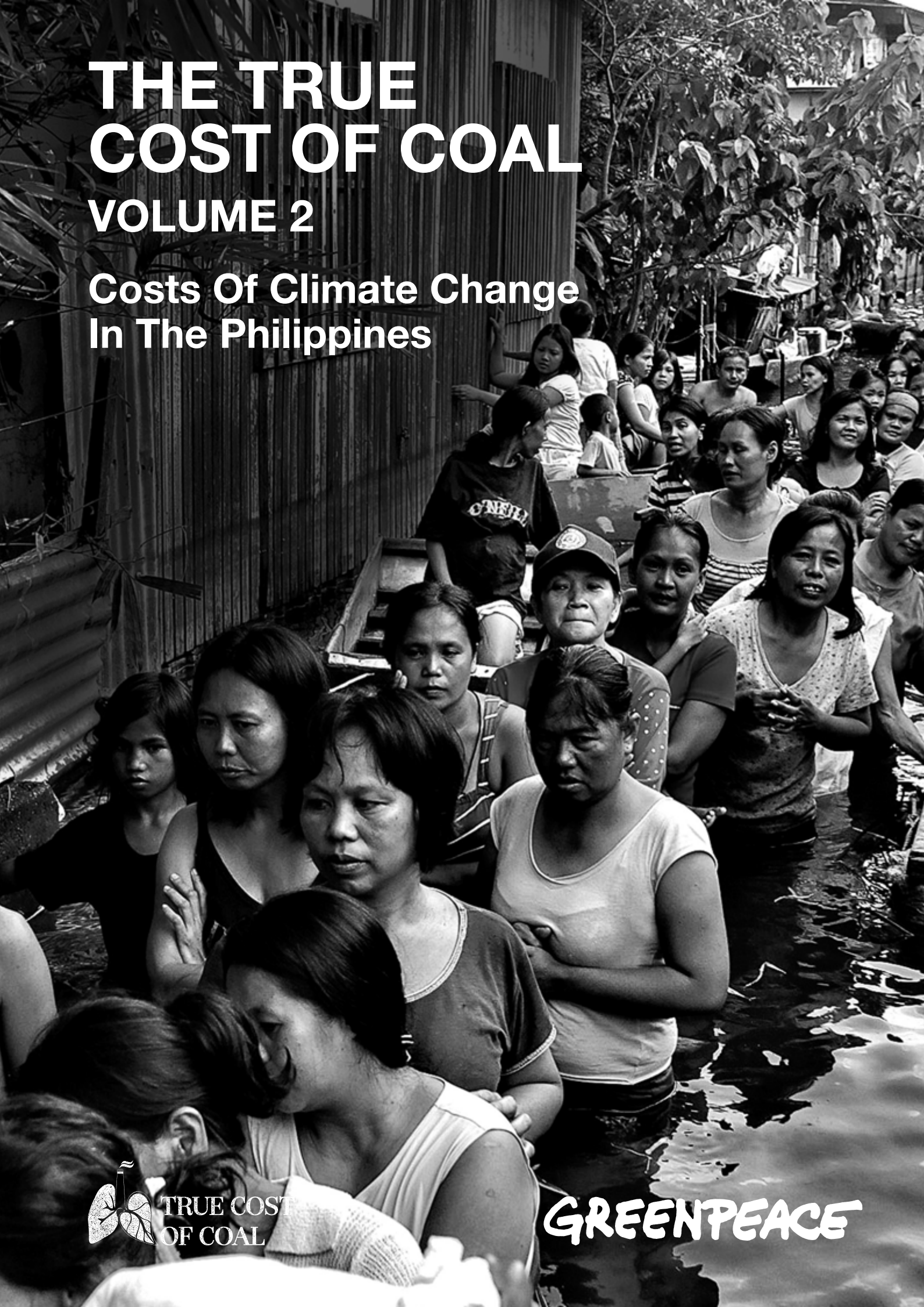
THE TRUE COST OF COAL

VOLUME 2

Costs Of Climate Change In The Philippines



TRUE COST OF COAL

GREENPEACE

THE TRUE COST OF COAL: COSTS OF CLIMATE CHANGE IN THE PHILIPPINES

Executive summary

Coal is the single greatest threat to our climate.

Given the economic, social and environmental havoc that climate change has wrought in the Philippines, embracing coal is a dangerous policy. Short term benefits of coal to some elite players in the Philippine economy pale in comparison to the billions that coal is costing the Philippines as a nation, with respect to climate change impacts alone.

In the Philippines, 13 operational coal-fired power plants already burn coal to produce electricity, with an installed capacity of 3,799.10 MW. Worse yet, the government plans to bring online another 45 coal-fired power plants. Operating the 45 new coal-fired power stations with a capacity of over 10,300 MW could push up the Philippines' carbon dioxide (CO2) emissions by over 64.4 to 79.8 million metric tons a year. Our leaders have been publicly talking a green talk, but quietly walking on the path of dirty fossil fuels.

Our coal addiction fuels climate change and undermines our ability to stand up as world leaders for a fair, ambitious, legally binding climate change treaty – one that can save us. The Philippines is highly vulnerable to climate change. Indeed, the country consistently tops climate change vulnerability indexes, with many experts listing the Philippines as amongst the 3 most vulnerable countries in the world.

Nearly one year has passed since Super Typhoon Yolanda, which was an example of the Philippines' vulnerability. It killed over six thousand, left over a thousand missing, and displaced over 4 million people – in addition to costing the economy hundreds of billions. What's worse, Yolanda was unprecedented but not unusual: the frequency of typhoons in the Philippines may increase.

Moreover, we now know that climate change is loading the dice for extreme weather events like Yolanda: Climate change has made sea levels rise. Higher sea levels in turn trigger higher storm surges, which mean that more water is pushed farther inland. This amplifies the damage done by tropical cyclones to people, housing, and infrastructure. Sea level rise has been occurring significantly faster in the Philippine Sea than elsewhere around the world, with increases in excess of 10mm/year. Even without extreme weather events, rising sea levels can spell catastrophe for the country: a one-meter rise in sea level could affect 16 regions, 64 out of 81 provinces, covering at least 703 out of 1,610 municipalities, inundating almost 700 million m2 of land and potentially displacing at least 1.5 million Filipinos.

Beyond extreme weather events and sea level rise, climate change triggers temperature shifts, rainfall shifts, flooding, landslides, and droughts, and can have extreme negative impacts on our agriculture as well as on health.
Without expanded climate change mitigation or adaptation, Philippines could suffer a mean loss

of 2.2% of Gross Domestic Product (GDP) by 2100 on an annual basis, considering only market impact (especially agriculture and coastal zones). The mean impact could be 5.7% of GDP each year by 2100 when including non-market impact (mainly health and ecosystems). This rises to 6.7% of our nation's GDP if catastrophic risks are taken into account. In the end, climate change and other weather-related calamities pose huge economic costs for the Philippines, and superstorms in particular cost us billions.

Our national policies on coal and climate change just aren't cutting it. We need to face facts, and act now. The Philippine Climate Change Commission, the Department of Energy, and our nation's top leadership must set us on a clear path to quit coal. It does not make sense for the Philippines to contribute to climate change through new coal-fired plants or expanded coal mining, if climate change will wreak havoc on the nation and its economy for generations to come.

Instead of clinging to its dirty coal addiction, the Philippines should be part of the global solution to climate change and embrace an energy revolution.

Lives and money lost to climate change

“The science has given us a picture that has become much more in focus. The IPCC report on climate change and extreme events underscored the risks associated with changes in the patterns as well as frequency of extreme weather events. Science tells us that simply, climate change will mean more intense tropical storms. As the Earth warms up, that would include the oceans.”[1] (Naderev Saño, the head of Philippines delegation speech at UNFCCC COP19)

“Climate change is already with us. It kills. It steals livelihoods. And it takes the most from those who have the least… Farmers face more hot days as they set to work. Families are sleeping outside in mosquito-infested areas because their homes are unbearable in the heat of the night… Rivers are drying up… while unprecedented floods are devastating other areas. Salt from rising seas harms fertile land and fresh water supplies. Coastlines erode. Land is submerged. Populations fail to make a living. People move. Pollution also kills. It acidifies lakes and oceans, poisons plants and animal life, corrodes infrastructure and contaminates the air we breathe. We pay for each of these damages in lives, suffering and dollars…climate change is already lowering economic output globally and will increasingly hold back growth – unless strong action is urgently taken… 5 million lives are lost each year today as a result of climate change and a carbon-based economy… Climate change is found to have already set back global development by close to 1% of world GDP… Inaction on climate change cost Least Developed Countries an average of 7% of their GDP for the year 2010 – with losses that will greatly increase in the years ahead.”[2]

Coal and CO2 emissions in the Philippines

In the Philippines, 13 operational coal-fired power plants burn coal to produce electricity, with 3,799.10 MW installed capacity. Rather than embracing renewable energy, the government plans to bring online another 45 coal-fired power plants. Our leaders have been publicly talking a green talk, but quietly walking on the path of dirty fossil fuels.

Coal is the most polluting energy source in the Philippines and the dominant source of carbon dioxide (CO2) emissions. Estimates vary but they all remain high. As of 2012, the Department of Energy reported that power generation in the Philippines was still dominated by coal, at nearly 38.76%.[3]

The government plans to bring online another 45 coal-fired power plants.

Trends would indicate that coal's role in our country has been growing, not receding. Data from the Department of Energy indicates that in 1991, the total percentage for power generation for coal was 7.57%, whereas in 2008 it was 25.89%, and in 2012 it had increased to 38.76%.[4]
For renewables, it fell from 33.92% in 2008, to 28.69% in 2011 – showing a steady increase for coal and a relative decline for renewables.

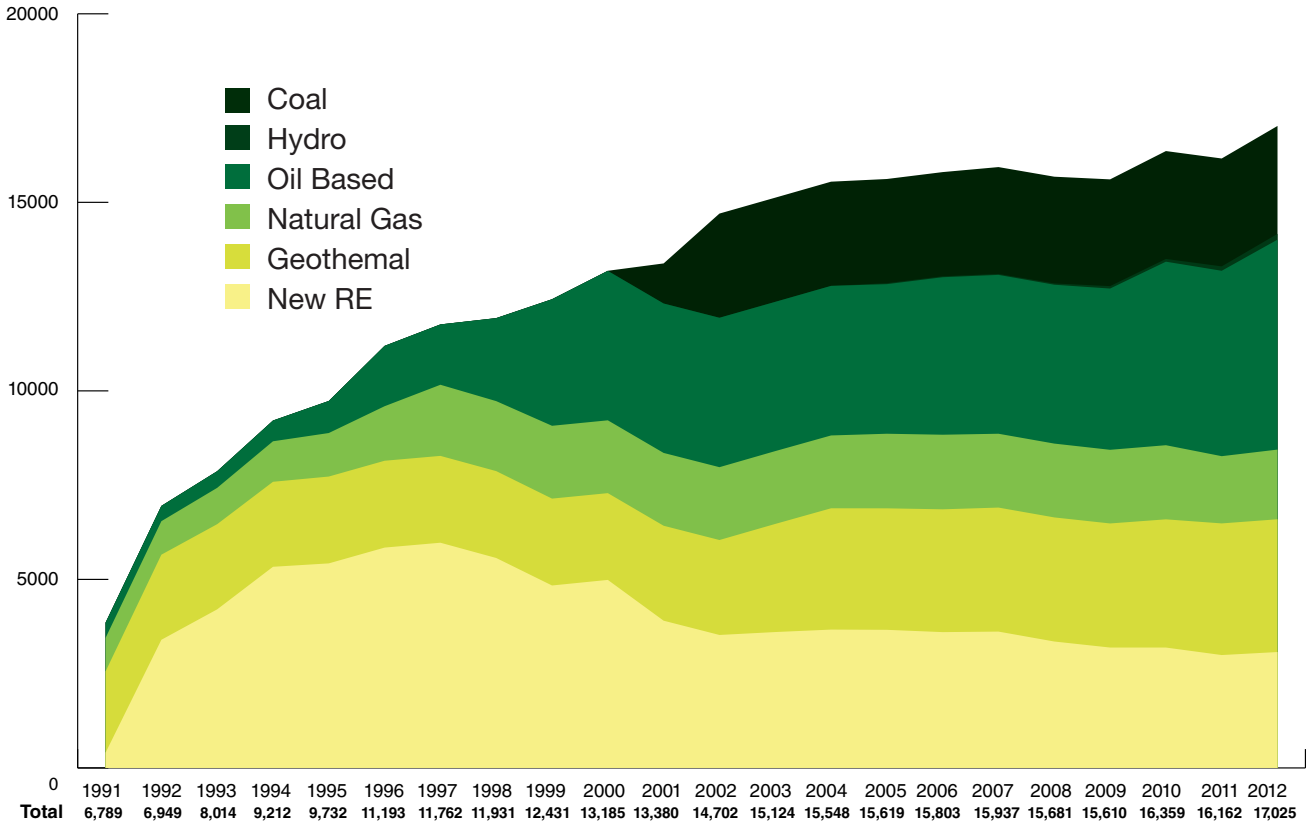


Figure 1
Total Power Generation by Source in Gwh (Philippines): 1991-2012

Our coal-fired power plants spew out millions of tons of pollution every year, contributing to climate change – in addition to filling neighboring air with toxic substances like mercury, lead, arsenic, cadmium and tiny sulfate and nitrate particles that wind up deep in people's lungs, operating as silent killers). According to Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, "Carbon emissions from power generation in the Philippines produced around 81.15 million metric tonnes in 2011."[6]

Coal's role in our country has been growing.

The emissions picture has been getting steadily worse over time. By 1998, the country discharged 76 million metric tonnes of CO2 "into the atmosphere from fossil fuel combustion alone;" and this 1998 level represented "a 72% increase relative to 1990 levels (WRI 2003)."[7] The 1998 level of 76 million metric tons of CO2 has now been far surpassed.[8]

Carbon emissions from power generation in the Philippines produced around 81.15 million metric tonnes in 2011.

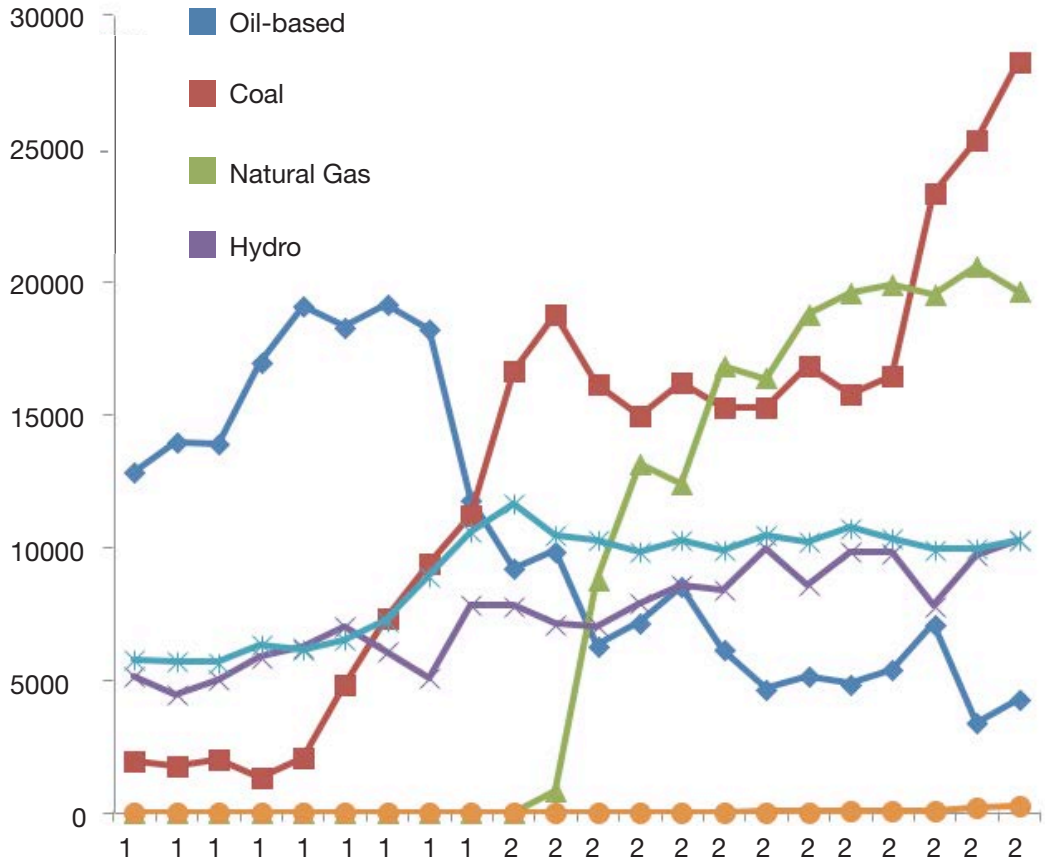


Figure 2
Total Power Generation by Source in Gwh (Philippines): 1991-20125

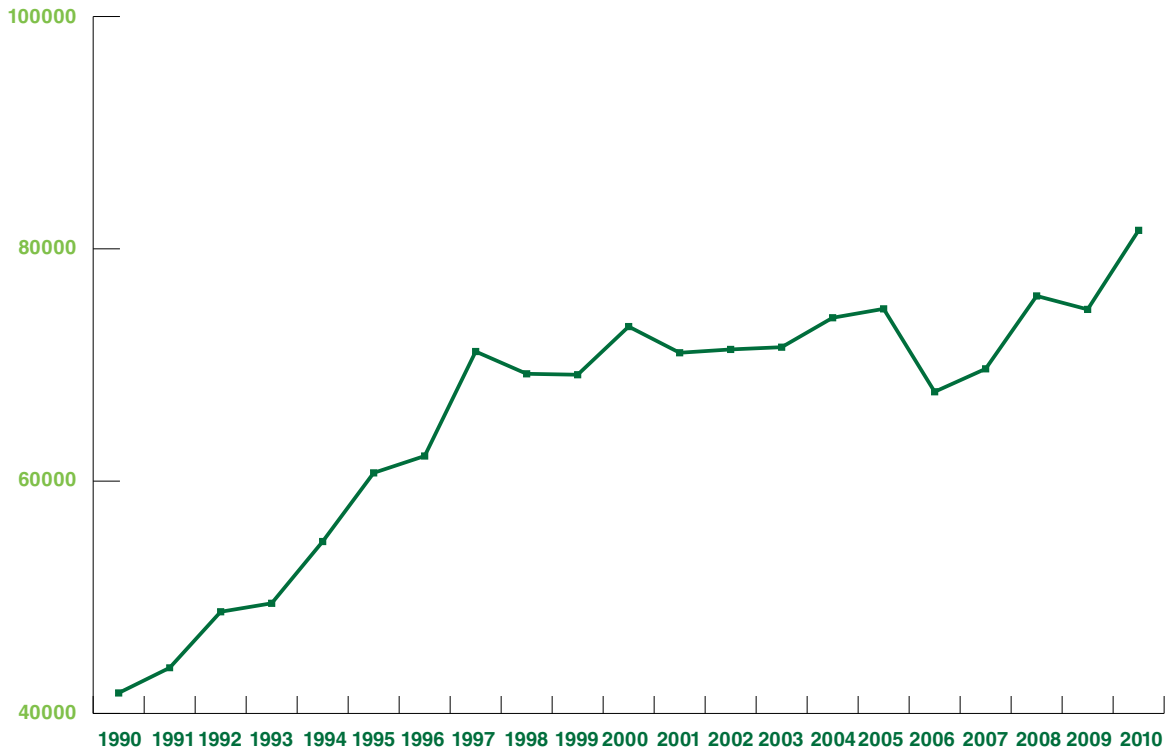


Figure 3
Philippines chart of thousands of tons of annual CO2 emissions9

Operating 45 new coal-fired power stations with a capacityof over 10,300 MW could push up the Philippines' CO2 emissions by over 64.4 to 79.8 million metric tons a year.[11]

Moreover, building new coal-fired power stations would undermine the Philippines' role in any international agreements to tackle climate change. Embracing coal lessens the Philippines' credibility in fighting for a good climate change treaty.

