financing laws that prevent federal fund dispersal could be loosened in times of crisis to facilitate the delivery of aid. Budget lines for disaster relief and preparation already exist, but very few of these resources are channeled toward slow onset disasters. As such, a separate budget line could be created for slow onset weather events like those associated with El Niño. These funds should be made available at the subnational level.

Consider removing rice import quotas. As we have seen, the Philippines Rice Self Sufficiency policy exacerbates GDP and consumption losses during El Niño. Simulations show removing rice subsidies and quotas is by far the most effective intervention for mitigating El Niño’s costs. It would increase supply and reduce prices by about 50 percent until they matched international rice prices. It would also allow rice supplementation from foreign sources during times when drought reduces domestic harvestable land, the major inhibitor to domestic rice production. It would also cost the government nearly nothing. Building on this point, the Philippines could consider encouraging food imports more generally during El Niño. This would offset food shortfalls and smooth price fluctuations.

Adopting drought-tolerant crop varieties can mitigate El Niño losses. If the DA fully utilized site-specific seasonal climate forecasts from PAGASA, they could recommend stress-tolerant crop varieties for different locations and ENSO phases. This could be supplemented by carrying out additional research on crop traits that respond favorably to climate stresses and establishing close linkages between farmer organizations and research institutions. As we have seen, IRRI and PhilRice are already promoting drought tolerant “Green Super” rice. More efforts like this could further build crop resilience to ENSO. Box 5 discusses how a large-scale project in Sub-Saharan Africa delivered drought-tolerant seeds.

Stock grain stores before an El Niño event is predicted to occur, while protecting producers. The Philippines’ extreme wet and dry conditions make grain stores critical to offset food shortfalls and smooth price fluctuations. Currently, the NFA has warehouses where grains can be stored, but these only cover 22 days of the country’s grain

147NEDA-Agriculture, Natural Resources, and Environment Staff (ANRES) (2017).
BOX 5: The Drought-Tolerant Maize for Africa (DTMA) Project.

The Drought-Tolerant Maize for Africa (DTMA) project introduced drought-tolerant seeds to smallholder farmers in Africa. Taking place from 2007 to 2015, it developed and disseminated over 200 new drought-tolerant, high-yielding, disease-prone, and locally adapted maize varieties to 13 African countries. By the time the project concluded, 72 percent of all maize grown in Sub-Saharan Africa was derived from these seeds. In 2014 alone, the project produced nearly 54,000 tons of certified drought-tolerant maize seeds, benefitting an estimated 5.4 million households, or 43 million people, across DTMA countries. Compared to the eight years before the project, Malawi and Ethiopia doubled their maize yields. During the project years, Rwanda and Burkina Faso, which increased agricultural investment and established conducive policy environments during those years, were the only Sub-Saharan African countries that also showed increases in maize production. This underlies the effectiveness of the DTMA.

There were some challenges and constraints with DTMA. For example, there were seed shortages, high seed prices, a scarcity of information, a lack of seed variety options, and an overall shortage of resources. Also, it is difficult to attribute the yield improvements solely to DTMA. Other factors may have also played roles, for example, conducive policy environments, favorable weather conditions, and Alliance for Green Revolution in Africa (AGRA). The project was funded by the Bill and Melinda Gates Foundation and jointly implemented among the National Agricultural Research systems by International Maize and Wheat Improvement Center (CIMMYT) and the International Institute of Tropical Agriculture (IITA).


requirements. Because of this, DA is looking to purchase additional storage silos. The Philippine Rice Research Institute has also developed “kwebo,” an innovative easy-to-construct typhoon resistant warehouse where grains can be stored during typhoon seasons. The CGE analysis showed how using cereal stocks during ENSO events can mitigate consumption losses. However, grain stores require making sure stores are stocked before crises hit and that transportation infrastructure is sufficiently resilient and well connected. Moreover, grain storage facilities are expensive to construct, the cost of which was not factored into the CGE analysis. If this option is pursued, caution should be taken. Increasing the domestic grain supply can diminish incomes for grain producers, so safeguards should be in place to protect against this. Box 6 provides the example of China’s grain storage system.

149 PhilRice (2017).
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BOX 6: China’s Grain Reserve System.

China’s national grain reserve system plays an important role in safeguarding the grain market from rising food prices. The system consists of two types of grain reserve programs: the national temporary grain reserve program and the national strategic grain reserve program. The national temporary grain reserve program allows China to cope with grain yield reductions from natural disasters and stabilize the grain market during supply shocks. This allowed China to escape the steep grain price increases that hit other Asia-Pacific countries.