Worldwide, coal fired power plants are the biggest source of man-made CO2 emissions. From mining to combustion, coal is the most polluting of all fossil fuels. Coal energy is the single greatest threat facing our climate. In 2011, globally, coal was responsible for 44% of carbon emissions from fuel – a higher percentage than even oil (35%) or natural gas (20%).[12]

Coal accounts for such a disproportionately large percentage of "the global CO2 emissions due to its heavy carbon content per unit of energy released… As compared to gas, coal is nearly twice as emission intensive on average."13 Coal burning for energy releases more carbon dioxide than any other fossil fuel, in addition to which coal mining is responsible for 8-10% of human-made methane emissions globally."[14]

The Philippines is highly vulnerable to climate change

The Philippines has increasingly been considered a "climate hotspot", highly vulnerable to impacts of climate change. As an archipelago of more than 7,100 islands sitting over vast ocean waters in the Western North Pacific, it is exposed to natural hazards, such as tropical cyclones (classified in the Philippine Area of Responsibility or PAR as depressions, storms and typhoons), floods, droughts, and accelerated sea level rise, among others. Because of its many low-lying islands, long coastlines and large coral reefs, the country is prone to flooding, storm surges and coral reef bleaching. With these weather- and climate-related hazards and risks, the Philippines was ranked second in the Global Climate Risk Index for 2012, next to Haiti. [15] Relatedly, in a 2012 study on the "Combined Vulnerability to Food Security Threats from Climate Change and Ocean Acidification Impacts on Seafood Availability… The Philippines is number 34 in the combined ranking for vulnerability from climate change and ocean acidification." Another study, the 2011 Global Climate Risk Index, ranked the Philippines in 4th place because of the country's very high vulnerability overall to climate change impacts and catastrophes: cyclones, drought, floods, extreme weather events, temperature rise, shifting rainfall patterns and sea level rise. The country placed 3rd in the United Nations World Risk Index.[18] The Philippines ranked 6th in the Maplecroft 2012 Climate Change Vulnerability Index (CCVI),[19] , while the World Risk Report 2012 by Alliance Development Works, the Nature Conservancy, and the United Nations

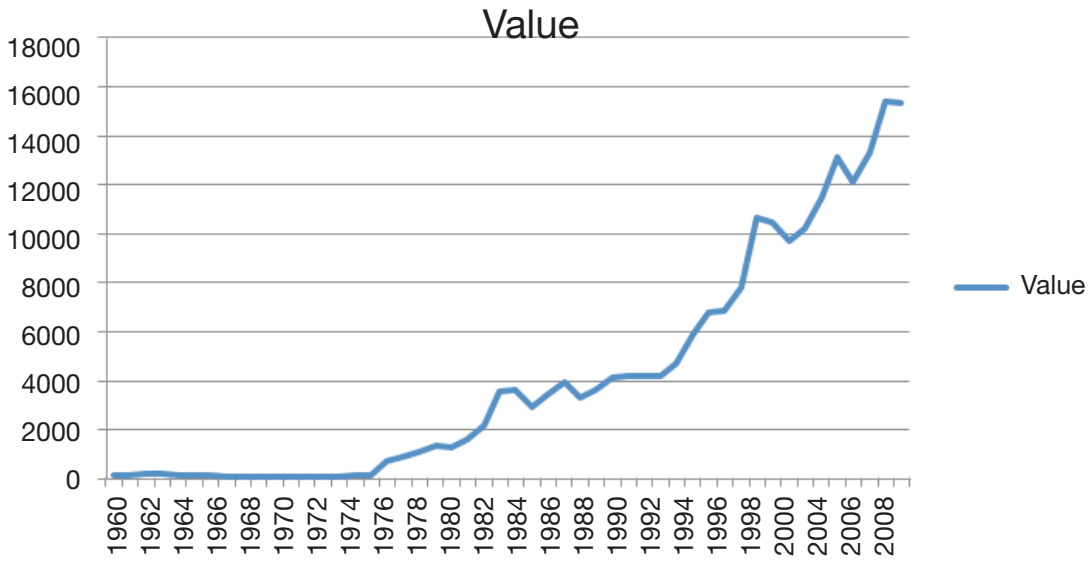


Figure 4
The chart of the value of CO2 emissions from solid fuel consumption in Philippines The value was 15,368.40 as of 2009. As the graph in the hyperlink shows, over the past 49 years this indicator reached a maximum value of 15,408.73 in 2008 and a minimum value of 62.34 in 1973.
Definition: Carbon dioxide emissions from solid fuel consumption refer mainly to emissions from use of coal as an energy source.[10]

Ranking 2012 (2011)	Country	CRI score	Death toll	Death per 100,000 inhabitants	Absolute loses (in million USS PPP)	Loses per unit GDP in %	Human Development Index[8]
1 (37)	Haiti	6.83	128	1.23	1220.66	9.53	161
2 (4)	Philippines	10.33	1408	1.47	1205.48	0.29	114
3 (3)	Pakistan	12.57	662	0.37	6087.82	1.11	145
4 (22)	Madagascar	15.67	113	0.50	356.98	1.69	151
5 (131)	Fiji	17.00	17	1.89	135.55	3.18	95
6 (369)	Serbia	17.67	28	0.39	1325.06	1.70	64
7 (131)	Samoa	18.33	6	3.28	220.91	19.57	95
8 (49)	Bosnia and Herzegovina	21.57	13	0.33	920.21	2.92	81
9 (95)	Russia	22.17	716	0.50	1366.20	0.05	55
10 (29)	Nigeria	22.33	405	0.25	837.45	0.19	153

Figure 5
Climate Risk Index for 2012: the 10 most affected countries [10]

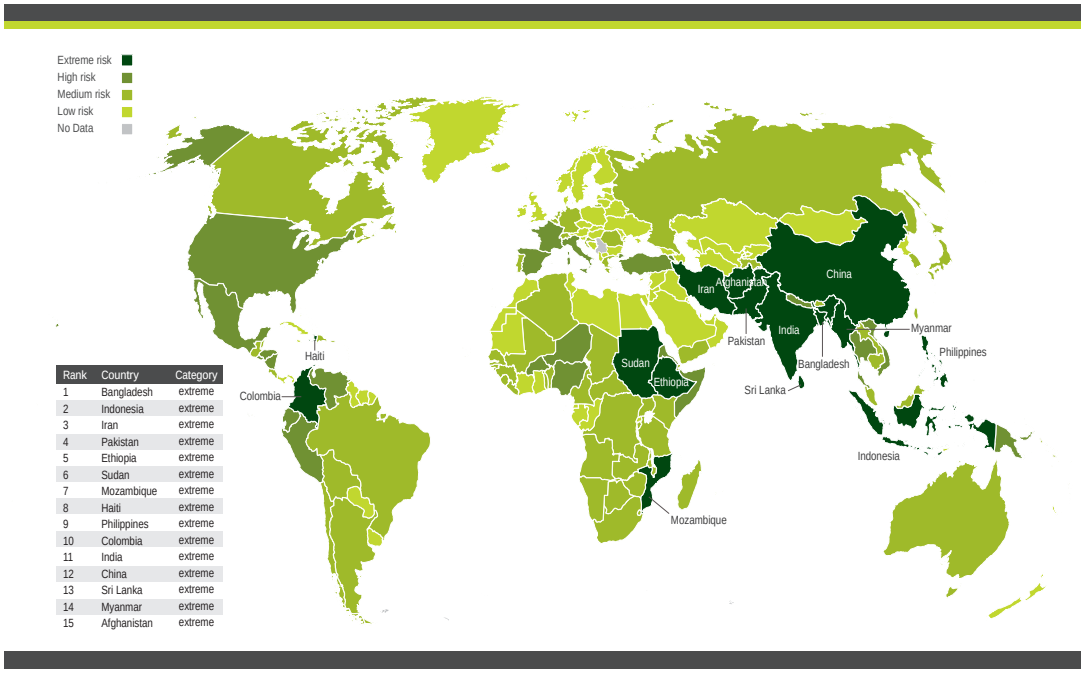
University ranked the Philippines as 3rd highest risk worldwide.[20] Maplecroft's 5th annual Climate Change and Environmental Risk Atlas identified Manila as the 2nd most threatened city in the world in terms of risk from the onset of climate change. Moreover, from 2000 to 2010, the Philippine population increased from 76.51 million to 92.34 million, at an annual growth rate of 1.9%. Rapid population growth rate of has put more people at risk to the impacts of climate change, especially the poor who have less ability to cope and adapt to disasters such as flooding or typhoons.

The storm is thought to have killed as many as 6,293 people, 1,061 more are believed to be missing, 28,629 were injured and about 4,095,280 million displaced.

Although the exact ranking of the Philippines varies, all these reports – and others too – validate that the Philippines consistently tops climate change vulnerability indexes.

Super Typhoon Yolanda is an example of the Philippines' vulnerability

When Typhoon Yolanda (international name Haiyan) struck the Philippines in November 2013 with one-minute sustained winds with speeds of 315 km/h (196 mph),[23] it entered history as the strongest storm ever recorded at landfall, and possibly the strongest typhoon in history with respect to wind speed.[24] The storm is thought to have killed as many as 6,293 people, 1,061 more are believed to be missing, 28,629 were injured and about 4,095,280 million displaced.[25] Ferocious winds and torrential downpours not only knocked out power and communications, but caused devastating flooding that triggered landslides and washed away homes, roads, clinics, schools, airport buildings and more. Thousands were buried under rubble and



Rank	Country	Category
1	Bangladesh	extreme
2	Indonesia	extreme
3	Iran	extreme
4	Pakistan	extreme
5	Ethiopia	extreme
6	Sudan	extreme
7	Mozambique	extreme
8	Haiti	extreme
9	Philippines	extreme
10	Colombia	extreme
11	India	extreme
12	China	extreme
13	Sri Lanka	extreme
14	Myanmar	extreme
15	Afghanistan	extreme

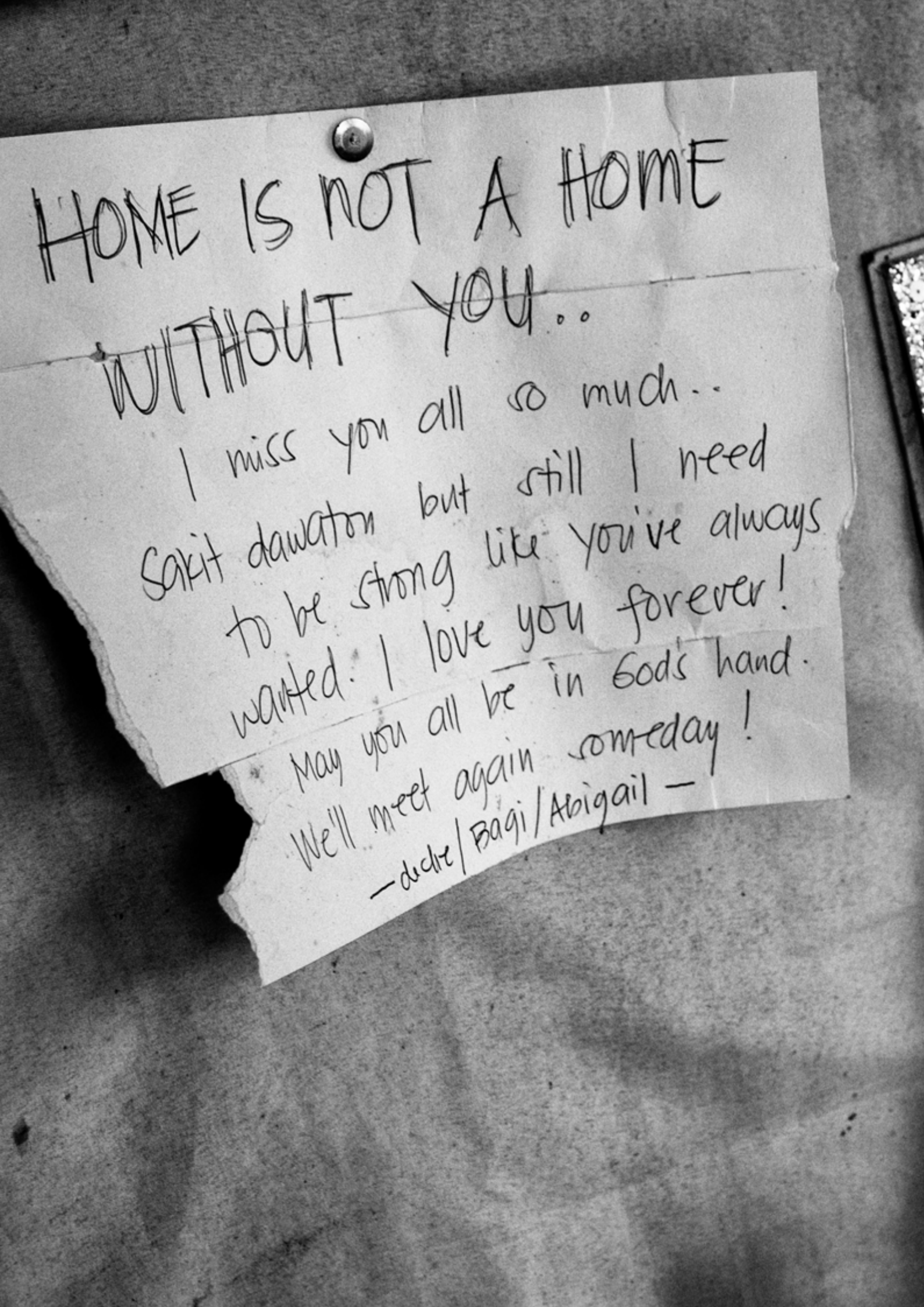
Figure 6
National Disaster Risk Index in 2010 [22]

The supertyphoon cost our economy millions in minutes.

millions left homeless and impoverished, fleeing for safety, with their life savings destroyed in a day and no way to recoup their financial losses. In particular, the storm devastated the whole city of Tacloban and other coastal towns of Leyte and Samar due to 5-7 meter storm surge and destroyed building structures, forests and farmlands. The supertyphoon cost our economy millions in minutes.

It added strains to other urban centers such as Metro Manila or Cebu as well, where evacuees migrated. In the short term, the government had to shoulder the living costs of these families. In the long term, jobs will have to be created for them in the cities they migrated to, whereas many of them were self-reliant prior to the typhoon. At least 380 million in cash and assistance were raised on an emergency basis by international aid donations[26] in the months following the superstorm, and "the World Bank Group's Board of Executive Directors approved the US$500 million quick-disbursing budget support."[27] The National Disaster Risk Reduction and Management Council (NDRRMC) reported on January 29, 2014 that Yolanda damages surpassed PHP 39 billion (over USD 895 million in July 2014 dollars) in costs to crops (PHP 9 billion), fisheries (PHP 6 billion) and livestock (PHP 2.9 billion) as well as infrastructure (PHP 19 billion).[28] "The NDRRMC added that total cost of government assistance for the affected families has reached PHP 1.185 billion."[29] Many experts believe that even the considerable government and international aid money pouring in will simply not be enough to rebuild what was lost. Estimates of damages run into the hundreds of billions. Already in December 2013, the National Economic and Development Authority (NEDA) "said the Yolanda recovery and reconstruction will require a total of PHP 361 billion in investments"[30] (roughly equivalent to USD 8.3 billion in July 2014 dollars).

Extreme weather events like Yolanda (known internationally as Haiyan) are probably fueled and made more likely by global warming. Climate


HOME IS NOT A HOME
WITHOUT YOU..
I miss you all so much..
Sakit dawaton but still I need
to be strong like you've always
wanted. I love you forever!
May you all be in God's hand.
We'll meet again someday!
-dedie/Bagi/Abigail-

Climate change is loading the dice for extreme weather events like Haiyan.

change is loading the dice for extreme weather events like Haiyan. The storm's strength and rapid development have been aided by unusually warm ocean waters and warm, moist air (warm air holds more water vapor than cold). Global warming also causes sea level rise, increasing the risk of flooding from storm surges, especially in low-lying areas like much of the Philippines. Carbon dioxide is the steroids that leads to grand-slam storms like Haiyan."[31] According to the USA National Climate Assessment for 2012, "Temperatures, rainfall, droughts, high-intensity hurricanes and severe flooding events all are increasing and projected to continue as the world's climate warms." How this will happen and by how much is a matter of intense debate.

19th Conference of the Parties : UN 2013 climate talks in Poland

At the COP19, Naderev Saño, head of the Philippine delegation, linked super typhoon Yolanda to climate change. 'What my country is going through as a result of this extreme climate event is madness, the climate crisis is madness. We can stop this madness right here in Warsaw.' " [33]

Environmentalist Bill McKibben commented on the tragically ironic timing of Yolanda, which smashed into the Philippines precisely when negotiators from around the world were arriving in Warsaw, Poland "for the latest installment of the United Nations Climate Talks, COP 19… [where] negotiators from the largest emitting countries will bask under the fluorescent lights of yet another conference center to bicker, delay and obfuscate."[34] The conference was hamstrung by a lack of commitment from major polluters and coal exporters, with Australia not even sending a junior minister to Warsaw.

What we don't know about climate change and extreme weather

Climate change deniers will insist that typhoons have happened throughout the Philippines' recorded history. This is true. Climate scientists are hesitant to attribute a single weather event on global warming. They are right. It is not possible to make a determination about climate change and a single storm. Senior research associate at the University of Miami Brian McNoldy explained, "Extremely intense tropical cyclones are rare, but have always been a part of nature."[35] Individual typhoons cannot be directly attributed to climate change. Efforts have been made to determine the portion of the increase in damages that might be attributed to climate change brought about by greenhouse gas emissions, but a study by Bouwer and other scholars[36] showed that it was not yet possible to do so. To date, there are no definitive studies, which indicate that individual disasters caused by single extreme weather events can be attributed to climate change.[37]

At this stage, "our understanding of how climate change affects extreme weather is still developing, [in addition to which] changes in precipitation are quite complex[38], and current computer models of climate have only a limited ability to predict the heaviest precipitation."[39] It could take many years for scientists to have a clearer picture of the relationship between climate change and stronger, more frequent extreme weather events. Our current understanding and predictions may be off-base, given that "recent observed changes in precipitation have been even greater than the changes projected by climate models."[40]

Evidence suggests that extreme weather may be affected more than we ever anticipated – just as Greenland's ice sheets have been melting faster rate than any scientists had predicted.

We need an improved, updated and complete database of extreme weather events in and around the Philippines to achieve greater clarity, like the data that we have for North Atlantic hurricanes.[41] The frequent debate over whether anthropogenic climate change has contributed to observed damage indicates a need for assessments of the detection and attribution of the effects of climate change, especially in and around the Philippines.[42]

Recent observed changes in precipitation have been even greater than the changes projected by climate models.

Extreme weather events

An extreme weather event differs significantly from the average or usual weather pattern. Extreme events include heat waves, droughts, tornadoes, and hurricanes – but the key is that extreme weather events are unusual, severe, or unseasonal. Definitions usually focus on weather at the extreme of historical distribution (e.g. weather outside a previously recorded range), where weather or climate is defined as the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends (tails) of the range of observed values of the variable.[43] For example, to assess extreme daily temperatures, threshold values used could be 99th or 1st percentiles.

However, some climate extremes such as droughts and floods may result from accumulation of weather or climate events that are not extreme in and of themselves – although their accumulation could end up being extreme. Moreover, some weather events, even if not extreme in a statistical sense, can still lead to extreme conditions or impacts if they cross a critical threshold in a social, ecological, or physical system, or if they occur at the same time as other damaging events. A weather system such as a tropical cyclone can have an extreme impact even if the specific cyclone is not extreme relative to other tropical cyclones.

Some weather events, even if not extreme in a statistical sense, can still lead to extreme conditions or impacts if they cross a critical threshold in a social, ecological, or physical system.

What we suspect about climate change and extreme weather

Despite climatologists' uncertainties however, it is now very likely that human influence has contributed to observed global-scale changes in the frequency and intensity of daily temperature extremes since the mid-20th century and likely that human influence has more than doubled the probability of heat waves in some locations.[44] It is likely that anthropogenic forcing has made a substantial contribution to the warming of each of the inhabited continents since 1950.

There is also medium confidence that human influence has contributed to large-scale changes in precipitation patterns over land.

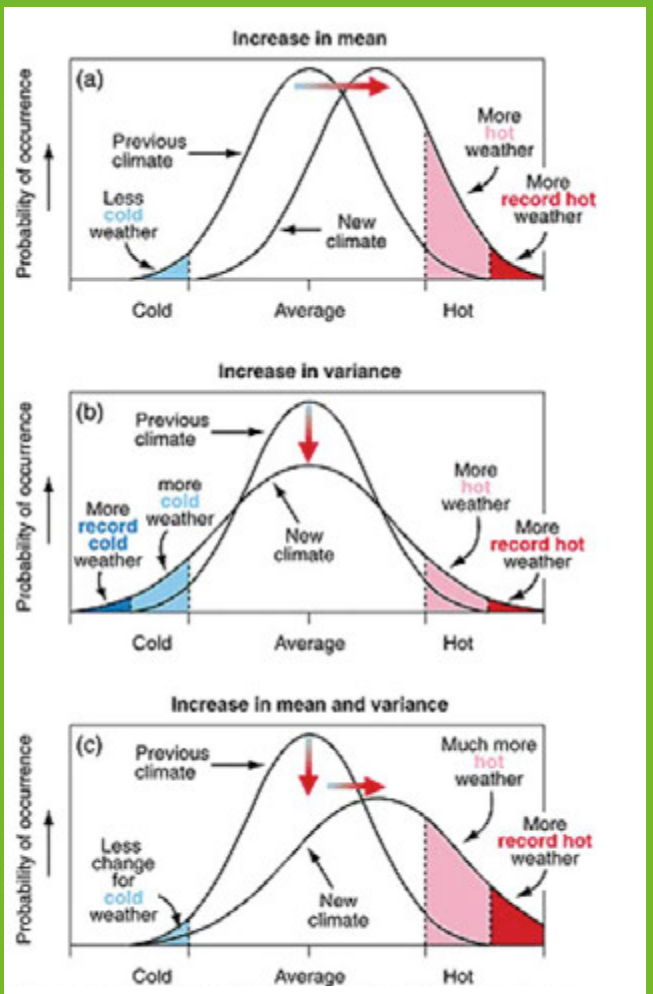
Moreover, a growing body of literature is emerging which may link climate change to potentially devastating weather. There is no clear consensus yet, but more researchers have found that global warming could make typhoons stronger and more frequent in the future. The 2010 peer-reviewed report in Nature Geoscience, posited that "existing modelling studies... consistently project decreases in the globally averaged frequency of tropical cyclones, by 6 to 34%. Balanced against this, higher-resolution modelling studies typically project substantial increases in the frequency of the most intense cyclones, and increases of the order of 20% in the precipitation rate within 100 kilometres of the storm centre."[45] At this stage, it is too early to properly judge the accuracy of new scientific claims, but they should sound an alarm bell for lawmakers of the Philippines to fund more research and to play it safe by embracing renewable energy at home while pushing for an ambitious, fair, legally binding, international climate treaty.

More researchers have found that global warming could make typhoons stronger and more frequent in the future.

What we know for sure

There are some points we can acknowledge with certainty. The devastation that tropical cyclone Yolanda and others like it (hurricanes, cyclones, and typhoons) wreak on countries like the Philippines can be aggravated by climate change for several reasons:

- Climate change has made sea levels rise.
- Higher sea levels trigger higher storm surges.
- Higher storm surges mean that more water is pushed farther inland.
- More water inland amplifies the damage done by tropical clones to people, housing and infrastructure.



Schematic showing the effect on extreme temperature when (a) the mean temperature increases, (b) the variance increases, and (c) when both the mean and variance increase for a normal distribution of temperature.

Figure 7
Climate change shifts the odds for extreme weather events [46]

Climate change increases temperatures in the Philippines and across the globe

Science has clearly proven that the globe is heating up.[47] We know for sure that a hotter planet results to a drastic change in climate patterns.

The most current global assessment by the Intergovernmental Panel on Climate Change (IPCC) in 2013 has indicated that human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reduction in snow and ice, in global mean sea level, and in changes in some climate extremes. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) states that warming of the climate system is "unequivocal" and that this is largely due to an increase in the atmospheric concentration of anthropogenic greenhouse gases.[49] One of the main conclusions is that many of the observed changes include warming of the atmosphere and ocean, diminishing amounts of snow and ice, sea level rise and the increasing concentrations of greenhouse gases.
In addition, we know that "the warming of air and sea temperatures – which is well under way – should on the whole give more power to tropical cyclones, in part because warmer air can hold more water vapor."[50] Warmer air holds 4% – 8% more moisture per extra degree Fahrenheit, and in a typhoon, each additional drop of moisture can become an additional raindrop for the typhoon to dump down on already flooded communities. The IPCC found that with a 4% increase in moisture per degree the atmosphere's water vapor content increased by 0.41 kilograms per square meter (kg/m2).[51] It is now virtually certain that the frequency and intensity of the strongest tropical cyclones in the North Atlantic has increased since the 1970s.[52]

In the Philippines, manifestations of changing climate are now evident. Increasing trends in annual mean temperature have been noted and extreme weather/climate events like increasing number of hot days and warm nights, and intense 24-hour rainfall are being seen to be more frequent. These are not unusual anymore and are becoming the norm. The IPCC also found that mean, maximum and minimum temperatures in the Philippines increased 0.14°C per decade since 1971.[53] Scholars and governments agree with the IPCC report. "Tibig (2004)[54] and Manton et al. (2001)[55] support this finding, showing departures from the annual mean, maximum and minimum temperatures in recent years of 0.61°C, 0.34°C, and 0.89°C, respectively, from the 1961–1990 normal values, indicating an increase in

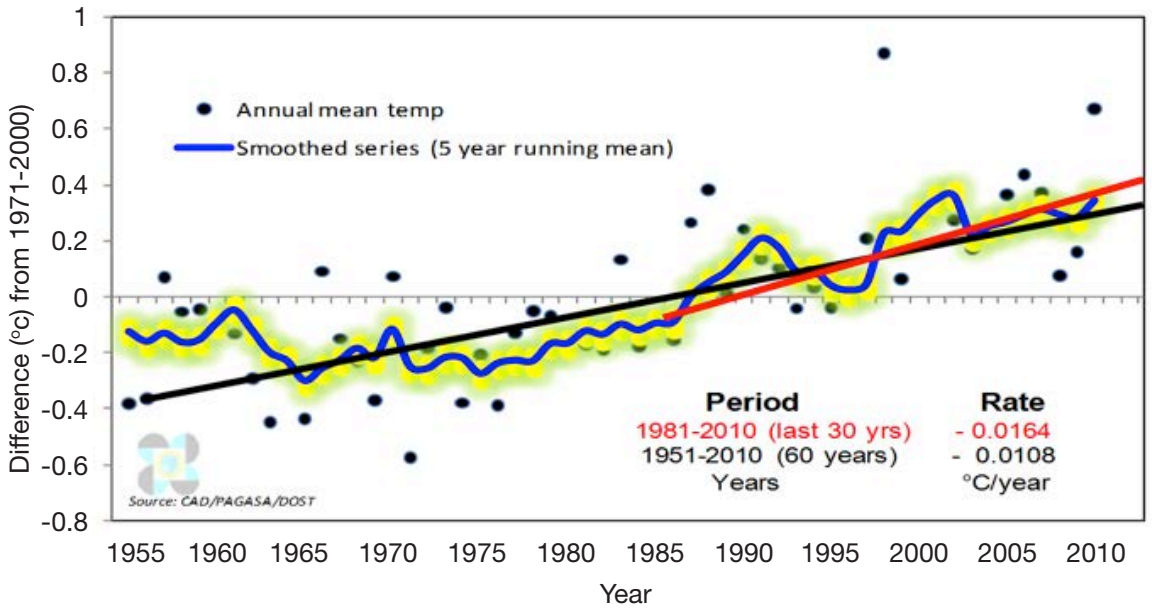


Figure 8
Observed annual mean temperature anomalies (1951-2010) in the Philippines based on 1971-2000 normal values.

temperature. The frequency of hot days and warm nights has also increased and the number of cold days and cool nights decreased."[56] The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)'s climatology division conducted a 2010 study analyzing climate data from 1960 to 2003. It too showed marked increases in the frequency of hot days and hot nights, and a decrease in cooler days. PAGASA predicted that we would see more days where temperature will rise above 35 degrees Celsius in 2020 and 2050.[57]

In the Philippines, analysis of surface land temperature trends shows an increase of 0.65 degrees Celsius in annual mean temperatures for the period 1951-2012. Fig. 8 shows temperature anomalies versus the (1971-2000) normal value for the period 1951 – 2010. Over the last 60 years, the average annual rate of increase is 0.0108oC per year, with the rate increasing to 0.0164 degrees Celsius per year in the last 30 years (1981-2010). Before 1987, the temperature was cooler. Anomalous positive temperatures only started thereafter with increasing rate with time. However, the interannual variations in the warmer period are still evident as the trend went down during the period from 1989 to 1996. The highest positive anomaly occurred in 1998, at the peak of one of the most significant El Niño events in the north-west Pacific causing widespread drought in the Philippines and massive forest fires in Indonesia.[58]

Figure 9 shows the yearly anomaly variation of the annual diurnal maximum temperature for the period 1951 to 2010. The deviation from the 1971-2000 normal values varies over the entire period from positive to negative with a rising trend in 1987, falling down to below zero in 1995-96, 1999 and 2008-09. Nevertheless, an increasing trend, statistically significant at 95% level, is noted in the 5-year linear running mean. An increase of 0.36 degrees Celsius has been observed in the

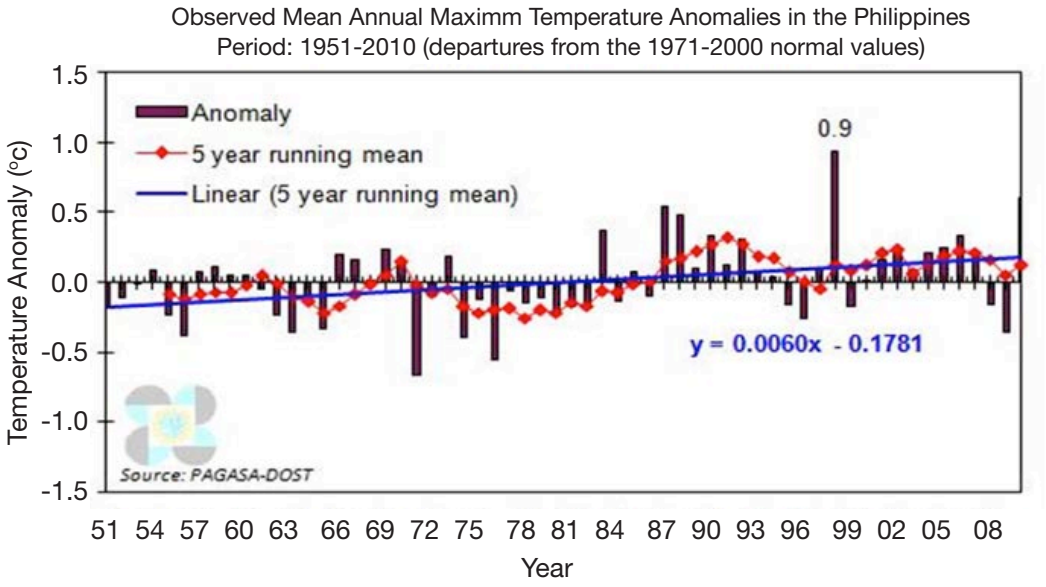


Figure 9
Observed annual maximum temperature anomalies (1951-2010) in the Philippines based on 1971-2000 normal values.

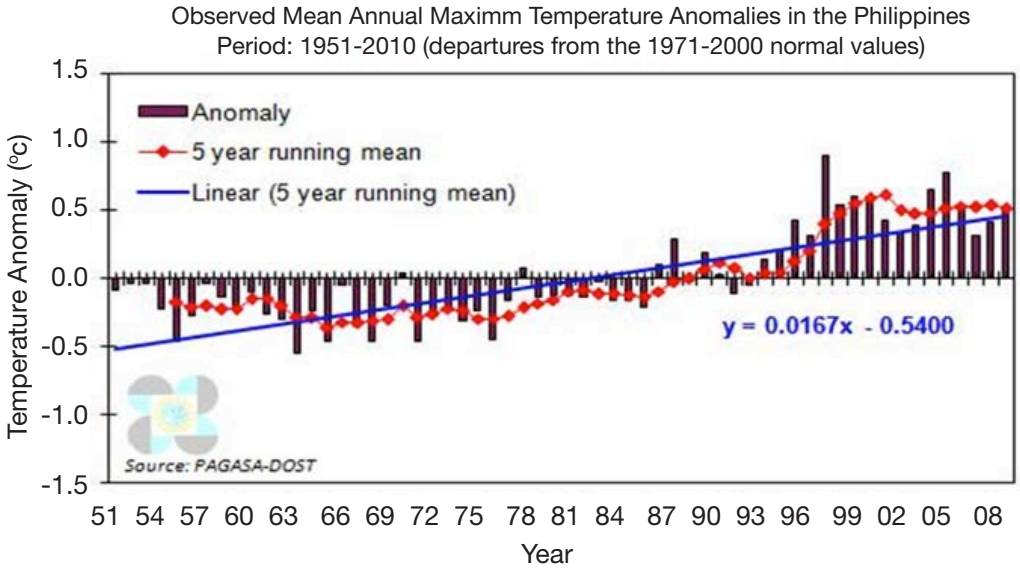


Figure 10
Observed annual minimum temperature anomalies (1951-2010) in the Philippines based on 1971-2000 normal values.

mean annual maximum temperature over the 60-year period, with the highest positive anomaly (+0.9) observed during the 1998 El Niño.

On minimum temperature (nocturnal), the analysis of anomalies in Figure 10 shows a higher increasing trend. Negative temperature anomalies were observed before 1987 and positive increasing anomalies thereafter with highest value of +0.9 during the 1998 El Niño. An increase of 1.0 degrees Celsius over the 60-year period has been observed and this is three times greater than that of the maximum temperatures. The large increase in the minimum temperatures (nocturnal) over the observed period indicates that nights are becoming warmer in the Philippines, demonstrating reduced variability and increased convergence between diurnal and nocturnal temperatures.

Climate change affects extreme daily temperatures

(extreme values-hot days, warm nights, and cold days, cool nights)

Analysis of extreme daily temperature from 1951 to 2008 shows the trends of hot days and cold nights to be statistically significant (95%). In Fig.11, the trends in the frequency of days with maximum temperature (hot days) above the mean 99th percentile are significantly increasing (▲) in most parts of the country. However, significantly decreasing (▼) trends are noted in some areas of the Bicol region, Visayas [specifically in Roxas] and Mindanao [specifically, in Zamboanga].

For cold nights (frequency of days with minimum temperature below the 1st percentile), significant decreasing trends (▼) are noted in most areas all over the country. This means that the number of cold nights in many areas of the Philippines during the period 1951 – 2008 had decreased when compared to the normal values for the period 1971 – 2000. However, some areas (i.e., Iba, Zambales and Dagupan in Luzon) have significant increasing (▲) trends (See Fig.12).

The extreme daily temperature trends, in particular those for cold nights and hot days are found to be more spatially coherent all throughout the country. The statistically significant trends in extreme events when considered in conjunction with the observed warming trends already described reveal a climate, which has undergone substantial changes, particularly over the last 30 years.

The AR4[59] reported a statistically significant increase in the numbers of warm nights and a

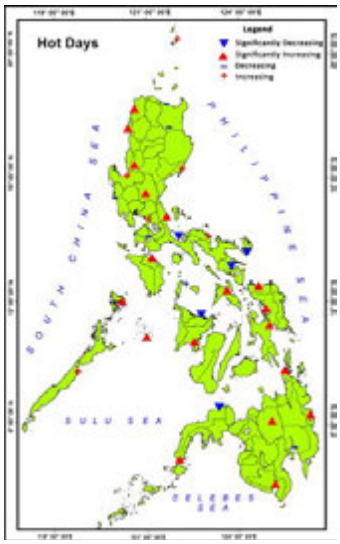


Figure 11
Trends in the frequency of days with maximum temperature above the 1971-2000 mean 99th percentile (Hot days)

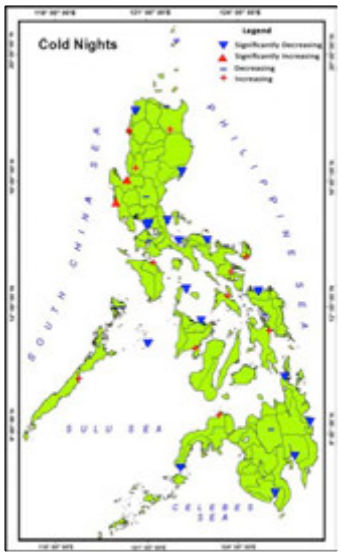


Figure 12
Trends in the frequency of days with minimum temperature below the 1971-2000 mean 1st percentile (Cold nights)

statistically significant reduction in the numbers of cold nights for 70 to 75% of the land regions with data. More recent analyses available since the AR4 are consistent with the assessment of increase in warm days and nights and a reduction in cold days and nights on the global basis (IPCC, 2012). The IPCC 2013 further concludes that further evidence indicates that the level of confidence that the majority of warm and cool extremes show warming remains high.[60] Despite differences in the different data sets used in assessing temperature extremes globally, results of analyses show large coherence trends in temperature extremes, indicating warming of both maximum and minimum temperature extremes, with faster increase in minimum temperature extremes than maximum temperature extremes, indicating a greater shift in distribution of nighttime temperatures than that of daytime temperatures – globally. Most of Asia also shows trends consistent with warming, but these are assessed here to be of medium confidence because of lack of literature for several regions apart from the 2006 global study from Alexander et al.[61] In some parts of the Asia-Pacific region, close to a doubling of the occurrence of warm nights and a halving of the occurrence of cold nights has been experienced.[62] Recent assessment, also indicate that there is low (where there is lack of literature/ studies) to high (depending on location) shifts in terms of warm spells/heat waves in southeast Asia and Oceania (e.g., Australia, New Zealand).[63]

Period	Projected Mean Temperature					
	Change			Average		
	Low-range	Medium-range	High-range	Low-range	Medium-range	High-range
2020 (2006-2035)	0.7°C	1.0°C	0.7°C	27.9°C	28.4°C	28.1°C
2050 (2036-2075)	1.6°C	2.0°C	1.7°C	28.7°C	29.4°C	29.1°C
2100 (2071-2100)	2.5°C	3.1°C	3.4°C	30.5°C	30.5°C	30.8°C
Observed (1951-2009)	0.57°C			27.4°C		

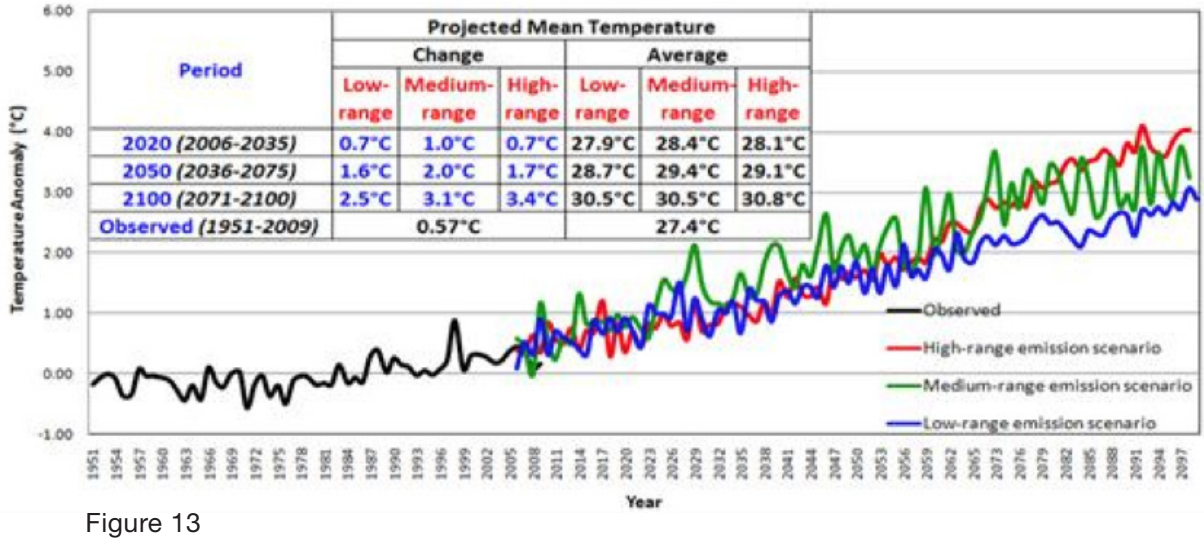


Figure 13
Observed and Projected Annual Mean Temperature Anomalies for the philippines Period 1951 to 2100 (Departure from 1971-2000 normal values)