China’s vertically managed grain reserve system has two levels of legal entities—the China Grain Reserves Corporation, or Sinograin, at the national level, and the provincial grain reserve corporations at the subnational level. The reserve corporations have a network of branch offices in major grain producing and consuming areas. In August 2003, China enacted regulations on the administration of central grain reserves. These regulations clarified legal responsibilities and grain use, storage, inspection, and supervision processes. In 2004, China liberalized its grain markets and, until recently, Sinograin and its provincial entities purchased grains from producers at floor prices, which were pre-set each year by the central government.

As a result, China accumulated large grain reserves and during major droughts in 2009 and 2010, the central government sent 1.4 million tons of reserve grains to drought-stricken southern provinces to alleviate local food shortages. This successfully stabilized local grain prices, protecting farmers’ incomes, mitigating the impact of steep price increases on poor consumers, and ensuring social and political stability. However, introducing such a large influx of cheap grain also created market distortions that can harm producers.


Adjust short-term social safety net programs to cover ENSO impacts’ protracted nature. Some safety nets are geared toward short-term solutions and are, therefore, not applicable to slow onset ENSO risks. For example, the Philippines cash-to-work program only covers 15 days of work, and the family food pack program only covers three days’ worth of food. However, the impacts of El Niño can extend for months. Longer term emergency assistance and support for rehabilitation and recovery are critical. Box 7 shows how Ethiopia adjusted social safety nets to accommodate climate shocks.

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150NEDA (2017).
Striking a Balance: Managing El Niño and La Niña in Philippines’ Agriculture

Provide emergency cash transfers during El Niño events. As was done during typhoon Yolanda, cash transfer conditionalities can be waived during times of crises to provide resources to vulnerable households. As the CGE analysis shows, conditional cash transfers significantly reduce consumption losses by women and poor households during El Niño events. However, supplementing poor households’ lost incomes is most effective when combined with trade and other policies that increase local food availability. One researcher\(^\text{152}\) notes that emergency cash transfer programs could be highly effective in response to future shocks.

Plans should be made to correct inefficiencies within RAIN and the El Niño Task Force. RAIN and the El Niño Task Force were established by the Philippine government to provide short-term preparatory and emergency responses during the 2015–16 ENSO event. These have had some notable successes but have also experienced implementation inefficiencies that reduced their overall effectiveness. Plans should be made

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\(^{151}\)World Bank (2010).

\(^{152}\)Bowen (2015); Bowen (2016).

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**BOX 7:** Ethiopia’s Productive Safety Net Program Integrated with Early Warning Systems and Disaster Risk Management.

Ethiopia’s Productive Safety Net Program (PSNP) is a large national social safety net (SSN) program that includes elements of climate resilience. The PSNP’s goal is to improve food security among Ethiopia’s poor and mitigate the impacts from shorter term shocks, mainly droughts. The PSNP is implemented almost entirely through national government systems, which are decentralized through regional and local administrations. The unique aspect of this system is its incorporation of early warning and disaster risk management into its institutional structure.

The Ministry of Agriculture is responsible for program management, with the Disaster Risk Management and Food Security Sector tasked with overall program coordination. The Early Warning and Response Directorate provides early warning information on natural hazards and ensures the PSNP’s emergency responses are linked to relief and hazard response activities. The Natural Resource Management Directorate oversees the public works and the Ministry of Finance and Economic Development oversees financial management.\(^\text{151}\) These federal implementation arrangements are replicated within the PSNP’s eight regions and 319 woredas (districts).

now to correct these inefficiencies, rather than waiting for future ENSO events. Many of the recommendations above could be used to strengthen RAIN. These include:

1. Create a coordinating committee to communicate strategies and projects, and share location- and crop-specific information.
2. Establish a mechanism for the El Niño Task Force to reconvene more regularly.
3. Prioritize likely hotspots prior to the onset of ENSO using this information.
4. Prepare an El Niño and La Niña risk and vulnerability map for each province.
5. Implement an early warning system in targeted areas to trigger contingency and preparation plans.
7. Adjust RAIN to focus more on long-term slow onset challenges, like water scarcity.

**Resilience**

**Sustain and scale up good practices.** There are many subnational ENSO-related best practices that have been tested and piloted by different actors in different regions. These practices could be effective at a larger scale. Examples include: climate resilient Tilapia practices, cloud seeding initiatives, innovative rice-fish farming, and crop residue soil management. However, many local best practices cannot be scaled up because of a lack of human or logistical capacity, or they simply end when the funding runs out. As such, besides simply identifying best practices, there is also a need to build capacity and develop policies to sustain funding sources.

**Investing in roads and irrigation infrastructure in rural areas would build resiliency to ENSO shocks.** The CGE analysis shows that irrigation is one of the more effective policy interventions to mitigate El Niño damages. Selective investments in expanding irrigation systems or rehabilitating existing systems would help maintain crop production levels and protect against the loss of harvestable land. Developing the rural transportation networks would improve farmers’ access to input and output markets, and ensure services and relief reach remote areas of the country. In both cases, care should be taken to select the proper locations to build these systems and make sure they are also climate resilient.

**Policy makers should seek ways to increase the active participation of women in decision making.** Women play large roles in both health and agriculture, often assisting the family’s farming activities by day and the family’s sick, young, and elderly by night. Studies\footnote{Ashwill and Blomqvist (2011).} have shown that women tend to use agricultural resources more
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...efficiently than men. With ENSO, particularly El Niño, impacting both health and agriculture, women have a role to play in mitigating these impacts. Moreover, this analysis shows that women are largely underrepresented in ENSO preparedness efforts, whether it be in the spheres of farming, disaster risk reduction, or climate change adaptation. A more concerted effort should be made to not just include women in these processes but empower them in leadership roles.

TABLE 9: Recommendations and Proposed Actions to Build pre-ENSO Preparedness and Resilience.

In Table 9, recommendations are divided into two groups: preparedness and resilience. Recommendations in blue are a high priority, recommendations in tan are a moderate priority. The last two columns denote which actions are short-term (S), or should be completed within a year, and which actions are medium- to long-term (M/L), or would not be achievable in less than a year.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Actions</th>
<th>S</th>
<th>M/L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparedness</strong></td>
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<tr>
<td>Prepare response measures for when ENSO-related climate events occur</td>
<td>Develop local drought and flood contingency plans that can be activated when ENSO-related climate events occur.</td>
<td>X</td>
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<td></td>
<td>Make sure contingency budgets, or other ENSO-related budget lines, can be accessed to provide humanitarian or relief support to affected areas and populations.</td>
<td>X</td>
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<td></td>
<td>Ensure emergency response inputs and supplies are available. This includes relief supplies, such as water and food, and agricultural inputs, such as seeds and fertilizers.</td>
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<tr>
<td></td>
<td>Ensure infrastructure needed for emergency responses—main roads, water ports, and other connectivity-related infrastructure—is sufficiently climate proofed.</td>
<td>X</td>
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</tr>
<tr>
<td>Correct inefficiencies within RAIN and the El Niño Task Force</td>
<td>Create a coordinating committee to communicate strategies and projects and share location- and crop-specific information.</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Establish a trigger mechanism to reconvene the El Niño Task Force more regularly.</td>
<td>X</td>
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<td></td>
<td>Prioritize likely hotspots prior to the onset of ENSO using this information.</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Prepare an El Niño and La Niña risk and vulnerability map for each province.</td>
<td>X</td>
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<tr>
<td></td>
<td>Implement an early warning system in targeted areas to trigger contingency and preparation plans.</td>
<td>X</td>
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<td></td>
<td>Establish expedited funds in regular government budgets for emergency response measures.</td>
<td>X</td>
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<td></td>
<td>Adjust RAIN to focus more on long-term slow onset challenges, like water scarcity.</td>
<td>X</td>
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<table>
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<tr>
<th>Recommendation</th>
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<tbody>
<tr>
<td><strong>Preparedness</strong></td>
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<tr>
<td>Harness La Niña’s rebound</td>
<td>Charge the El Niño Task Force with exploring agricultural strategies for La Niña.</td>
<td>X</td>
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<td></td>
<td>Make plans to rehabilitate water storage facilities, increase water catchment, expand planting, shift planting dates, shift areas based on crop needs, and so forth.</td>
<td>X</td>
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<td></td>
<td>Take measures to reduce flood risk in flood-prone areas.</td>
<td>X</td>
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<tr>
<td>Assess ENSO-related slow onset disasters and government responses</td>
<td>The DA should develop a comprehensive system of ex ante and ex post assessment and reporting for slow onset disasters.</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Document the chronology of actions taken in the affected areas before, during, and after the El Niño event.</td>
<td>X</td>
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<td></td>
<td>Identify more cost-effective interventions and adapt them to the Philippines’ climatic and institutional context.</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Prepare detailed ENSO risk and vulnerability maps</td>
<td>Use historical data sources and PAGASA’s forecasting operations as the maps’ information base.</td>
<td>X</td>
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<td></td>
<td>Maps describe the spatial distribution of crop types and potential impact levels.</td>
<td>X</td>
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<td></td>
<td>Incorporate information on topography; hydrology; cropping systems; crop calendars; risks such as floods, drought, or saline intrusion; seasonal climate patterns and forecasts; infrastructure such as roads, dikes, canals, or sluices; and vulnerability including poverty and ethnic differentiation.</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>Make maps “smart” by recommending actions for farmers or businesses.</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>Develop maps with a range of stakeholders, but PAGASA would lead these efforts.</td>
<td>X</td>
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<tr>
<td>Improve ENSO forecasting and dissemination</td>
<td>PAGASA should develop a set of phase-specific scenarios and response protocols to guide agencies within DA in responding to possible rice supply volatility.</td>
<td>X</td>
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<td></td>
<td>Augment drought outlooks with historical climate analysis and recorded market responses.</td>
<td>X</td>
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<td>Make forecasts more detailed to make them more relevant to local farmers.</td>
<td>X</td>
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<td>Expand dissemination channels through social media, extension services, and awareness raising campaigns.</td>
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<td></td>
<td>Cooperate with cellular carriers to disseminate information.</td>
<td>X</td>
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<tr>
<td>Strengthen the early warning capacity of government agencies</td>
<td>Identify constraints in PAGASA’s human and technical capacity.</td>
<td>X</td>
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<td></td>
<td>Expand the coverage of Automatic Weather Stations or meteorological stations.</td>
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<td>Make forecasts more user friendly and more timely.</td>
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(continued)
### TABLE 9: Continued.