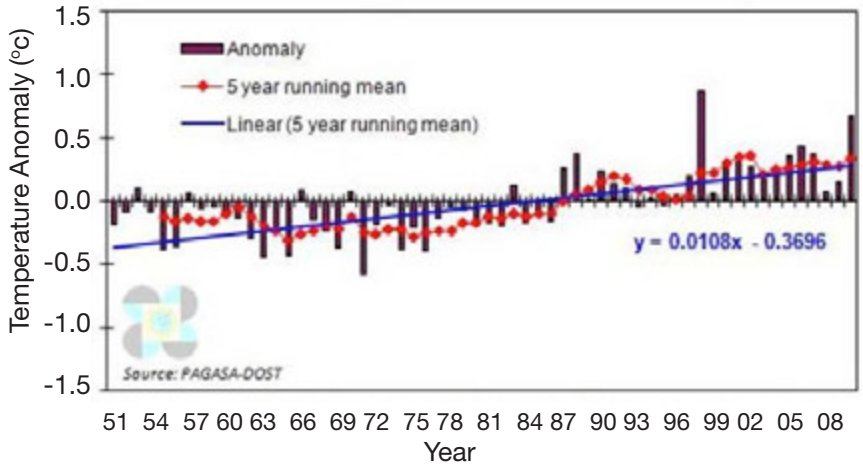


Figure 14
Observed annual mean temperature anomalies (1951-2010) in the Philippines based on 1971-2000 normal values

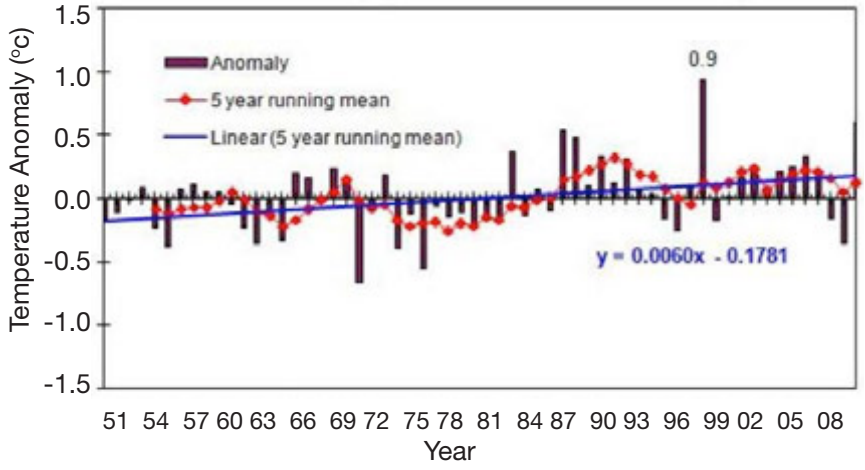


Figure 15
Observed annual mean annual maximum temperature anomalies in the Philippines during the 1951-2010 period (compared with the 1971-2000 normal values)

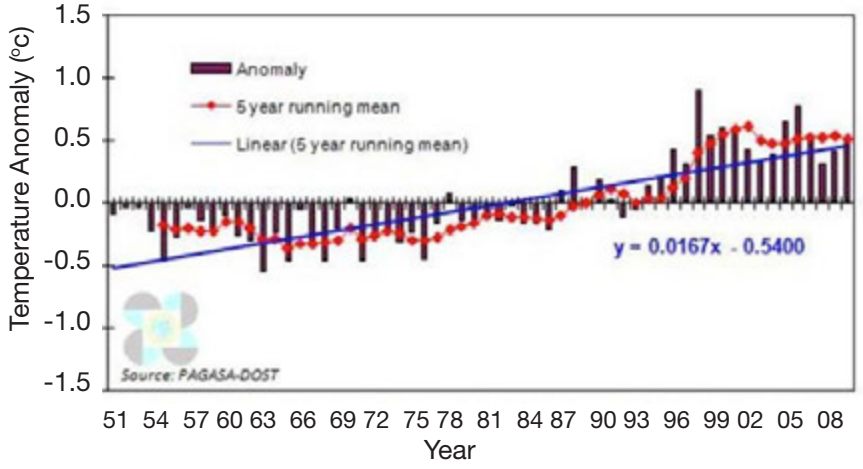


Figure 16
Observed annual mean annual minimum temperature anomalies in the Philippines during the 1951-2010 period (compared with the 1971-2000 mean values)

Climate change has caused exceptional sea level rise in the Philippines

As a geographically isolated low-lying archipelagic nation, the Philippines is in a particularly vulnerable position. “Sea level rise has been occurring significantly faster in the Philippine Sea than elsewhere around the world.”[67] This problem is compounded by the fact that the country is surrounded by warm Pacific Ocean waters (warm waters fuel storms, making them more powerful). The Philippines’ already warm waters are heating up fast.

This can cause problems during superstorms. “As Haiyan began forming, sea temperatures were between 0.5 and 1 degree Celsius higher than normal in the waters east of the Philippines.”[68]

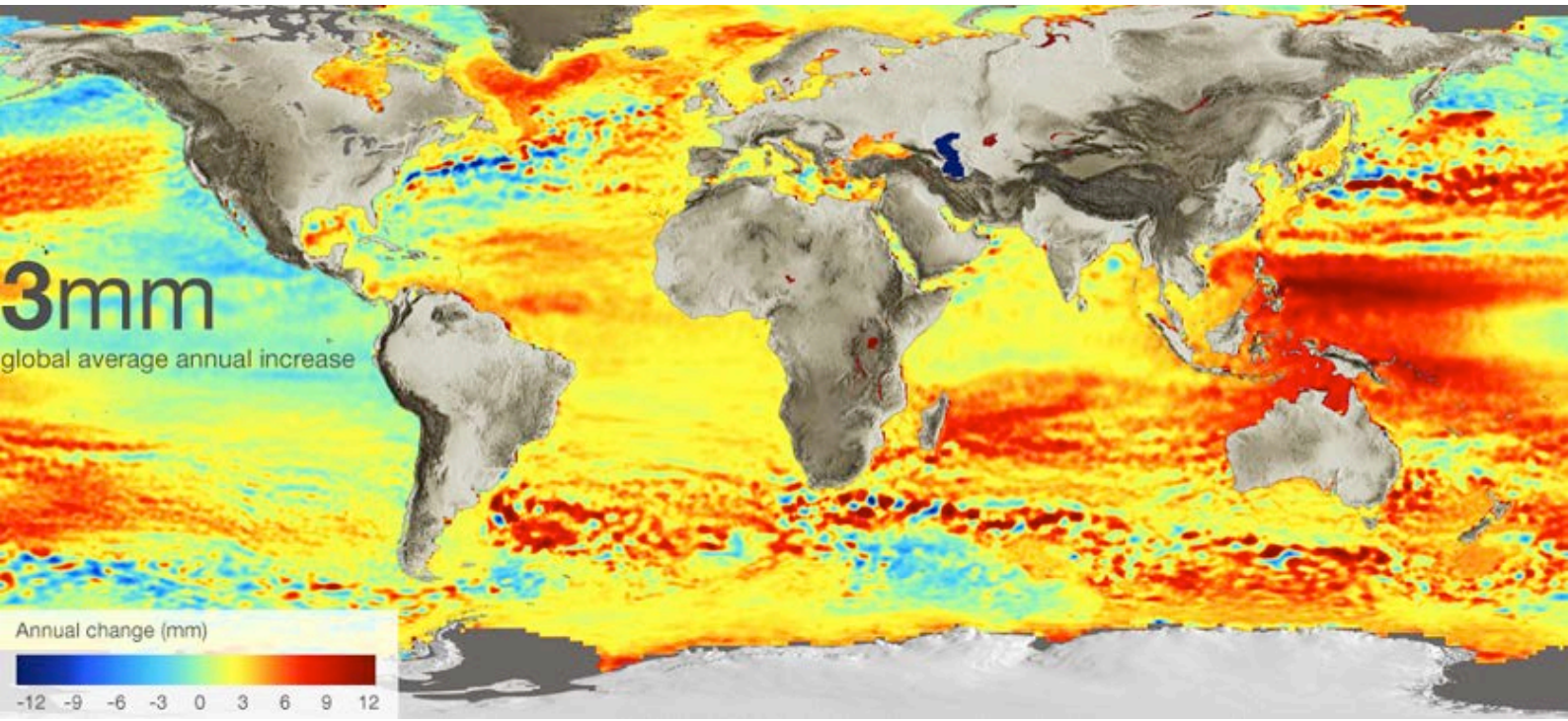


Figure 17
Annual average sea-level rise, 1983-2010

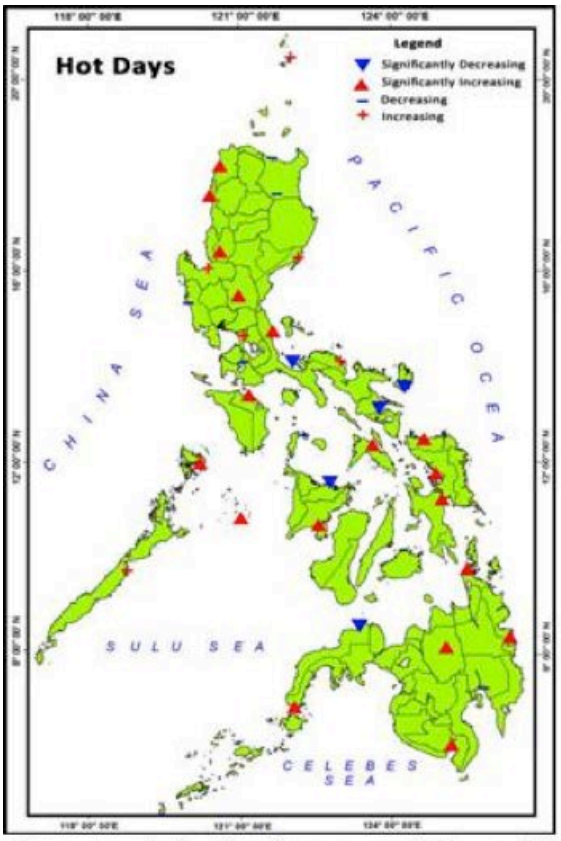


Figure 18
Trends in the frequency of days with maximum temperature above the 1971-2000 mean 99th percentile

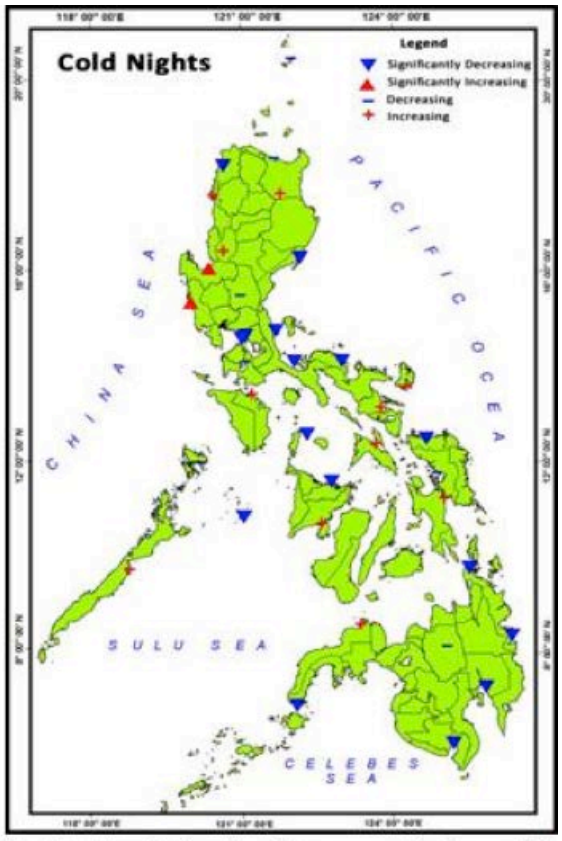


Figure 19
Trends in the frequency of days with minimum temperature below the 1971-2000 mean 1st percentile

A new map with a clearer global picture of sea level rises

"Scientists have reviewed almost two decades of satellite data to build a new map showing the trend in sea levels. Globally, the oceans are rising but there have been major regional differences over the period… A major reassessment of 18 years of satellite observations has provided a new, more detailed view of sea-level change around the world. Incorporating the data from a number of spacecraft, the study re-affirms that ocean waters globally are rising by just over 3mm/yr. But that figure, according to the reassessment, hides some very big regional differences - up and down. The Philippine Sea, for example, has seen increases in excess of 10mm/yr."[69]

Putting aside debates on specific mechanics of global warming's influence over various typhoons;[70] climate change is very likely to have made Yolanda deadlier in part because of sea level rise.

With or without extreme weather events, sea level rise poses problems for Filipinos. A 2007 report by Greenpeace Philippines already showed that even a partial and conservative projection of a one-meter rise in sea level "is projected to affect 16 regions 64 out of 81 provinces, covering at least 703 out of 1,610 municipalities,[71] inundating almost 700 million square meters of land and potentially displacing at least 1.5 million Filipinos."[72] Other studies also found that sea level rise contributed to coastal erosion in the Philippines.[73]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The Philippines is severely impacted by frequent cyclones

Yolanda was not a rare occurrence. Rather, 2013 marked "the third year in a row that the Philippines has been struck by devastating storms of similar magnitude. In 2011, Tropical Storm Sendong (international name Washi) left more than 1,200 people dead as it sliced through the southern province of Mindanao."[74] In 2012, the even stronger category five Super Typhoon Pablo (international name Bopha) killed more than 1,000 people with 175mph winds (282km/h), particularly affecting the island of Mindanao. "It was the 16th major storm of the year, hundreds of thousands of people had lost their homes."[75]

The Asian Development Bank calculated, "In the Philippines, the frequency of typhoons entering its area of responsibility increased more than four-fold during 1990–2003. On average, 20 tropical cyclones, most of them originating in the Pacific, frequented the area each year, with nine (on average) making landfall… During the past 15 years, the country was hit by the strongest typhoon ever recorded, the most destructive typhoon, the deadliest storm and the typhoon that registered the highest recorded 24-hour rainfall.

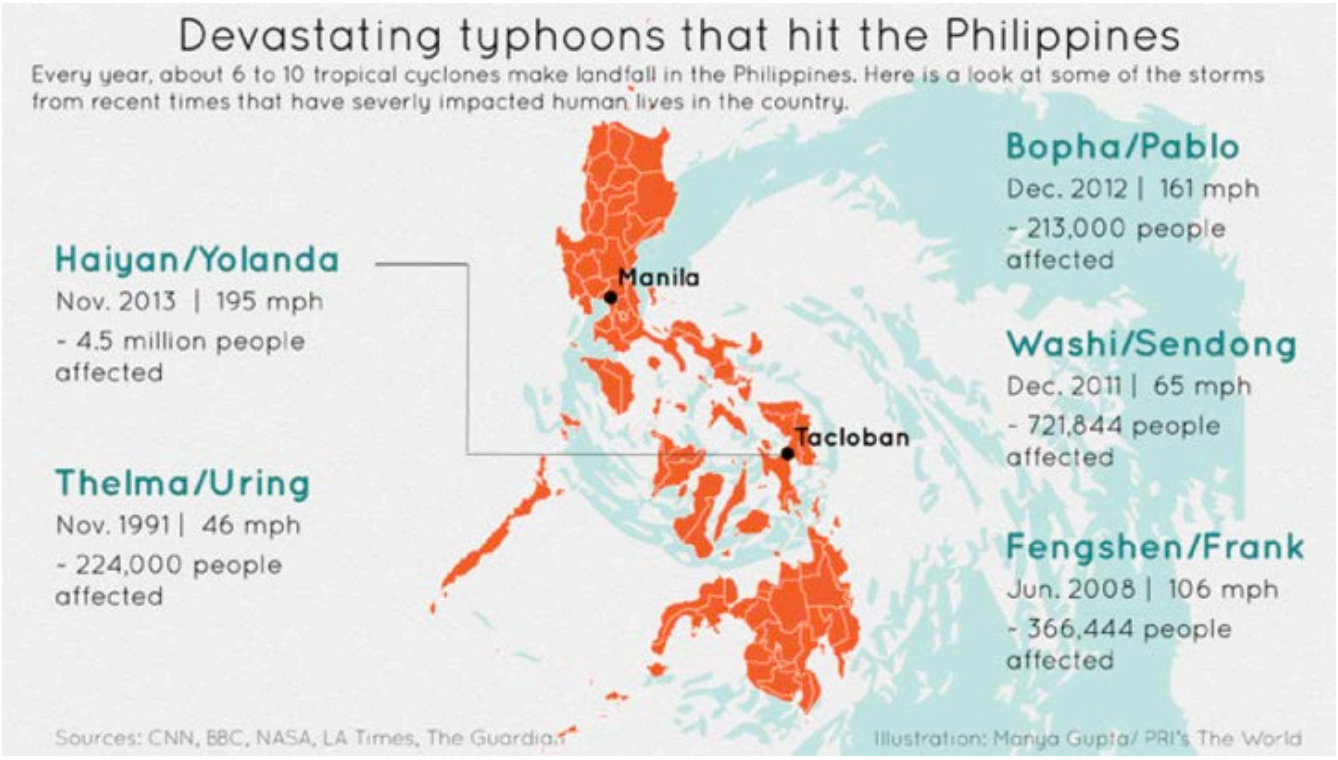


Figure 20
Devastating typhoons that hit the Philippines

According to Amadore (2005), extreme events in the Philippines are usually accompanied by persistent torrential rains that cause landslides and flash floods, killing people and destroying property as well as the environment. Almost 80% of disasters occurring in the country over the past 100 years have been weather-related, with typhoons and floods contributing to the two highest event categories."

Scientists going back-and-forth and over analyzing today's storms "shouldn't obscure the fact that climate change will bring an assortment of dangers, possibly including more powerful storms,"[77] as the global temperatures continue to rise.

The Philippines is located in the North Western Pacific (WNP) area where the most number of tropical cyclones (TCs) develop around the globe (Fig. 2.9). On the average, 30 TCs develop a year in the area and about 20 of them enter the PAR. From 1948 to 2010, 1,641 TCs formed over the WNP and 1,154 or 70% of them passed the PAR. The tracks of all these TCs are shown here.

Climatologically, most TCs in the WNP are generated in the Philippine Sea or the South China Sea, within a latitude band of 10° to 25°N, and also, that the three prevailing tracks of TCS are a westward moving track, a recurving track that continues toward Japan or Korean peninsula and a recurving track to the northeast, mostly east of 140°E;

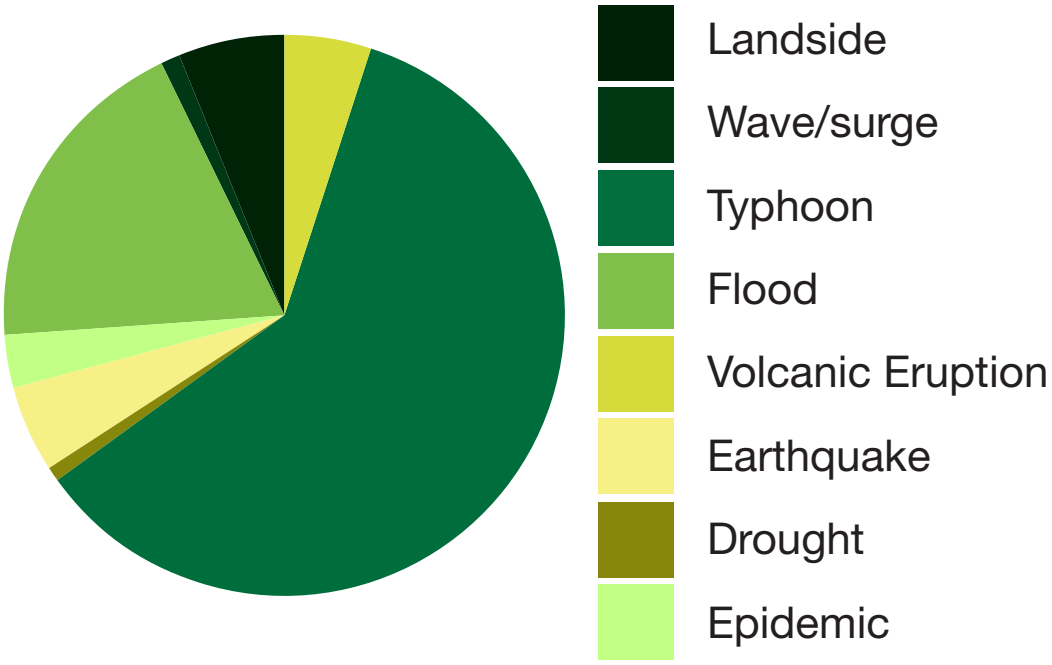


Figure 21
Disaster in Philippines (1905-2006)

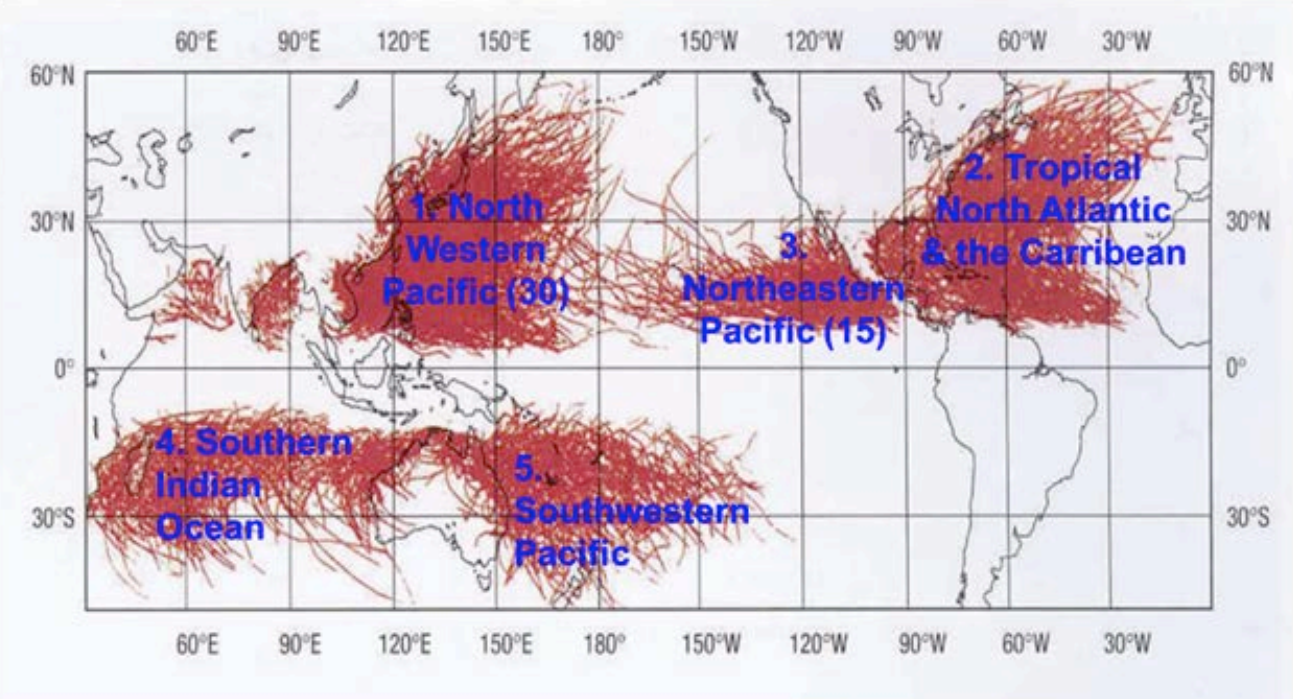


Figure 22
Areas of formation of tropical cyclones around the globe

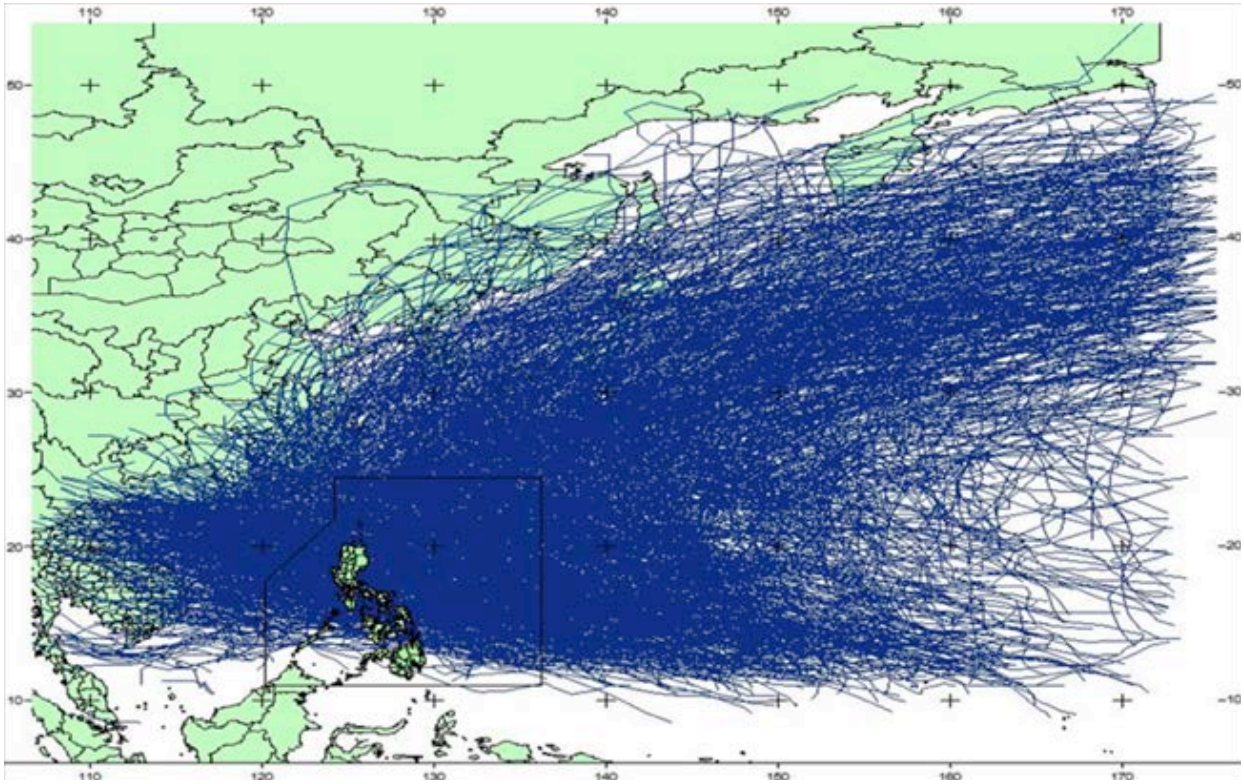


Figure 23
Tracks of tropical cyclones over the Western North Pacific (WNP) for the period 1948-2010

Climate change triggers rainfall shifts, flooding, and droughts

Climate change is causing rainfall patterns in the Philippines to shift, causing droughts and floods and impacting the country's agriculture – often hurting poor farmers[78] who can least afford to implement climate change resilience measures.

A PAGASA study indicated that rainfall was significantly less in March, April and May 2010; and that increases in rain are likely in 2020 and 2050 in Luzon (0.9-63 %) and Visayas (2-22 %) during the monsoon seasons (June-August and September-November).[79]

In calculating the extent of damages due to floods and storms in the Philippines over the past 5 decades, the Asian Development Bank (ADB) found that "recorded floods/storms have risen dramatically, particularly in the Philippines, rising from just under 20 during 1960—1969 to nearly 120 by 2000—2008."[80]

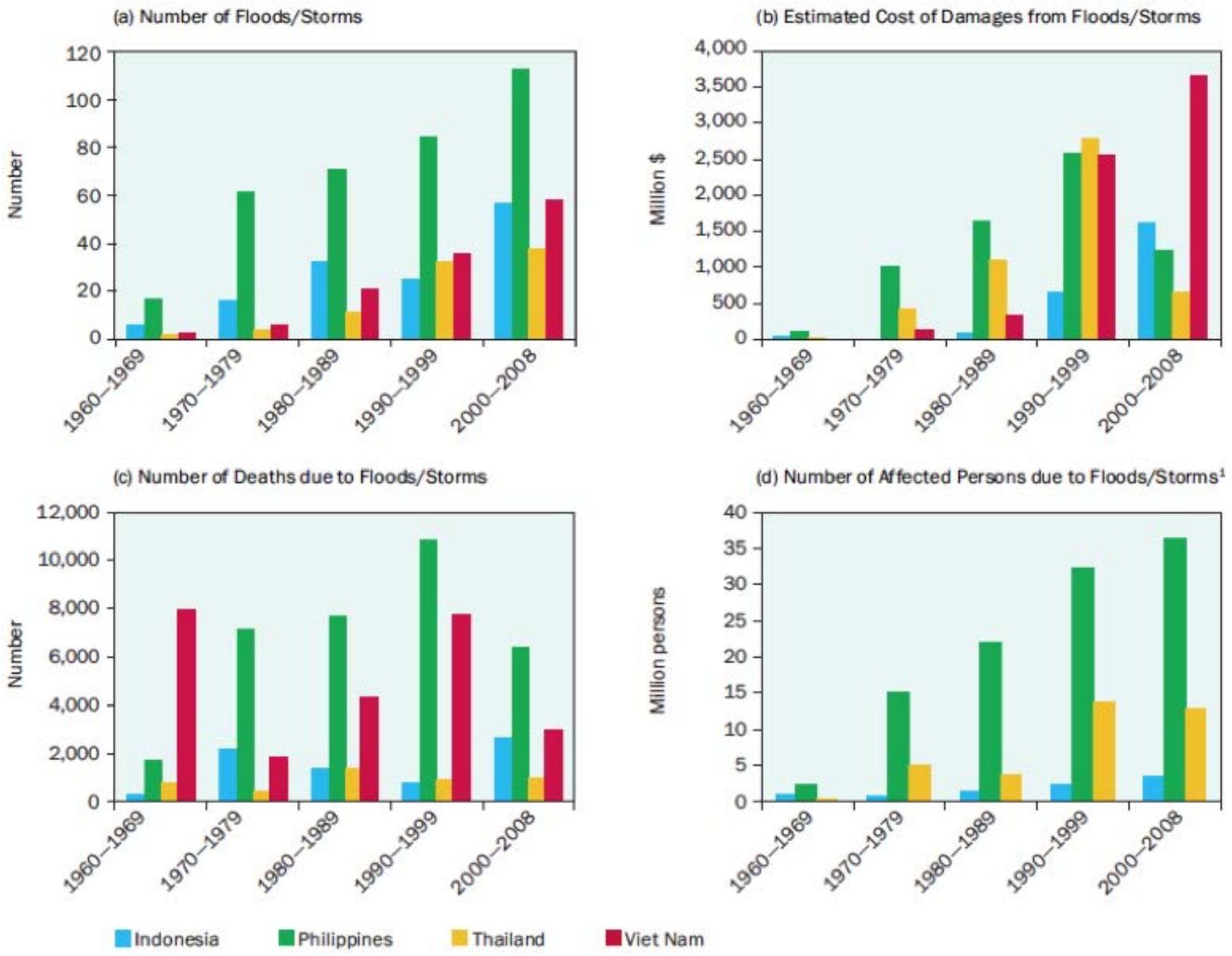


Figure 24
Extent of Damages due to Floods/Storms (1960-2008)

For the country as a whole, the ADB also found that: "since 1960, mean annual rainfall and the number of rainy days in the Philippines have increased. But as in other places, the country has experienced similar variability in the onset of the rainy season." Regarding variability, climate specialist Emmanuel G. Anglo[81] found evidence of decreased rainfall in Luzon and Mindanao but increased rainfall in the Visayas.[82] Climate specialist Dr. Rosa T. Perez[83] also found that variability would continue in the future, with impacts from ENSO events (El Niño Southern Oscillation).[84]

The rates of increases or decreases in the trends are point values (i.e., specific values in the synoptic weather stations only) and are available at PAGASA, if needed.

Extreme weather events and heavy rains cause floods, flash floods, runoff into rivers and reservoirs, mudslides, massive landslides and more. "Between 1991 and 2006, around 10,000 people died as victims of flash floods and landslides."[85] Amadore, who wrote an earlier report for Greenpeace in 2005, found that between 1975 and 2002, intensified tropical cyclones cost the country 593 deaths on average, and agriculture and property worth $138 million.[86]

Triggered by flooding (flooding may become more likely as a result of climate change), "the 2001 Camiguin flash flood in the Philippines, which was triggered by tropical typhoon Nanang, affected more than 35,000 people and killed 157. Total damage was estimated at $96 million. The 2006 Guinsaugon, Leyte landslide, which was

triggered by super typhoon Reming, killed 1,126 people. The 2006 Legazpi, Albay mudslide, also brought about by typhoon Reming, killed 1,399 people and brought significant damage to the communities of the area, many of which have had to be completely rebuilt or relocated. These two landslides, affecting more than 800,000 families, were considered the world's second and third deadliest disasters of 2006."[87]

Extreme daily rainfall trends

The analysis of trend of extreme daily rainfall intensity using the events that exceeded 99th percentile for the period 1951-2008 shows increasing (+) trend in most parts of the country but with significant increase (95%) (▲) observed only in Baguio (in Luzon), and Tacloban and Iloilo (in the Visayas) as shown in Fig. 26. An exception is the significant decrease (▼) in a single station (Coron Island in Luzon).

Meanwhile, Fig. 27 shows the trend in the frequency of the daily rainfall in excess of the mean 99th percentile. Majority of the stations all over the country show increasing (+) trend in the number of days of extreme rainfall events. A few stations (Laoag and Calapan (in Luzon) and Tacloban and Panay (in the Visayas)) exhibited

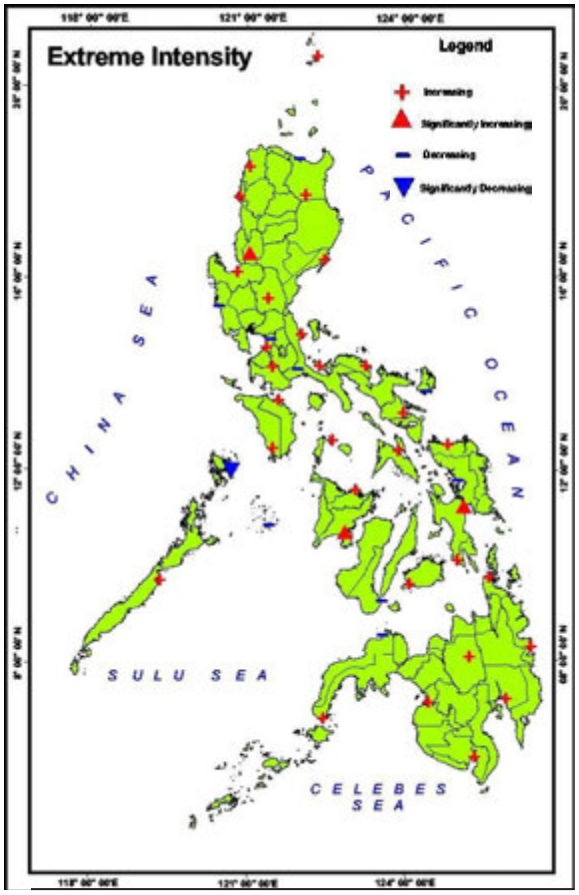


Figure 25
Trends in extreme daily rainfall intensity in the Philippines (1951-2008) compared with the 1971-2000 mean values.

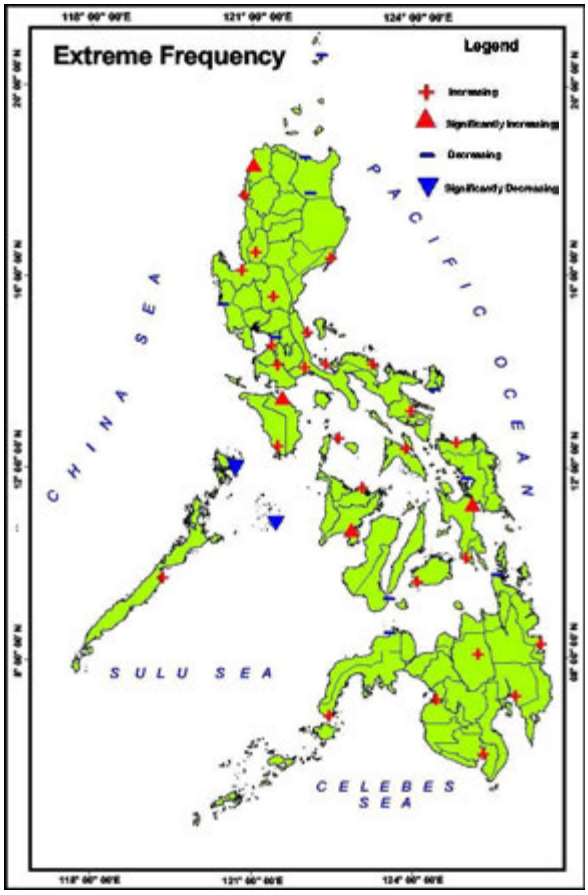


Figure 26
Trends of extreme daily rainfall frequency in the Philippines (1951-2008) compared with the 1971-2000 mean value.

The period 1951 – 2008 analysis has shown increases in both the frequency and intensity of extreme daily rainfall events at most stations throughout the Philippines

significant increases (▲), while again, Coron Island (in Luzon) showed significant decrease (▼) I. Although the period 1951 – 2008 analysis has shown increases in both the frequency and intensity of extreme daily rainfall events at most stations throughout the Philippines, the majority do not show a high level of statistical significance at the 95% confidence level.

Summarizing these results, in the Philippines, the period 1951 – 2008 analysis has shown increases in both the frequency and intensity of extreme daily rainfall events at most stations throughout the Philippines, although, with very few stations showing statistically significant increases (additionally, there is no spatial coherence as there remains a high level of variability between stations).

In 2007, the AR4 (Trenberth et al., 2007) concluded that it was likely that there had been increases in the number of heavy precipitation events (e.g., 95th percentile) over the second half of the 20th century within many land regions, even in those where there had been a reduction in total precipitation amount, consistent with a warming climate and observed significant increasing amounts of water vapor in the atmosphere. Recent studies have updated this assessment of the AR4, with more regional results now available (IPCC, 2012; IPCC, 2013). Overall, this additional evidence confirms that more locations and studies show an increase than a decrease in extreme precipitation, but that there are also wide regional and seasonal variations, and trends in many regions are not statistically significant.

The IPCC 2013 has updated the assessment of trends of extreme precipitation globally to from low confidence (lack of literature) to high confidence and it is likely that there have been statistically significant increases in the number of heavy precipitation events (e.g., 95th percentile) in more regions than there have been statistically significant decreases, but there are strong regional and subregional variations in the trends (i.e., both between and within regions).

Extreme monsoon performance

On monsoon activity, the most notable extreme event in the Philippines is the enhanced southwest monsoon, locally termed as “habagat,” that happened on 6-8 August 2012. This has caused great flooding over Metro Manila and surrounding provinces with a total damage to infrastructures and agriculture amounting to about PHP 639 million and PHP 1.6 billion, consecutively. A death toll of 95 persons was recorded and more than 800,000 families were left homeless. Daily rainfall of 323.4 mm (August 6), 391.4 mm (August 7), and 292.6 mm (August 8) were recorded at the Science Garden, Quezon City PAGASA Station. The total 3-day rainfall of 1007.4mm for August 6-8 is about 200% of the August monthly normal rainfall (504.2mm) at the observing site. The daily rainfall was continuous for 24 days from July 16 to August 8 with peak on August 6-8. Fig. 28 shows the extent of flooding in Metro Manila as a result of massive flooding.

Droughts and floods

Climate change could brings us not only more heavy rains and flooding but also more droughts and more unpredictability.