<table>
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<th>Recommendation</th>
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<th>M/L</th>
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<tbody>
<tr>
<td>Strengthen LGUs’ capacity to deliver aid and services and prepare for El Niño events</td>
<td>Fully implement <em>Listong Pamilyang Pilipino</em> (preparedness project) and <em>Listong Pamayanan</em> (capacity development project).</td>
<td>X</td>
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<tr>
<td></td>
<td>Collaborate with international partners to increase capacity building measures.</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>Expand and enhance NDRRMC and the DA’s efforts to strengthen local government capacity.</td>
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<td>X</td>
</tr>
<tr>
<td></td>
<td>Provide resource and technical assistance to help LGUs deliver aid to disaster impacted areas, resettle affected households, and expand preparedness measures.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Prepare for El Niño events</td>
<td>Include these funds in the DA’s regular programing.</td>
<td>X</td>
<td></td>
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<td></td>
<td>Funds should be triggered by early warning systems to avoid undue delays and political issues.</td>
<td>X</td>
<td></td>
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<td></td>
<td>Ease election financing laws and generally improve procedures that prevent federal fund dispersal in times of crisis.</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>Create a separate budget line for slow onset weather events like those associated with El Niño.</td>
<td>X</td>
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<td></td>
<td>Make these funds available at the subnational level.</td>
<td>X</td>
<td></td>
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<tr>
<td>Develop a database of ENSO-related initiatives</td>
<td>Make the database geo-referenced.</td>
<td>X</td>
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<tr>
<td></td>
<td>Include all initiatives from civil society, the private sector, international organizations, and local and national governments.</td>
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<td></td>
<td>Identify priority areas.</td>
<td>X</td>
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<td></td>
<td>Categorize projects by scale, including local, provincial, or national; project type, such as livelihoods, climate data, technologies, or agricultural extension services; and target populations, including youth, women, farmers, local governments, or ethnic minorities.</td>
<td>X</td>
<td></td>
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<tr>
<td>Remove rice import quotas</td>
<td>Remove current quotas.</td>
<td>X</td>
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<tr>
<td></td>
<td>Consider additional policies to encourage food imports more generally to offset food shortfalls and smooth price fluctuations during El Niño.</td>
<td>X</td>
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<tr>
<td>Recommendation</td>
<td>Actions</td>
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<tr>
<td><strong>Adopt drought- and flood-tolerant crop varieties (and fishery practices)</strong></td>
<td>Use site-specific seasonal climate forecasts from PAGASA.</td>
<td>X</td>
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<td></td>
<td>With these forecasts, DA should recommend stress-tolerant crop varieties for different locations and ENSO phases.</td>
<td>X</td>
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<td></td>
<td>Carry out additional research on crop traits that respond favorably to climate stresses</td>
<td>X</td>
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<td></td>
<td>Establish links between farmer organizations and research institutions.</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>Scale up the dissemination and farmer awareness of these seeds and appropriate farming practices through improved extension services.</td>
<td>X</td>
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<td></td>
<td>Look into scaling up the IRRI and PhilRice “Green Super” rice initiative.</td>
<td>X</td>
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<tr>
<td></td>
<td>Adopt climate-resilient tilapia culture practices.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Improve grain storage capacity</strong></td>
<td>Before a predicted El Niño event, stock grain stores for more than the current 22-day reserve.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Purchase additional storage silos.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Model these after The Philippine Rice Research Institute’s “kwebo” warehouses.</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Assure transportation infrastructure is sufficiently resilient and well connected to the stores.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Apply safeguards to protect producers.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Expand and adjust social safety nets (SSNs)</strong></td>
<td>Assess constraints to expanding current SSNs.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Target poor, rural areas with food-for-work programs, expanded labor market programs, farm provision subsidies, and conditional cash transfers.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Adjust these programs to make them more responsive to droughts and other ENSO impacts through better targeting or by expanding these systems in times of ENSO-related crises.</td>
<td>X</td>
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<tr>
<td></td>
<td>Expand the Philippines’ cash-to-work program beyond 15 days of work, and the family food pack program beyond three days’ worth of food during ENSO events.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Provide emergency cash transfers during El Niño events</strong></td>
<td>As was done during typhoon Yolanda, wave cash transfer conditionalities during ENSO events.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Consider activating additional transfers for ENSO preparedness.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combine these transfers with trade and other policies to increase local food availability.</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

(continued)
**TABLE 9: Continued.**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Actions</th>
<th>S</th>
<th>M/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustain and scale up good practices</td>
<td>Identify Philippine best practices on ENSO-related themes that have been tested and piloted by different actors.</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Examples include climate resilient Tilapia practices, cloud seeding initiatives, innovative rice-fish farming, and crop residue soil management.</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Increase human and resource capacity to scale up these practices.</td>
<td>X</td>
<td></td>
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<tr>
<td>Invest in rural infrastructure</td>
<td>Assess the prevalence and condition of rural transportation systems and irrigation and water harvesting systems.</td>
<td>X</td>
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<td></td>
<td>When feasible, expand irrigation and water harvesting systems to improve water use efficiency, especially in drought-prone areas.</td>
<td>X</td>
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<td></td>
<td>Develop plans to improve rural roads with a focus on connecting agricultural production to markets.</td>
<td>X</td>
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<td></td>
<td>Climate proof all of these facilities.</td>
<td>X</td>
<td></td>
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<tr>
<td>Target women</td>
<td>Develop a strategy targeting women who are vulnerable to ENSO (agriculture workers, rural inhabitants, natural resource managers).</td>
<td>X</td>
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<tr>
<td></td>
<td>Develop quotas or guidelines to empower women in leadership or coordination positions in local- or national-level efforts to combat ENSO impacts.</td>
<td>X</td>
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<tr>
<td></td>
<td>Introduce resource-efficient, low-carbon practices for women.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Target women in SSNs.</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Annex

Annex 1: Methodological specifics

This annex outlines the specifics of the methodology summarized in Box 1.

General

We employ an analytical framework that combines a detailed review of the available evidence with new analysis of ENSO impacts on crop agriculture as well as spillover impacts on the rest of the economy. We first examine historical climate data, including variability in rainfall and temperature, and from this, we identify the occurrence of ENSO events in the historical record. More specifically, we compare short-term climate fluctuations during ENSO event years to recent “neutral” weather years (without ENSO shocks) to identify deviations in rainfall and temperature variables.

Changes in weather variables during the crop growing season are translated into physical, agricultural productivity outcomes using a combination of statistical and process-based models. The statistical analysis, which is based on nationally representative annual data, does not produce results that are detailed enough in time or space to adequately isolate the economic impacts of ENSO events. We, therefore, use process-based crop models to estimate ENSO-affected seasonal yield deviations of major crops in a grid-based spatial analysis framework. Daily historical weather data (spatially interpolated from weather station data), linked with the corresponding ENSO phase, was used as input to the crop modeling framework that estimated crop yield changes for important crops: rice, maize, and tomatoes. Rice and maize are major crops in the country, and tomatoes act as a proxy for a broader array of vegetables (a standard approach in climate studies).