When examining climate change impacts and water resources in the Philippines, PAGASA found that:

Extreme climatic events like droughts and floods have serious negative implications for major water reservoirs in the country. A preliminary and limited assessment of the country's water resources was undertaken through the application of general circulation model (GCM) results and climate change scenarios that incorporate incremental changes in temperature and rainfall and the use of a hydrological model to simulate the future runoff-rainfall relationship. Results showed that changes in rainfall and temperature in the future will be critical to future inflow in the Angat reservoir and Lake Lanao, with rainfall variability having a greater impact than temperature variability. In the Angat reservoir, runoff is likely to decrease in the future and be insufficient to meet future demands for water. Lake Lanao is also expected to have a decrease in runoff in the future.[89] Through the years, extreme rainfall events

Extreme climatic events like droughts and floods have serious negative implications for major water reservoirs in the country.

manifested through the occurrence of floods and droughts as a result of rainfall variability has considerably impacted the users of impounded water both in the Magat Dam and Lake Lanao dam. There has been high variability in rainfall received in the country during the period 1951-present, primarily due to changes in the rainfall-causing systems in the country which include ENSO events and tropical cyclone occurrences. For instance, a previous study on the impacts of ENSO events during the 1971-2000, drought episodes in varying intensities in different parts of the country had been observe.

Impacts of Enso on Philippines rainfall

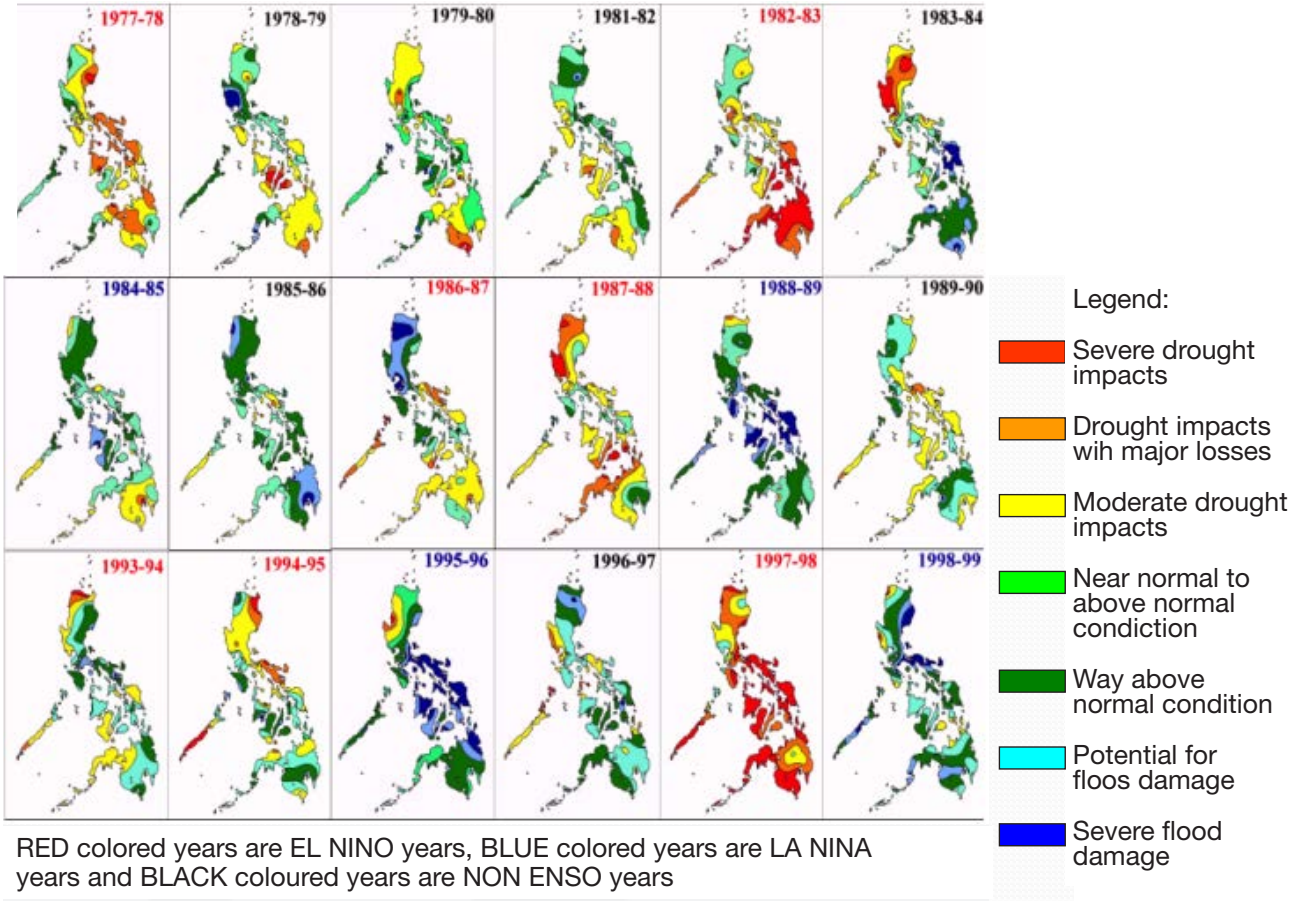


Figure 27
Drought episodes in different parts of the country in varying intensities (as shown in accompanying legend) during the ENSO events, 1971-2000. (Source: PAGASA)

The 1997–1998 El Niño drought years led to severe water shortages at the Angat reservoir, which provides most of the water for Metro Manila and required water rationing as well as disrupting hydroelectric power. Drought leads to water stress, which impacts ecosystems, forestry, agriculture, livelihood, health,[90] and human settlements. Our forests could face diebacks or forest fires during droughts. Communities depending on ecological services provided by forests will suffer. "In the Philippines, the highest recorded forest fire damage occurred in the El Niño years of 1983, 1992, and 1998 when fire destroyed between 50,000 and 65,000 ha of forests… Thousands of hectares of secondary growth and over-logged forests were also burned during the 1997–1998 ENSO events (Glantz 2001, PAGASA 2001)."[91]

El Niño-related droughts – amplified by climate change – are costly to the Philippine economy.[92]

Top officials are now speaking out about how climate change exacerbates droughts and rainfall in the Philippines. "Undersecretary Graciano Yumul of the Department of Science and Technology (DOST) said that in the next 20 to 50 years, the Philippines would find 'the dry seasons drier and the wet seasons wetter…With the climate change scenario, we will see more of this as a frequent reality,' Yumul said in an interview. 'What we used to consider as abnormal we should now consider as normal,' he noted."[93]

Changes in Mean Annual Rainfall over the Philippines

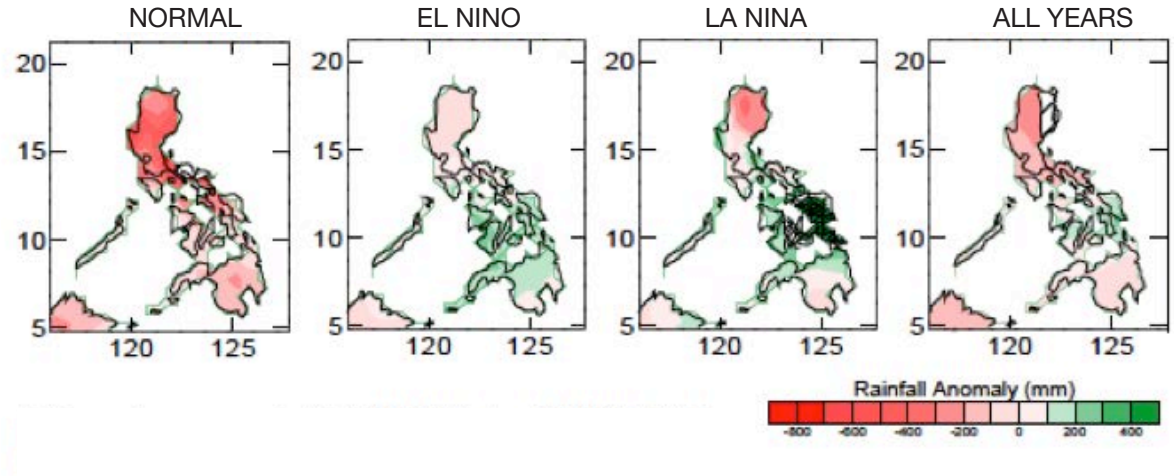


Figure 28
Difference in mean annual rainfall, 1976-2000 minus 1951-1975. ENSO events based on Multivariate ENSO Index (Wolter and Timlin 1998)

Negative impacts of climate change

Impacts on agriculture

Temperature and rainfall changes related to climate change (which is itself largely fueled by coal) affect agriculture in the Philippines. "Crops have been shown to suffer decreases in yields whenever temperatures have exceeded threshold values and possibly result to spikelet sterility, as in the case of rice… In areas where rain patterns change or when extreme events such as floods or droughts happen more often, grain and other agricultural produce could suffer shortfalls… Tropical cyclones, particularly if there will be an increase in numbers and/or strength will continue to exert pressure on agricultural production. Moreover, temperature increases coupled with rainfall changes could affect the incidence/ outbreaks of pests and diseases, both in plants and animals. Decreased yields and inadequate job opportunities in the agricultural sector could lead to migration and shifts in population, resulting to more pressure in already depressed urban areas, particularly in mega cities. Food security will largely be affected, especially if timely, effective and efficient interventions are not put in place. Insufficient food supply could further lead to more malnutrition, higher poverty levels and possibly, heightened social unrest and conflict."[95]

According to scholars from the Department of Agronomy; Institute of Statistics; and School of Environmental Science and Management, at the University of the Philippines Los Baños, "Typhoons, floods and droughts caused 82.4% of the total Philippine rice losses from 1970 to 1990…. Weather aberrations, climatic fluctuations such as El Niño, and the growing concern for their effects on agriculture have stimulated academic, public and policy-level interests on the analysis of the impacts of climate variability on agricultural production systems…Long-term climate variability influences sowing date, crop duration, crop yield, and the management practices adapted in rice production. Short-term weather episodes can also affect yield by inducing changes in temperature, potential evapotranspiration and moisture availability. The degree of vulnerability of crops to climate variability depends mainly on the development stage of the crops at the time of weather aberration."[96]

The author of a study on small rice farmers' adaptation to climate change in the Philippines found that farmers were already affected by climate change in the two areas studied in depth. Moreover, the author stated: "with regard to temperature, a scientific study done in 2004 reported that rice yields in the Philippines decline with higher night temperature due to global warming. They determined that for each 1 °C increase, there was a corresponding 10

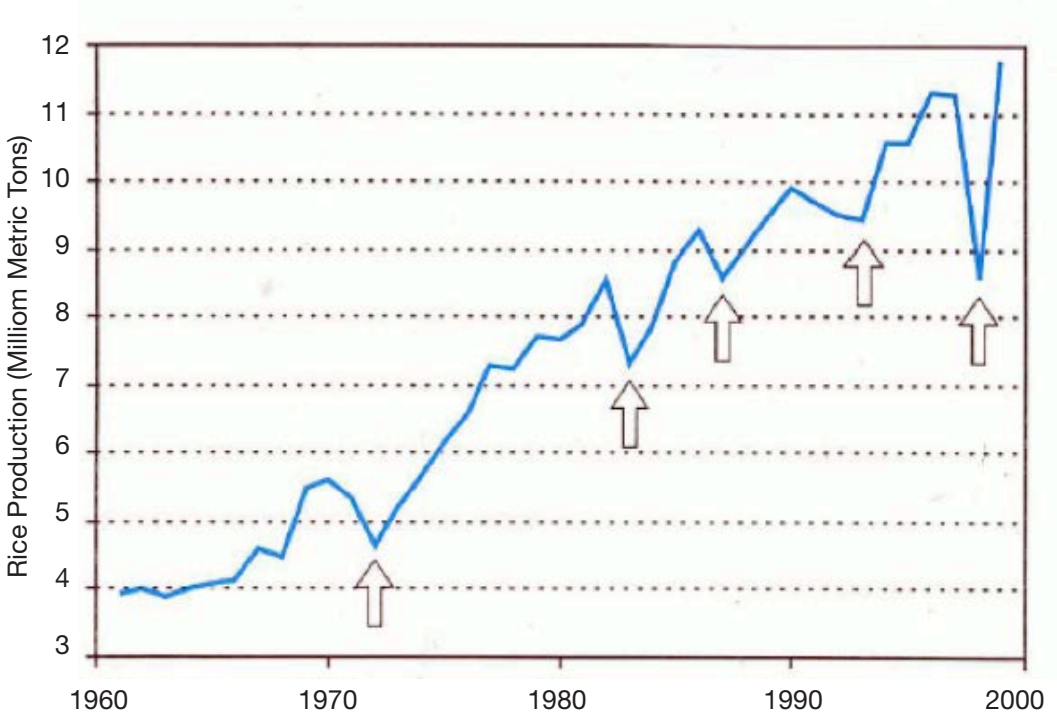


Figure 29
Philippines rice production (arrows indicate El Niño events)

percent decrease in yield (Peng, et al.). Lasco et al. (2006 cited in Tolentino 2009[98]) also found that rice yields can vary from 6.6 percent increase to 14 percent decrease for every 1 °C increase in temperature."[99] Other reports and research by climate specialists working on the intersection of climate change and agriculture also point to problems looming in the Philippines' future – including work that shows how rice production stands to be affected by changes in El Niño events.

Impacts of climate variability/climate change on Philippine agriculture were shown in a vulnerability and adaptation assessment done in 2008 in the preparation of the Second National Communication (SNC) of the Philippines to the United Nations Framework Convention on Climate Change (UNFCCC). This assessment indicated that agricultural production had been highly dependent on temperature increases and rainfall changes, such that yields decreased in years when temperatures were unusually high and rainfall arrived late and/or became less, and increased in those years when rainfall exceeded the threshold values for critical stages of the crops. For rice production in particular, process-based simulation studies in selected representative stations in the country applying projected temperature increases and rainfall changes in 2020 and 2050 showed decreasing yields as temperature increase and rainfall decrease beyond threshold values at critical stages of the crop. Agricultural production is to a large degree influenced by water availability and threshold temperature values.

Crops have been shown to suffer decreases in yields whenever temperatures have exceeded threshold values.

In the Philippines, we have already seen cropping seasons during El Niño years during which farmers were obliged to give up rain-fed rice farms because of droughts.[101] Maize, sugarcane, and coconut were also affected. Recurrent extreme droughts have lessened gross value added and volume of production in the agricultural sector in some regions particularly during the El Niño years of 1982–1983 and 1997–1998.[102] A +2 degrees Celsius rise in temperature could reduce rice yield by 22% in the country.[103]

Climate change's potential deleterious effects on agriculture could hurt many vulnerable people, as well as hurting the economy overall. Regarding the contribution of agriculture to the economy, the Gross Value Added of Agriculture in 2011 for the Philippines was 15,397 million US$.[104] Moreover, agriculture contributed to 35% of employment in the Philippines in 2009; in 2010 it was 33%; and in 2012 it was 32% of employment.[105] Of course, the agricultural sector provides food, domestically, as well as for exports, so it is tied to food security, especially for society's most vulnerable. The Philippine economy and food security are heavily dependent on local agricultural production. Around 47% of the total land area of the Philippines is dedicated to agriculture and 2/3 of the population depends on it for livelihood, to some extent.[106] If climate change negatively influences agricultural productivity, that affects our GDP, unemployment, and food security too.

[100] Figure 30


AVON
MERALCO

Impacts on health

It is now widely accepted that climate change can have impacts on health, globally. A study by the ADB on health impacts of climate change in three countries including the Philippines, cited World Health Organization data in a table that neatly sums up the biggest global health impacts:

Specifically in the Philippines, this ADB study highlighted links between rainfall patterns (shifting with climate change) and patterns in the number of cases of dengue.

Scholars Flavier et al. found that in the Philippines, malaria, dengue, diarrhea, and cholera showed a 10–58% association between health and climate variables.[108]

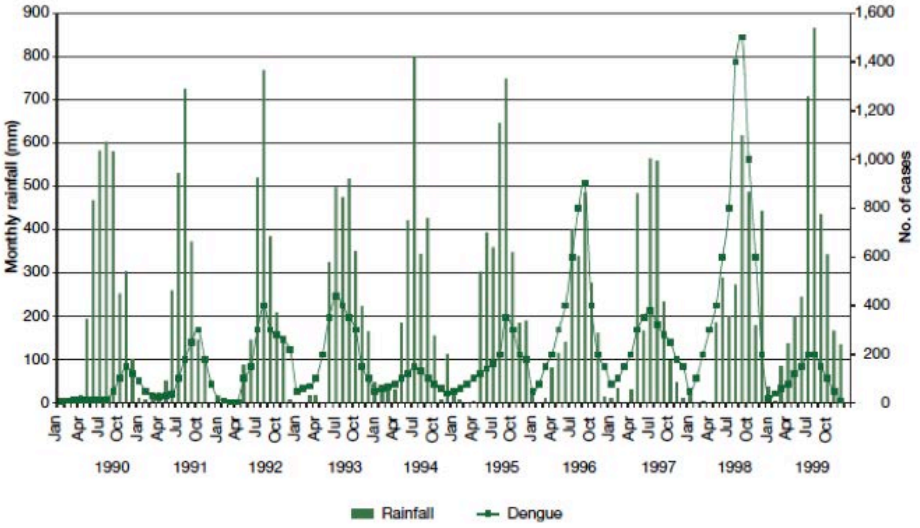
A University of the Philippines article about "Health Impacts of Climate Change," cited an "interview with the 'mosquito expert', entomologist and public health professor Dr. Lilian A. De Las Llagas [who] highlights the fact that vector-borne diseases are the most important public health problems confronting the nation today.

Projected Health Impacts of Climate Change

Health Outcome	Effects of Climate Change
Cardiovascular and respiratory diseases	• Heat waves cause short-term increases in mortality. • Deaths from heat stroke increase during heat waves. • Weather affects concentrations of harmful air pollutants.
Allergic rhinitis	• Weather affects the distribution, seasonality, and production of aeroallergens.
Deaths and injuries, infectious diseases, and mental disorders	• Floods, landslides, and windstorms cause death and injuries. • Flooding disrupts water supply and sanitation systems and may damage transport systems and health care infrastructure. • Floods may provide breeding sites for mosquito vectors. • Floods may increase post-traumatic stress disorders.
Starvation, malnutrition, and diarrheal and respiratory diseases	• Drought reduces water availability for hygiene. • Drought increases the risk of forest fires, which adversely affects air quality. • Climate change may decrease food supplies (crop yields and fish stocks) or access to food supplies.
Mosquito-, tick-, and rodent-borne diseases	• Higher temperatures shorten the development time of pathogens in vectors and increase the potential of transmission to humans. • Each vector species has specific climate conditions (temperature and humidity) to be sufficiently abundant to maintain transmission.
Waterborne and food-borne diseases	• Survival of disease-causing organisms is related to temperature. • Climate conditions affect water availability and quality. • Extreme rainfall can affect the transport of disease-causing organisms into the water supply.

Source: Adapted from Kovats, K., L., Ebi, and B. Menne. 2003. *Methods of Assessing Human Health Vulnerability and Public Health Adaptation to Climate Change*. Geneva: World Health Organization. www.who.dk/document/E81923.pdf

Figure 30 [107]



Apr = April, Jan = January, Jul = July, mm = millimeter, no. = number, Oct = October.

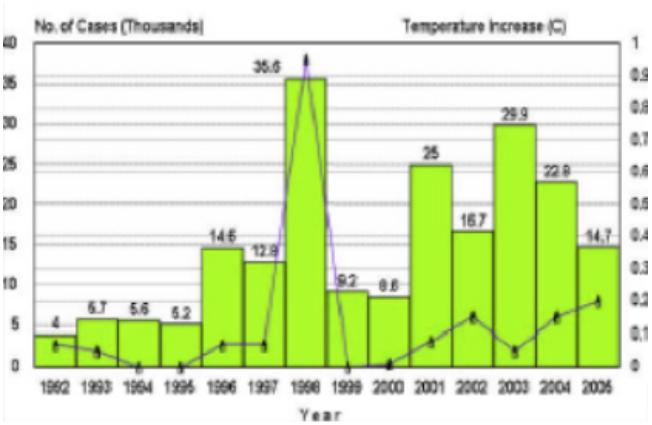
Sources: Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and Department of Health, Philippines.