Our integrated approach to measuring the economy-wide impacts of climate shocks is similar to what is often used for long-term climate change impact studies. The DSSAT and CGE models represent some of the most sophisticated tools available for such analysis, and the high-resolution spatial databases used in both types of models is quite unique, both for the Philippines and developing countries in general. The framework allows us to not only isolate the expected impacts of ENSO events, but to also
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experiment with alternative policy responses, such as changes to trade and tax policies or an extension of social safety nets.

The model estimates the economic outcomes associated with agricultural productivity losses (usually during El Niño) and gains (usually during La Niña). We consider both moderate and strong ENSO events. Although the crop models consider historical events, the CGE model is parametrized to reflect the current economy. The model therefore simulates the impact of historical ENSO events were they to reoccur today and affect the current economy. Since agriculture’s share of national GDP has declined over time, the impact of lowering agricultural productivity has a smaller economy-wide effect today.

The crop models also estimate how yield responses differ when using improved or traditional seed varieties, with and without chemical fertilizer, or depending on the water management regime (with and without irrigation infrastructure). Crop-specific yield deviations are estimated for 0.5 × 0.5 degree grids covering the cropland extent in the whole country, and the gridded results are aggregated to major subnational regions using cropland use patterns. Although only three crops are modeled, we econometrically estimate yield impacts for other crops using yield correlation coefficients that measure historical co-movements between the three modeled crops and other crops grown in the Philippines.

Non-crop impact channels are also considered, such as livestock and fisheries. In the absence of sophisticated models for these subsectors, we rely on secondary evidence compiled from other studies. These studies typically focus on a specific ENSO year, such as the severe 2016 event. We supplement the livestock sector analysis using estimated Temperature Humidity Indices, which, drawing on the literature, allow us to estimate heat stress levels and productivity losses for cattle and poultry.

The estimated impacts of ENSO events on crop, livestock, and fisheries yields are then imposed on a dynamic computable general equilibrium (CGE) model. This class of model captures all producers and consumers in an economy, including the government and interactions with the rest of the world (e.g., imports and exports). All sectors and households are disaggregated across major subnational regions. Region- and crop-specific productivity shocks thus translate into changes in agricultural and national GDP, employment, and prices. The model reacts to crop- and sector-specific productivity changes by reallocating resources and products between sectors and households to minimize overall losses to the economy (i.e., autonomous adaptation). The model is linked to a survey-based micro-simulation module that tracks changes in national and subnational poverty rates.
The impact of El Niño and La Niña events on regional crop production was estimated by the crop models. Crop modeling was limited to rice, maize, and tomato/vegetables, but all crops are represented in the CGE model. Impacts on crops without a corresponding crop model were inferred from long-term yield co-movements (as captured by national production data for 1985–2016). For example, the interannual correlation between maize and banana yields is 0.72. We assume that ENSO’s impacts on banana yields can be estimated by multiplying the long-term yield correlation by the maize yield deviation from the crop models. The crop models estimated that maize yields fall by 11 percent during strong El Niño events, and so root crop yields are reduced by 8 percent (i.e., $11\% \times 0.72 = 8\%$). This approach is commonly used in economy-wide climate change analysis. A similar procedure was followed for all other crops, except for sugarcane and coffee, where no significant long-term yield relationship could be established. Note that this approach is conservative because it assumes gains and losses for non-modeled crops are smaller than those for maize and rice (i.e., the correlation coefficient is never greater than one).

ENSO’s impacts on livestock were estimated using a livestock model that was specifically built to measure impact of heat stress on livestock based on their biological response to temperature change (St. Pierre, Cobanov, and Schnitkey, 2003). Specifically, the model utilizes the monthly minimum and maximum THI presented in the previous section to calculate the extent and cumulative severity of heat stress had the temperature reached above certain thresholds. Output losses are reflected by reduced milk, meat, and egg production, as well as by the number of excess animal deaths. As noted earlier, we calculated typical changes in the THI during ENSO events and used the above model to estimate production losses. We estimate that livestock production falls by around 0.4 percent for cattle and dairy during El Niño, and poultry declines by 0.1 percent. These production impacts are imposed on the CGE model’s corresponding livestock sectors as a productivity loss, which, in turn, affects downstream meat and other food processing sectors. Finally, production losses by type of fish during El Niño (see Damatac and Santos 2016) were aggregated to sector-level productivity losses using weights derived from the value of production by fish type. Overall, fish productivity is estimated to fall by 3.6 percent during El Niño. This is only a rough estimate, given the complexity of the fisheries.