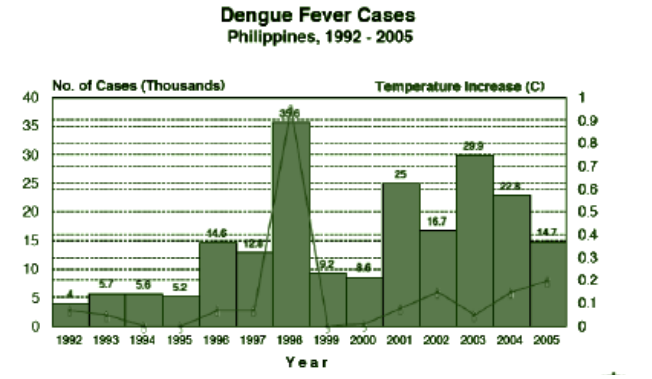
Figure 31
Monthly Rainfall and Number of Cases of Denge Fever in the Philippines 1990-1999

These mosquito-borne diseases, particularly dengue and malaria, are the major health problems of the country."[109]

Scholar Amadore also found that health was affected by extreme heat, water shortages, flooding, and other catastrophes linked to ENSO events in the Philippines.[110] The 1997 El Niño and 1998 La Niña triggered cholera, dengue, malaria and typhoid outbreaks. "Dengue cases have significantly increased since the early 1990s when the number of recorded dengue cases then averaged only about 5,000 per year. In 1998 and 2003, the number of dengue cases rose by six- to seven-fold to 35,500 and 30,000, respectively." [111]

Denge Cases vs. Temperature Change





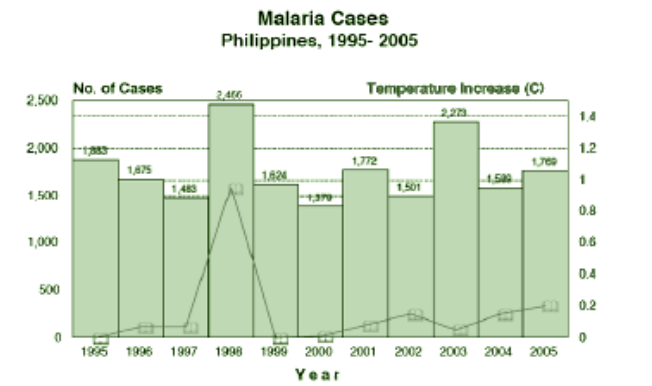
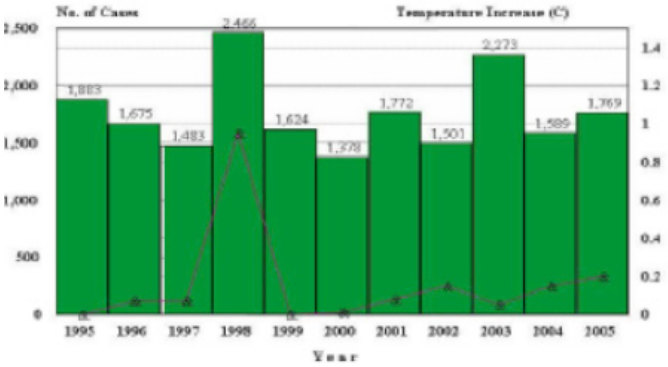
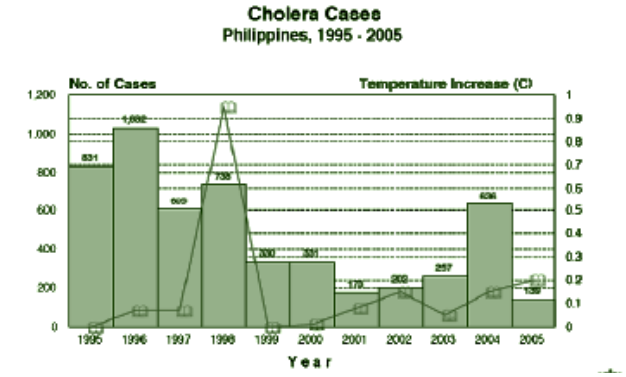
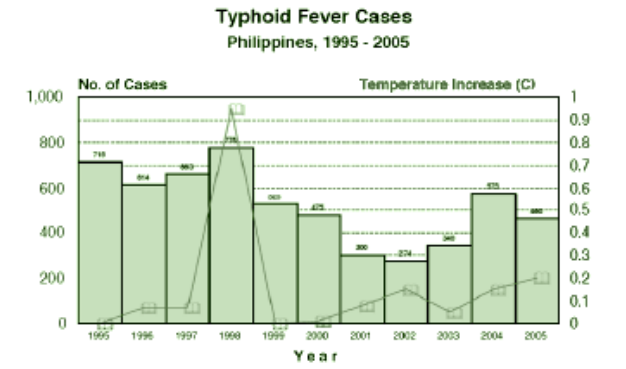


Figure 32 [122]

Malaria Cases vs. Temperature Change







These scholars are not alone in their assessments of the risks that climate changes poses to health in the Philippines. The WHO in the Philippines has also warned of the real potential impacts on health in the Philippines, that climate change is having and will have, citing links between temperature spikes and dengue, cholera, malaria, typhoid, and other diseases.[113]

Health was affected by extreme heat, water shortages, flooding, and other catastrophes linked to ENSO events in the Philippines.

Impacts on the economy

Climate change and associated weather-related calamities create massive financial burdens for the Philippines. The ADB estimates that "without further mitigation or adaptation… Indonesia, Philippines, Thailand and Vietnam are projected to suffer a mean loss of 2.2% of gross domestic product (GDP) by 2100 on an annual basis, if market impact only (mainly related to agriculture and coastal zones) are considered, well above the world's 0.6%. The mean impact could be dramatically worse, equivalent to 5.7% of GDP each year by 2100, if non-market impact (mainly related to health and ecosystems) is included; and 6.7% if catastrophic risks are also considered. These are far higher than the world's 2.2% and 2.6%, respectively."[114]

Superstorms alone cost the Philippines billions of dollars. As mentioned earlier, Philippine officials declared that post-Yolanda reconstruction would cost vast sums.

Date	Event	Damages: Total Cost Number of Casualties
November to December 2004	Real, Infanta and Aurora (REINA) flashflood and mudflows	PHP 8 billion 1,068 dead 553 missing
February 17, 2006	Northeast monsoon St. Bernard, Southern Leyte flashflood/ landslide	PHP 115 million 154 dead 968 missing
September 2006	Rage of TY MILENYO (international name: XANGXANE)	PhP 6.6 billion 213 dead 48 missing
November 28 to December 3, 2006	TY REMING (international name: DURIAN) devastated Bicol region, max winds 320 KPH	PHP 5,4 billion 734 dead 764 missing
June 2008	TY FRANK (international name: FENGSHAN) MV Princess of the Stars sank	PHP 13.3 billion 557 dead 87 missing
September 26, 2009	TS ONDOY (international name: KETSANA), Flooding in Metro Manila	PHP 10.9 billion 464 dead 37 missing
September 30 to October 10, 2009	TY PEPENG (international name: PHARMA), Flooding in Northern Luzon	PHP 27.3 billion 465 dead 47 missing
October 16-21, 2010	TY JUAN (international name: MEGI)	PHP 12 billion 31 dead 4 missing
December 16, 2011	TS SENDONG (international name: WASHI), Flashflood in Cagayan de Oro & Iligan City in Mindanao	PHP 2.1 billion 1,268 dead 181 missing
August 6-8, 2012	Enhanced “habagat” (southwest monsoon), Flooding in Metro Manila	PHP 2.3 billion 95 dead
December 3, 2012	TY PABLO (international name: BOPHA) devastated Mindanao	PHP 43.2 billion 1,248 dead 834 missing
November 8, 2013	TY YOLANDA (international name: Haiyan) devastated Visayas region	PHP 39 billion 6293 people dead 1061 missing

Table: Weather- related disasters experienced in the Philippines over the past 10 years

But even before that, weather-related calamities in 2012 "claimed over 3,000 lives, affected 15.3 million Filipinos and resulted in economic losses of over PHP 26 billion."[115] At the 2012 United Nations Climate Talks, "Conference of the Parties 18" held in Doha, the Philippines chief climate change envoy and (Philippines Climate Change Commission Commissioner) Naderev Saño stated, "Each destructive typhoon season costs us 2% of our GDP, and the reconstruction costs a further 2%, which means we lose nearly 5% of our economy every year to storms."[116]
Scholars from PAGASA found that "During the past few decades, extreme climatic events have adversely affected the Philippine economy."[117]

In the Philippines, the damage due to destructive tropical cyclones is seen to be increasing for the past four decades; from US$124 billion in 1971-1980 to US$2,890 billion in 2001-2010. For the past 10 years, weather-related disasters experienced are listed in the table below. In 2004 flashfloods and landslides in Quezon and Aurora provinces had occurred due to three consecutive tropical cyclones from November to the first week of December. One of the most disastrous events was the passage of typhoon Pepeng (international code name: Pharma) resulting to PHP 27.296 billion (US$ 620 million) in damages. Metro Manila residents will never forget two massive flooding events; the first one brought about by tropical storm Ondoy on September 26, 2009 during which 500 mm of rainfall was recorded in 24 hours, and second, the enhanced "habagat " or southwest monsoon which brought a deluge of rains on August 8, 2012. Another devastating storm was typhoon Pablo, which wiped out the low-lying communities in Mindanao on December 3, 2012, barely a year after the tropical storm Sendong tragedy in Cagayan de Oro and Iligan City on December 16, 2011.

The common denominator of all these tragic events was flooding due to excessive rainfall.

the Philippines is already paying a heavy financial price for climate change.

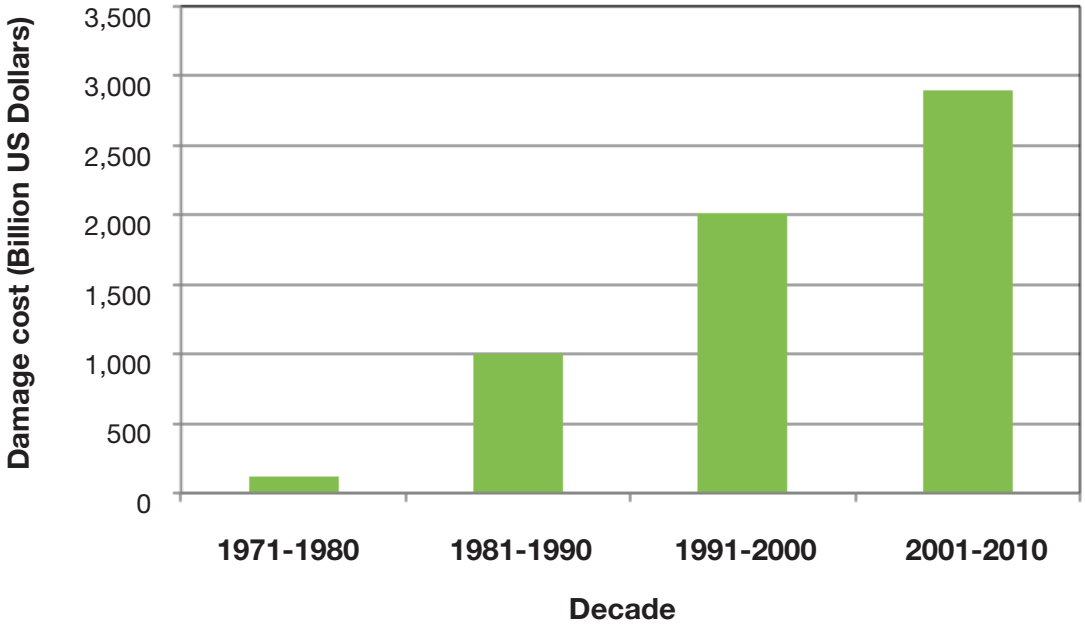


Figure 33
Total cost of damage due to destructive tropical cyclones per decade for the period 1971-2010

Even if the nation's decision makers and energy moguls disregard how climate change drives deaths, human suffering, environmental destruction, and social upheaval, they must consider that the Philippines is already paying a heavy financial price for climate change.

If the Philippines, which stands to lose so much economically, is still embracing coal domestically, how can it call on the world's biggest coal burners to change course? Should not the Philippines set an example at home, if it is calling abroad for a dramatic shift away from coal and fighting for a fair, ambitious, legally binding climate change treaty? Is there not a huge disconnect between the Philippines' progressive position at the UNFCCC, where they make demands internationally on the one hand, and on the other, the Philippines' headlong domestic rush towards coal.

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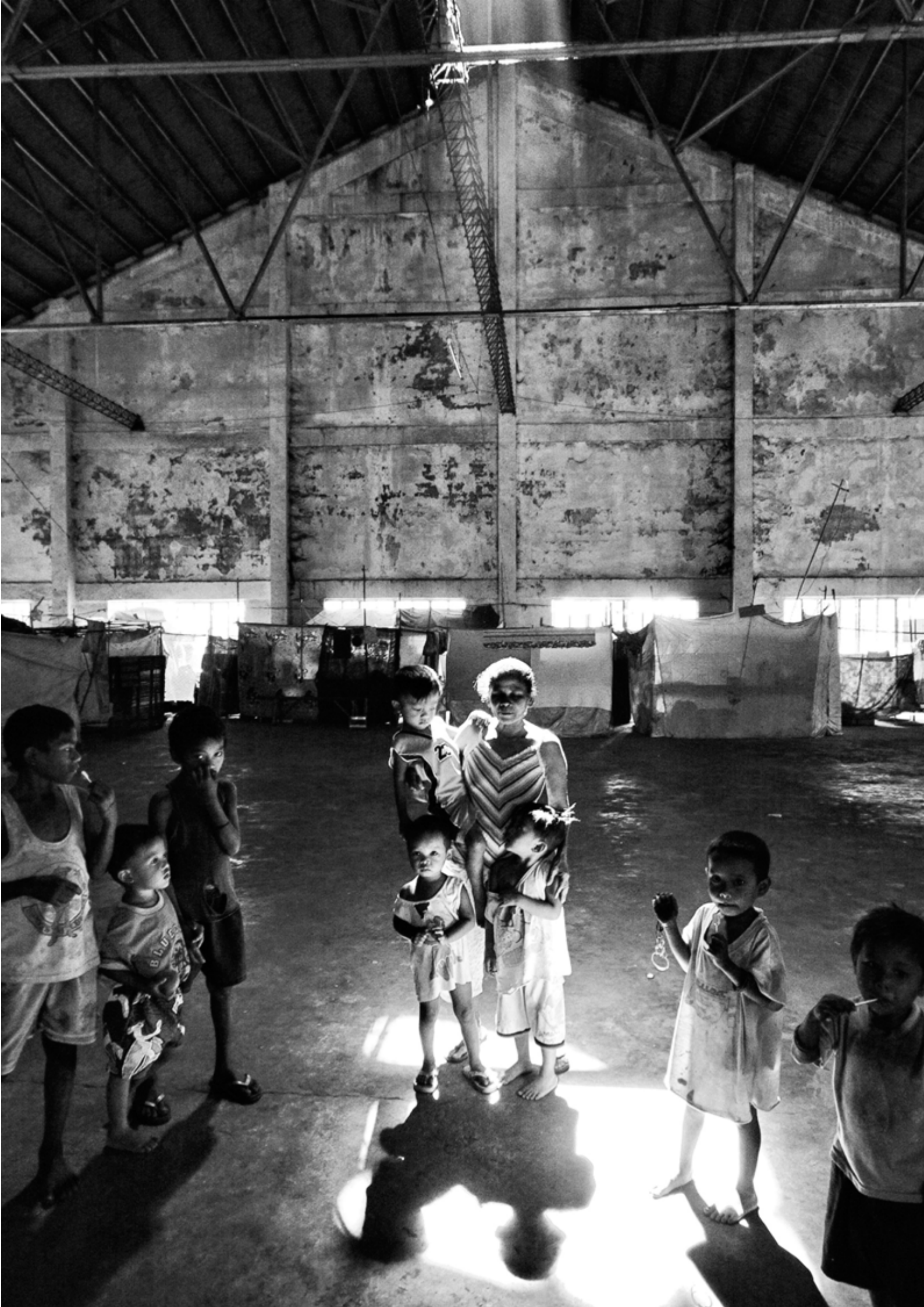

Not cutting it: National policies on coal and climate change

The Department of Energy must reform its misguided Philippine Energy Plan, scrap its proposals for 45 new coal-fired power plants, and instead craft a new plan to quit coal, stop contributing to climate change, remove roadblocks to renewable energy development and make the Philippines a global leader in green energy.

International assistance, papers and strategies will not be enough if we, as a nation, fail to deal squarely with the herd of elephants in the room: an irresponsible headlong rush to coal-based energy; ineffective promotion of renewable energy; and inadequate national or local energy efficiency initiatives.

Although it could stillchange course and become a true climate defender in the future.

The Philippine Climate Change Commission can do more

The Philippine Climate Change Commission (CCC) has a good National Climate Change Action Plan (NCCAP). Unfortunately, the Department of Energy's Philippine Energy Plan, which advocates for more coal, conflicts with the NCCAP,[119] as well as the National Framework Strategy on Climate Change (NFSCC), and guidelines for Local Climate Change Action Plan (LCCAP).

Although it could still change course and become a true climate defender in the future, in the past the CCC has been defending coal instead of opposing it. Previously, Commissioner Heherson Alvarez of the CCC "jumped to the defense of President Benigno Aquino's national renewable energy policy, which has been slammed by environmental groups… [and] told Greenpeace that the country's economic reality meant that coal-fired powers stations were a necessity… [emphasis added] He was responding to a Greenpeace statement that criticized the president's preference for coal-fired power as 'alarming'."[120] CCC Commissioner Alvarez' notion that developing renewable energy sources should go hand in hand with embracing coal is absurd and disregards all science on coal and climate change. It has undermined the CCC's credibility. Ignoring the fact that existing geothermal, modern biomass, and hydro are already cost competitive with coal in the Philippines, and that other forms of renewables can also save the Philippines money and jobs in

the short, medium, or long term (as explained in the Greenpeace report, Green is Gold) Alvarez has echoed the coal industry's mendacious claim that "economic limitations dictate the continued pursuit of coal-based energy."[121] CCC Commissioner Alvarez publicly stated the untruth that alternative energy "cannot yet compete with fossil fuel prices," and that "economic realities dictate the expedient use of hydrocarbons for power generation as the Philippines strives for stability and growth."[122] The truth is that many alternative energy technologies are already competing with fossil fuel prices. Geothermal and hydro are already cost-competitive.[123] Solar and wind are rapidly becoming cheaper and more cost-effective, with solar particularly valuable at peak hours, when it is most powerful and when demand is also at its peak.[124] Moreover, using fossil fuels feeds climate change, which poses existential threats to the Philippines that could snuff out all stability or growth.

Greenpeace calls on the CCC to speak out squarely against the 45 new coal fired power plants coming online; and mainstream a call to quit coal into the NCCAP. Greenpeace calls on the CCC to show true leadership, fully embrace its role, and take steps immediately to remedy the policy incoherence of multiple conflicting plans, none of which has a seamless or consistent approach to reducing the Philippines' greenhouse gas emissions.

We have a problem implementing our environmental laws

The truth is, talking a green talk does not absolve the government from the need to walk the green walk. Policies such as the Renewable Energy Act of 2008, the Philippine Climate Change Act of 2009, the Philippine Energy Plan 2008-2030's emphasis on renewables, or Republic Act 9729 (which seeks to mainstream climate change into the formulation of government policy by setting up a National Framework Strategy and Program on Climate Change) and many others will all remain paper tigers unless the elephants in the room are addressed, especially our increasing use of coal.

The Philippines' current energy policy needs to be overhauled in order to steer the country on the right path to (a) avoid making climate change impacts worse; (b) show real international climate leadership and strengthen the country's standing in international negotiations; (c) build a climate resilient energy infrastructure through decentralized renewable energy systems; (d) deliver real development benefits with large scale renewable energy projects including job creation and GDP growth with minimal environmental and social externalities.

The top leadership can do better

President Benigno Aquino III has attempted to portray coal as necessary and positive, while touting an inadequate renewable energy policy. In his 2013 State of the Nation Address, Aquino "lamented the protests against building power plants and in favor of investing in renewable energy sources. The President defended the construction of more coal-fired power plants in his 2013 State of the Nation Address, citing his perceptions of the alleged limitations of renewable energy. Aquino stated, "Let me be clear: I believe in renewable energy and we support its use, but there should also be baseload plants that can ensure a steady supply of electricity for our homes and industries… The plant in Redondo, Zambales is a good example. A TRO was issued against the plant because of the argument that renewable energy is better. Did they happen to mention that renewable energy is also more expensive—from the cost of building the plants to the eventual price of energy?... Did they mention that it cannot provide the baseload—the capacity required to make sure brownouts do not occur? If you put up a wind-powered plant, what do you do when there is no wind? If you put up a solar plant, what do you when the sky is cloudy?" The President is not alone in publicly stating misleading or untruthful statements about coal and renewable energy. Energy Secretary Carlos Jericho L. Petilla declared, "renewable energy is the ideal form of energy but the cost of putting up plants for this type of energy is very high to the point that power consumers could pay double the monthly rate they are paying now, [whereas] coal is the only answer to the nation's current extreme power shortages." Even on the 15th of May 2014, at the inauguration of the country's biggest new solar plant, San Carlos Solar Energy in Negros Occidental (SACASOL), President Aquino still backed coal, and stated: "I am pleased to announce that more power plants are underway for the Visayas Grid alone, with most slated for commissioning from this year until 2016: from traditional energy sources…" In the same speech, he continued, "As you might know, there is a need for government to manage the energy mix, from which the cost of power is derived. Unfortunately, renewable energy is still the most expensive component. It follows that if our entire energy mix is derived from renewable sources, then the price of electricity—which people are already complaining about today—will rise even more."

The president's pro-coal statements were inaccurate, as we argued in our *Green is Gold* report. Greenpeace's findings are supported by overwhelming evidence that the use of coal comes with severe social, economic and environmental costs. Even before the Feed in Tariff, several renewable energies were cost competitive with coal, and renewable energy is all the more

The facts are clear. The science is there. Coal is costing us billions as a result of climate change. The time has come to quit coal.

financially viable now because of the FIT – even without considering social, health, environmental or other costs. When the latter are factored in, the balance sheet is clear: coal and the climate change it foments, cost the Philippines exorbitant sums.

Instead of taking Greenpeace's word for it, the President should commission an independent assessment of the true cost of coal to the Philippines. We also call on President Aquino to abandon the 45 new coal-fired power plants, stand up for renewable energy loud and clear, promote robust energy efficiency policies, prioritize the environment in his reform agenda, and make history.

The facts are clear. The science is there. Coal is costing us billions as a result of climate change. The time has come to quit coal.

Greenpeace Recommendations

- **No new coal:** Immediately impose a complete ban on the construction of the 45 new coal plants, and forbid any expansion of existing coal plants.

- **Old coal must go:** Establish a plan to retire the existing 13 coal fired plants, with a clear retirement schedule.

- **Go green:** Fast track renewable energy projects and remove roadblocks to renewable energy as a matter of urgency (further, detailed recommend ations on renewables can be found in our report entitled Green is Gold).

- **Coordinate better:** Ensure greater coordination with relevant authorities and policy coherence, in a concerted effort to quit coal, embrace renewbles, promote, energy efficiency, and mitigate climate change impacts.

- **Lead globally:** Embrace an international leade ship role to push for a fair, ambitious, legally binding climate treaty, at the highest level.

- **Empower communities:** Develop a sustainable master-plan for climate resilience establishing decentralized, community-based renewable energy systems connected to micro-grids.

[1] Responding to Climate Change (RTCC), "'It's time to stop this madness' – Philippines plea at UN climate talks." 13 November 2013.

[2] Fundación DARA Internacional, "Second edition of the Climate Vulnerability Monitor: A Guide to the Cold Calculus of a Hot Planet," 2012.

[3] Republic of the Philippines, Department of Energy, "Philippine Power Statistics," 2012 (Some news sources cited lower numbers, such as UPI Business News, "Philippines ready to move forward on renewable energy?" 03 June 2013, which gave 37% as the figure.)

[4] Republic of the Philippines, Department of Energy, "Philippine Power Statistics," 2012 (This data on the increased use of coal is borne out by other sources as well. See e.g.: "According to the World Bank in 2010, 34.4 % of the country's electricity was coal-sourced." In CleanBiz.Asia, "Philippine climate change group defends indefensible," 07 August 2013.

[5] All data is based on the Philippine Power Statistics available through the Republic of the Philippines, Department of Energy, "Philippine Power Statistics."

[6] GIZ, "Renewable energy in the Philippines: Costly or competitive? Facts and explanations on the price of renewable energies for electricity production," June 2013.

[7] Erwin L. Corong, "Tariff Reduction, Carbon Emissions, And Poverty: An Economy-Wide Assessment for the Philippines," Economy and Environment Program for Southeast Asia (EEPSEA), 2006

[8] Official Website for the Millennium Development Goals Indicators, accessed July 2014.

[9] Official Website for the Millennium Development Goals Indicators, accessed July 2014.

[10] Indexmundi website, "Philippines - CO2 emissions," accessed July 2014.

[11] Greenpeace's calculations are based on the "Platts World Electric Power Plants Database." All the proposed new Philippine coal fired power plants, for which there is information, are either subcritical pulverized coal or small CFB units. Thus, the assumption used in calculations was 36-39% thermal efficiency. In calculations, Greenpeace also used a range of 90-97 around the Intergovernmental Panel on Climate Change (IPCC) standard emission factor for hard coal, 94.6 gCO2/MJ, and assumed a capacity factor of 80-85%, which implies 5.82 - 7.22 MtCO2/year/GW. For 10.3 GW, the calculation is approximately 60.0 - 74.4 MtCO2 per year; which must be added to the 752 MW identified as under construction; raising the final calculation to 64.4 - 79.8 million metric tons a year, for the Philippines' CO2 emissions.

[12] IAEA Statistics, 2013 Edition, CO2 Emissions from Fuel Combustion.

[13] IAEA Statistics, 2013 Edition, CO2 Emissions from Fuel Combustion.

[14] Wendy Miles, Rut Dini Prasti H., and Kussaritano, "Mining the Heart of Borneo: coal production in Indonesia," Mongabay, 20 November 2013.

[15] Kref, Sönket & David Eckstein, "Global Climate Risk Index 2014: Who Suffers Most from Extreme Weather Events? Weather-Related Loss Events in 2012 and 1993 to 2012", Germanwatch, November 2013. [hereinafter, Germanwatch Global Climate Risk Index 2014.]

[16] Germanwatch Global Climate Risk Index 2014.

[17] Matthew Huelsenbeck, "Ocean-Based Food Security Threatened in a High CO2 World: A Ranking of Nations' Vulnerability to Climate Change and Ocean Acidification," Oceana, September 2012.

[18] United Nations University Institute for Environment and Human Security, "World Risk Index," 2011.

[19] Maplecroft, "Maplecroft Climate Change Vulnerability Index (CCVI)," 2012.

[20] Alliance Development Works, the Nature Conservancy, and United Nations University, "World Risk Report 2012," 2012.

[21] Maplecroft, "Climate Change and Environmental Risk Atlas 2013," 2013. "The CCVI has been developed by Maplecroft to identify risks to populations, company operations, supply chains and investments in 197 countries down to a level of 25km2. It evaluates exposure to climate related natural hazards; the sensitivity of populations; development; natural resources; agricultural dependency; research and development; government effectiveness and education levels."

[22] rin news, "Natural disaster index 2010, Maplecroft," 2010.

[23] According to the Joint Typhoon Warning Centre (JTWC). See the Joint Typhoon Warning Centre website at http://jtwccdn.appspot.com/JTWC/. See also Wikipedia, "Typhoon Haiyan," at http://en.wikipedia.org/wiki/Typhoon_Haiyan. ("the Joint Typhoon Warning Centre (JTWC) assessed the system as a Category 5-equivalent super typhoon on the Saffir-Simpson hurricane wind scale; the storm passed over the island of Kayangel in Palau shortly after attaining this strength. Thereafter, it continued to intensify; at 1200 UTC on November 7, the Japan Meteorological Agency (JMA) upgraded the storm's maximum ten-minute sustained winds to 235 km/h (145 mph), the highest in relation to the cyclone. The Hong Kong Observatory put the storm's maximum ten-minute sustained winds at 260 km/h (160 mph) prior to landfall in the central Philippines, while the China

Meteorological Administration estimated the maximum ten-minute sustained winds at the time to be around 75 m/s (270 km/h or 167 mph). At 1800 UTC, the JTWC estimated the system's one-minute sustained winds to 315 km/h (196 mph).") See also other references online confirming the 315 km/h figure, at Weather.com announcements, at weather.com.ph/announcements/super-typhoon-haiyan-yolanda-update-number-011; weather.com.ph/announcements/super-typhoon-haiyan-yolanda-update-number-007; and http://www.accuweather.com/en/weather-blogs/weathermatrix/typhoon-haiyan-yolanda-strongest-storm-on-earth/19696692

[24] "Winds from typhoon Haiyan were estimated to have been 314km/h or higher when the monster storm made landfall on the Philippine island of Samar. That speed, if confirmed, would make it the strongest storm on record, exceeding hurricane Camille, which hit Mississippi in the US in 1969." See, Peter Hannam, "Typhoon Haiyan influenced by climate change, scientists say," The Sydney Morning Herald, 11 November 2013. See also Mark Fischetti, "Was Typhoon Haiyan a Record Storm?" Scientific American, 27 November 2013.

[25] Republic of the Philippines, National Disaster Risk Reduction and Management Council, "SitRep No. 108 Effects of Typhoon "Yolanda" (Haiyan)," 03 April 2014. See also Zaida delos Reyes-Palanca, "Yolanda costs hit P36.6B," Journal Online, 19 December 2013.

[26] Government of the Philippines, Foreign Aid Transparency Hub (FAiTH), Full Report. See also, Wikipedia, "Typhoon Haiyan," (at http://en.wikipedia.org/wiki/Typhoon_Haiyan) listing international aid as follows: Australia: $70 million; Bangladesh: $1 million; Belgium: $677 thousand; Canada: $40 million; China: $1.4 million; Denmark: $7.8 million, France: $1.4 million; Holy See: $150 thousand; Hong Kong: $5.16 million; Iceland: $100 thousand; Indonesia: $1 million; Ireland: $1.36 million; Italy: $1.36 million; Japan: $52 million; Kuwait: $10 million; Malaysia: $1 million; Mexico: $1 million; New Zealand: $1.22 million; Norway: $41.6 million (in addition to whuch Norwegian Red Cross and the Norwegian branch of Save the Children raised $4.9 million and a concert raised $4 million); Panama: $200,000 worth of humanitarian aid; Saudi Arabia: $10 million; Singapore: $276 thousand; South Korea: $25 million; Spain $1.8 million; Switzerland: $5.4 million; Taiwan: $200 thousand; United Arab Emirates: $10 million; United Kingdom: $131 million; United States: $86.7 million; Vietnam: $100 thousand.

[27] World Bank, "Philippines: Timely Reconstruction to Lessen Impact of Typhoon Yolanda," World Bank, 06 December 2013.

[28] Republic of the Philippines, National Disaster Risk Reduction and Management Council, "NDRRMC Update, SitRep No. 104, Effects of Typhoon 'Yolanda' (Haiyan)," 29 January 2014.

[29] Zaida delos Reyes-Palanca, "Yolanda costs hit P36.6B," Journal Online, 19 December 2013.

[30] Reliefweb, "PHP361 billion needed for Yolanda recovery, reconstruction," 18 December 2013.

[31] 350.org, "Super Typhoon Haiyan Is a Wake-Up Call for UN Climate Summit." [hereinafter 350.org, Super Typhoon]

[32] The report was presented to the U.S. Global Change Research Program (USGCRP). By law, the group conducts a national assessment every four years for Congress and the president. The USGCRP is comprised of 13 federal agencies, including NASA. Business leaders, the public and non-governmental organizations also contribute.

[33] Sheril Kirshenbaum, "Did Climate Change Intensify Supertyphoon Haiyan?" Scientific American, November 11, 2013. [hereinafter Kirshenbaum, Supertyphoon Haiyan]

[34] 350.org, Super Typhoon.

[35] Bradley Campbell, "Super Typhoon Haiyan can be blamed on climate change, right? Maybe not,"
PRI's The World, November 11, 2013. [hereinafter Campbell, Super Typhoon Haiyan.]

[36] Bouwer et al, 2007.

[37] Intergovernmental Panel on Climate Change, 2013. [hereinafter IPCC 2013] (Moreover, at this stage, there is low confidence in attribution of changes in tropical cyclone activity to human influence owing to insufficient observational evidence, lack of physical understanding of the links between anthropogenic drivers of climate and tropical cyclone activity and the low level of agreement between studies as to the relative importance of internal variability, and anthropogenic and natural forcings. The UNESCO/WMO Typhoon Committee 2013 Report affirms that it remains uncertain whether there has been any discernible human influence on tropical cyclone frequency, intensity, precipitation or rainfall, track, or any other related storm activity metric in the WNP region, even as Gillett et al, 2008 concluded that an anthropogenic warming signal can be identified in sea surface temperatures (SSTs) in the WNP region.)

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[41] Peter Hannam, "Typhoon Haiyan influenced by climate change, scientists say," The Sydney Morning Herald, 11 November 2013.

[42] Stone et al, 2013.

[43] IPCC, 2012.

[44] For attribution of increasing surface temperature extremes, IPCC AR4 (Hegerl et al, 2007) concluded that based on multiple lines of evidence that surface temperature extremes have likely been affected by anthropogenic forcing or increased greenhouse gas concentrations in the atmosphere. Recent studies of attribution of changes in temperature extremes have tended to affirm the conclusions reached in the AR4. For instance, Alexander and Arblaster (2009) found that trends in warm nights over Australia could only be reproduced by a coupled model that included anthropogenic forcing. IPCC 2013 (Bindoff et al, 2013) concludes that the evidence for human influence on temperature extremes has grown since AR4 and the SREX. No attribution studies on locally observed trends have yet been done. In general, single extreme events cannot be simply and directly attributed to anthropogenic climate change, as there is always a possibility the event in question might have occurred without this contribution (Hegerl et al., 2007). However, for certain classes of regional, long-duration extremes (of heat and rainfall) it has proved possible to argue from climate model outputs that the probability of such an extreme has changed due to anthropogenic climate forcing (Stott et al., 2004; Pall et al., 2011).

[45] Knutson et al, "Tropical cyclones and climate change," 2010.

[46] Solomon et al., "Overview: Current Extreme Weather & Climate Change" (for the IPCC), 2007.

[47] Global mean surface temperature has increased since the late 19th century, and that each of the past three decades has been successively warmer at the Earth's surface than all the previous decades in the instrumental records (IPCC, 2013). Linear trend analysis indicate that for the globally averaged combined land and ocean temperature, there has been a warming trend of 0.85 [0.65 to 1.06] °C over the period from 1880 to 2012.

[48] See also Bindoff et al, 2013.

[49] IPCC Summary for Policymakers (SPM), 2013.

[50] Supertyphoon Haiyan and Climate Change," Time, 11/11/2013. [hereinafter Time, Supertyphoon Haiyan.]

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[58] Moya and Malayang III, 2004.

[59] Trenberth et al., 2007, based on Alexander et al., 2006.

[60] The degree of certainty in key findings in the IPCC Summary for Policymakers (SPM) is expressed as a qualitative level of confidence (from very low to very high), and when possible, probabilistic ally with a quantified likelihood (from exceptionally unlikely to virtually certain). The probability for the assessed likelihood of an outcome or a result are virtually certain (99-100%), very likely (90-100%), likely (66-100%), about as likely as not (33-66%), unlikely (0-33%), very unlikely (0-10%), and exceptionally unlikely (0-10%).

[61] Alexander et al., 2006.

[62] Choi et al, 2009.

[63] Alexander and Arblaster, 2009; IPCC, 2013.

[64] The increase in maximum (or daytime) temperatures and minimum (or night time) temperatures are shown in Fig.7 and Fig.8. During the last 60 years, maximum and minimum temperatures are seen to have increased by 0.36 C and 1.0 C, respectively. See: Tibig, L., "Trends in Extreme Daily Temperatures and 24-hr Rainfall in the Philippines," 2004.

[65] See the Republic of the Philippines, National Climate Change Action Plan 2011-2028: "the Philippines, like the rest of the world, has exhibited increasing temperatures, with observed mean temperature increase of 0.64 °C or an average of 0.01 °C per year-

increase from 1951-2010. In the last 59 years, maximum (daytime) and minimum (nighttime) temperatures are also seen to have increased by 0.36 °C and 0.1 °C, respectively. Using a mid-range emissions scenario, the climate projections done by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) for 2020 and 2050 indicate that all areas of the Philippines will get warmer, with largest increase in temperatures in the summer months of March, April and May (MAM). Mean temperatures in all areas in the Philippines are expected to rise by 0.9 °C to 1.1 °C in 2020 and by 1.8 °C to 2.2 °C in 2050. …The climate projections further indicate that, generally, there is reduction in rainfall in most parts of the country during the summer (MAM) season. However, there is likely increase in rainfall during the southwest monsoon season in June, July and August (JJA) until the transition months of September, October and November (SON) in most areas of Luzon and Visayas. Increase in rainfall is also likely during the northeast monsoon months of December, January and February (DJF), particularly in provinces/areas characterized as Type II climate. There is, however, a generally decreasing trend in rainfall in Mindanao, especially by 2050 (PAGASA 2011)."

[66] Philippine Atmospheric, Geophysical and Astronomical Services Administration website.

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[68] Simon Allison, "Did climate change cause Super Typhoon Haiyan?" Daily Maverick, 12 November 2013.

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[70] See a July 2013 article by Massachusetts Institute of Technology climatologist Kerry Emanuel, predicting that the frequency and the intensity of tropical cyclones would increase in the 21st century, and that the increases would be most prominent in the western North Pacific, which is where Haiyan struck. "A recently developed technique for simulating large [O(104)] numbers of tropical cyclones in climate states described by global gridded data is applied to simulations of historical and future climate states simulated by six Coupled Model Intercomparison Project 5 (CMIP5) global climate models. Tropical cyclones downscaled from the climate of the period 1950–2005 are compared with those of the 21st century in simulations that stipulate that the radiative forcing from greenhouse gases increases by over preindustrial values. In contrast to storms that appear explicitly in most global models, the frequency of downscaled tropical cyclones increases during the 21st century in most locations. The intensity of such storms, as measured by their maximum wind speeds, also increases, in agreement with previous results. Increases in tropical cyclone activity are most prominent in the western North Pacific, but are evident in other regions except for the southwestern Pacific. The increased frequency of events is consistent with increases in a genesis potential index based on monthly mean global model output. These results are compared and contrasted with other inferences concerning the effect of global warming on tropical cyclones." Emanuel, K..A., "Downscaling CMIP5 climate models shows increased tropical cyclone activity over the 21st century," Proceedings of the National Academy of Sciences, 2013.

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GREENPEACE

Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment, and to promote peace.

"Greenpeace is active in many part of Asia. Our work in the region has included stopping hazardous waste imports, opposing radioactive shipments, campaigning against forest destruction, halting the spread of GMOs, stopping dirty and polluting technologies like waste incinerators and coal power plants, promoting renewable energy, and advancing sustainable solutions to key environmental problems. We made a commitment to develop a presence in Asia in late 80s and early 90s, and first established an office in Japan (1989) and then China (1997). Initial investigations were also initiated in SEA, focusing primarily on Indonesia and Philippines. After many years of investigations and establishing campaign presence in key countries, Greenpeace succeeded in opening an office in the region. Greenpeace Southeast Asia was formally established on March 1, 2000. Greenpeace now has hundreds of thousands of members in Indonesia, Thailand, and the Philippines (globally Greenpeace has 2.8 million supporters worldwide); and offices in Bangkok, Jakarta, and Manila. Each office is governed by a board, which appoints a representative called a trustee. In each office, trustees meet once a year to agree on the long-term strategy of the organisation, to make necessary changes to governance structure, to set a ceiling on spending, and to elect the Board of four members and a chairperson. Often working with other local groups, Greenpeace has run successful campaigns in the Philippines, Thailand, Malaysia, and Indonesia. Through its campaigns, Greenpeace aims to protect the region from further ecological ruin and serve as beacon of awareness and action for environmental protection and sustainable development."

greenpeace.org

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