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154Rice in the CGE model is matched to the rice crop model’s yields (with a correlation coefficient of 1.00). Maize is matched to maize (1.00); cassava is matched to tomatoes (0.91); nuts and oilseeds are matched to rice (0.70); banana is matched to maize (0.72); and other crops are matched to rice (0.58). There is no positive correlation for sugarcane, coffee, and other fruits (i.e., these crop groups are not directly affected by ENSO).
The CGE modelling

RIAPA is a recursive dynamic computable general equilibrium (CGE) model that simulates the functioning of a market economy, including markets for products and factors (i.e., land, labor, and capital). RIAPA measures how impacts are mediated through prices and resource reallocations, and ensures that resource and macroeconomic constraints are respected, such as when inputs or foreign exchange are limited. RIAPA provides a consistent “simulation laboratory” for quantitatively examining value-chain interactions and spillovers at national, subnational, and household levels.

RIAPA divides the national economy into different sectors and household groups that act as individual economic agents. Producers maximize profits and supply output to national markets, where it may be exported and/or combined with imports depending on relative prices, with foreign prices affected by exchange rate movements. Producers combine factors and intermediate inputs using sector-specific technologies. Maize farmers, for example, use a unique combination of land, labor, machinery, fertilizer, and purchased seeds. Workers are divided by education levels, and agricultural capital is separated into crop and livestock categories. Labor and capital are in fixed supply, but less-educated workers are treated as underemployed. Producers and households pay taxes to the government, who uses these and other revenues to finance public services and social transfers. Remaining revenues are added to private savings and foreign capital inflows to finance investment, i.e., investment is driven by levels of savings. RIAPA is dynamic, with past investment determining current capital availability.

RIAPA tracks changes in incomes and expenditures for different household groups, including changes in food and nonfood consumption patterns. Poverty impacts are measured using survey-based micro-simulation analysis. Individual survey households map to the model’s household groups. Estimated consumption changes in the model are applied proportionally to survey households, and post-simulation consumption values are recalculated and compared to a poverty line to determine households’ poverty status.

Policy scenario interventions

In order to understand if and how different policy options can mitigate impacts from ENSO events, different policy options are incorporated into the model. Some of the scenarios reflect existing policies in the country, such as relaxing import protections for cereals or expanding current social transfer programs. Other scenarios consider policies that may not exist today or be considered central to the national debate, e.g., irrigation infrastructure, stored grains, and cash transfers. The scenarios are therefore
Annex 1: Methodological Specifics

a combination of current and potential policy options benchmarked to existing policies and evidence to ensure that the scale of policy change is plausible and relevant.

The model simulates a range of policy options that could mitigate damages during ENSO events. Some of the scenarios reflect existing policies in the country, such as relaxing import protections for cereals or expanding current social transfer programs. These options are viewed by many people as central to the national policy debate around agriculture, food security, and natural disasters. Other scenarios consider policies that may not exist today or be considered central to the national debate. Irrigation infrastructure, for example, already exists in many parts of the country, yet we simulate further expansion because this is commonly seen as one means of avoiding the damages caused by climate variability. We do, however, scale the scenarios so that they reflect existing conditions. For example, the expansion of irrigation infrastructure reflects the extent to which croplands are already irrigated (i.e., it is more difficult to expand irrigation in regions where irrigation is already used extensively). Similarly, the extent to which stored grains can be used to offset production losses is constrained by past evidence on national grain stocks. Finally, an expansion of cash transfers to households is informed by the scale and distribution system of current public safety net programs.

We consider the following seven policy scenarios:

- **Drought-tolerant varieties:** We provide farmers in the model with more drought-resistant maize, rice, and tomato varieties, leading to 1–3 percent higher yields on average for rainfed farming during El Niño years. Rather than assuming universal adoption, drought-resistant varieties are deployed in a limited way to regions that anticipate the greatest water challenges. The Philippines Rice Research Institute (within the Department of Agriculture) and the International Rice Research Institute (IRRI) have developed and disseminate region-specific drought-tolerant rice varieties to farmers in the rainfed lowlands and uplands. Expanding the adoption of drought-tolerant seeds could be achieved via existing systems.

- **Additional irrigation:** The amount of cultivated land in the model that uses irrigation infrastructure is increased. Rice is already widely irrigated in the Philippines, i.e., 80 percent coverage of rice land in Luzon, 57 percent in Visayas, and 74 percent in Mindanao. This limits any further expansion. We simulate a final 89 percent coverage for Luzon and Mindanao, and 68 percent for Visayas, and Mindanao. This is therefore a large expansion of existing irrigation for rice production. Maize is rarely grown on irrigated lands, and so while we model a doubling of irrigated maize land, the final coverage remains very low in all regions (24 percent in Luzon, 2 percent in Visayas, and 3 percent in Mindanao). Our irrigation scenario assumes that there is
adequate water to operate additional irrigation systems. Although we focus on irrigation infrastructure, an alternative option might be to improve water use efficiency. Since we do not capture potential water supply constraints, the scenario is somewhat equivalent to one that maintains yields during ENSO shocks through more efficient water use.

- **Food import subsidies:** Introduce a 25 percent price subsidy for imported cereals during El Niño years, and a 10 percent subsidy on other processed foods (e.g., meat, dairy, fruits and vegetables). The goal of an import subsidy is to offset any increases in food prices caused by ENSO’s disruption of domestic production. In the model, demand shifts toward imported foods, and consumers benefit from lower prices (relative to a situation without the subsidy). Note that for farmers who are hurt by an ENSO shock, the subsequent increase in market prices offsets some of their losses. Providing an import subsidy limits any price increases, and so can make farm revenue losses larger. Moreover, subsidies have fiscal implications. The fiscal burden of providing import subsidies are “internalized” in the CGE model through lower government revenues and larger deficits, which in turn have economy-wide implications. We report net impacts.

- **Grain storage:** Supply 500,000 tons of rice and 100,000 tons of maize from public and private stocks. Depleting stocks addresses short-term supply shortfalls during ENSO events and offsets some of the price increases caused by production losses. Like import subsidies, depleting grain stores benefits consumers, but may prevent market forces from limiting farm revenue losses via higher prices for agricultural products. The scenario assumes that storage facilities already have or can be expanded to achieve this capacity. Historical evidence indicates that the Philippines has the capacity to accommodate the scale of drawdown in this scenario. For example, the FAO Food Balance Sheets show that, over the last decade, the country depleted its collective grain stocks within a given year by more than the 0.6 million tons simulated here (e.g., stocks are estimated to have declined by 1.1 million tons in 2008, and by 0.7 million tons in 2009). This suggests that our grain storage scenario is within the country’s capacity to achieve. Note that we do not consider the financial cost of restocking public and private grain stores in the years following an ENSO event. Note also that our grain storage scenario is equivalent to an alternative scenario in which the government procures grain in foreign markets (financed by foreign borrowing) and distributes the grain in domestic markets.

- **Cash transfers:** Provide short-term cash transfers to poorer households (Quintiles 1–3) equal to US$46 per capita. Currently, the government’s various social protection and pension schemes transfer, on average, US$23 per month to a typical family (i.e., US$10.5 per household plus US$12.3 for two children). Our cash transfer scenario roughly doubles the amount of funds distributed to households
Annex 1: Methodological Specifics

during El Niño years. Households in the model are able to use these funds to either offset higher food costs, or to purchase nonfood products, whose prices may also rise during ENSO events as economic shocks spill over from agriculture to nonfarm sectors. The fiscal cost of expanding social transfers is internalized through higher direct taxes (e.g., pay-as-you-earn and corporate taxes). The scenario assumes that the distribution of new cash transfers occurs through existing social protection systems and does not increase the administrative cost of this system. This is equivalent to assuming that additional administrative costs (not actual transfers) are borne by foreign development partners.

- **Remove rice quotas**: Eliminate rice import quotas, leading to greater supply and lower domestic prices for milled rice. The current price gap between wholesale domestic milled rice and rice from Thailand and Vietnam (free-on-board) is about 100 percent. Removing quotas reduces domestic rice prices by about 50 percent so that they more closely match potential import prices. The foreign exchange costs of removing the rice import quota are internalized via changes in the real exchange rate. This policy simulates reform of the Philippine rice self-sufficiency policy.

- **Combined**: All the above policies implemented concurrently.

These scenarios do not capture all possible government responses to ENSO shocks; nor are the scenarios designed to reflect the complexities of specific policies. Such detailed analysis is beyond the scope of this study. Instead, the scenarios are purposefully selected to reflect the range of policy instruments available to the government, including investments in farm production (i.e., seeds and irrigation); trade and price policies (i.e., import subsidies and quotas); and standard emergency responses (i.e., grain stock management and social safety nets). Within each type of instrument there are further options to be considered, such as the targeting and distribution mechanisms for emergency cash transfers.
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