The Philippines: A Climate Hotspot

Climate Change Impacts and the Philippines

April 2007

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FOREWORD

Climate change, triggered by global warming, is a creeping, very slow-start phenomenon, which is why it is hardly noticeable in our daily lives. It is when extreme events happen more often, when some species are slowly vanishing or when shorelines are little by little advancing, that suspicion of some changes in the global system is taking place.

The scientific community has stated recently that *"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level,"* and that "*most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."* (Summary for Policymakers, Working Group I, IPCC, 2007).

This report, *The Philippines: A Climate Hotspot* is very relevant and timely, and hopefully would motivate our decision-makers and just everybody else to respond positively to the challenges posed by this unfolding specter of climate change.

Leoncio A. Amadore, Ph.D.
April 2007

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I. INTRODUCTION

The Philippines is a climate hotspot, vulnerable to some of the worst manifestations of climate change.

As a developing country, with very little access to vital resources, it has a low ability to adapt and a lower ability to cope with disasters brought about by climate change impacts. Yet, even with the emerging trends of climate variability, many provinces in the Philippines are still not aware of their vulnerability, much less be able to prepare to cope with its impacts.

A vital tool in identifying the susceptibility of an area to climate and weather-related events and consequently reducing the risks that a community and an ecosystem have to bear is vulnerability assessment and mapping. In this research, Greenpeace used geographic information systems (GIS) to map out provinces in the Philippines that experienced tragedies such as flash floods and landslides triggered by extreme weather events as well as areas which are vulnerable to sea level rise brought on by climate change.

The results showed that aside from recurring typhoons and increase in precipitation that is experienced by certain regions in the country, sea level rise is a major threat to marine ecosystems and to coastal human populations and their livelihoods. Of 16 regions in the Philippines, only one is not vulnerable to sea level rise. However, this region, the mountainous Cordillera Administrative Region, is highly at risk from typhoons and variability in precipitation.

But climate change not only exacerbates socio-economic and environmental problems that each region in the Philippines is currently experiencing, it also threatens the country's rich cultural heritage as well as some of the rarest and most diverse fragile ecosystems in the world.

Climate experts agree that a fundamental change in how the world uses energy should take place within the next decade in order to avert the worst impacts of climate change. If the world continues to disregard this wake up call and opt for inaction, the number of people who are already experiencing the brunt of climate change, especially those from developing countries such as the Philippines, will continue to rise in millions.

Climate change and its worsening impacts

At no other time has the science of climate change been more robust than today. At no other time, too, have the impacts of climate change become more apparent and deadly, particularly for vulnerable and developing countries such as the Philippines. A joint statement signed by eleven of the most distinguished national science academies to world leaders in July 2005 gave unequivocal advice: "The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action."[1]

If the world is to avoid the dire impacts of dangerous climate change from taking place, it is imperative that government must take action without delay to stop global temperatures from increasing beyond the point where damage to the planet's ecosystems become irreversible. Among the most potent solutions to the problem readily accessible and viable before the world today is the dramatic shift away from climate-harmful, fossil fuel energy production towards widely-available renewable energy generation.

The United Nation-organized Intergovernmental Panel on Climate Change (IPCC), the foremost scientific authority on the issue, stated in its most recent report that there is "new and stronger evidence that most of the warming observed over the last 50 years is attributable to humans."[2] Human activities that resulted in an increase in greenhouse gas concentrations are primarily fossil

fuel use, land-use change and agriculture.[3]

According to the IPCC, eleven of the last twelve years (1995-2006) rank among the twelve warmest years on record.[4] The World Meteorological Organization seconded this by declaring 2005 as the warmest year on record, followed by 1998, 2002, 2003 and 2004, while the 1990s is considered to the hottest decade in recorded history.[5]

The impacts of such warming throughout the world are diverse and alarming. Manifestations include widespread retreat of glaciers and decrease in snow cover, changes in heat content and chemical composition of the oceans, increase in sea level, and aspects of extreme weather events, such as droughts, heavy precipitation and intensity of tropical cyclones.[6] Regional climate changes combined with the effects of forest clearing could also transform forest ecosystems into savannah. Scientists also predict that mid-range climate change scenarios will doom a million species to extinction by mid-century if climate-harmful emissions continue to increase.[7]

II. THE PHILIPPINES: A CLIMATE HOTSPOT

The Philippines, as a developing country, is highly vulnerable to climate change impacts.

Like most Asian countries, the "adaptive capacity of human systems is low [while] vulnerability is high" in the Philippines, largely due to its geographical features, low level of economic development and exposure exacerbated by poor access to resources. Thus, unless steps are taken to arrest the runaway growth of global greenhouse gas emissions, climate change is projected to "exacerbate the misery and predicament of [the country's] already over-burdened populace." [8]

Business-as-usual practices, according to the IPCC, "would cause further warming and induce many changes in the global climate system during the 21st century … larger than those observed during the 20th century." [9] This projection further increases the vulnerability of the Philippines, which already ranks 4th in the Global Climate Risk Index.[10] It exposes the true cost of climate change which is not limited to economic losses: climate change threatens human lives, cultural heritage and ecosystems.

Climate change will amplify the different socio-economic burdens already shouldered by Filipino families, such as hunger and water scarcity. Moreover, risks associated with the projected spread of vector-based insect-borne diseases, such as malaria and dengue, due to warming temperatures are increasing[11] even as budgetary support for health care in the Philippines continues to deteriorate.

The country's vulnerability to severe weather events, such as harsher storms, droughts, and extreme precipitation will worsen the existing disparity of living standards between the rich and the rapidly increasing ranks of the destitute. Provinces and regions, such as Albay, Ifugao, Sorsogon and Biliran[12] that were identified by the Manila Observatory as areas that are most at risk to climate and weather related changes, are noticeably areas with a high Poverty Incidence Rating.[13]

The threat of climate change impacts will also further marginalize indigenous peoples such as the T'boli of Mindanao and the Badjao of the Sulu Seas whose customs and livelihood are deeply rooted in the well-being of the environment, devaluing their "contribution to the conservation and protection of biological diversity and ecosystems which is crucial for the prevention of climate change". [14]

As an archipelago which has the 2rd largest coral reef cover in the world[15] and a coastline which is roughly the equivalent of the earth's circumference[16], the Philippines is at threat from large-scale impacts of climate change on the ocean. There is a danger of a recurrence of massive coral bleaching similar to the one experienced by marine protected areas and conservation priority sites in the provinces of Pangasinan, Puerto Galera, Negros, Dumaguete and Palawan last 1998 which were linked to the increase in ocean surface temperature that was brought about by the El Niño Phenomenon.[17] An increase in sea level due to thermal expansion, melting of glaciers, ice caps and ice sheets threatens coastal areas, island ecosystems and low-lying communities which are already experiencing subsidence and haphazard coastal development.

The Philippines is also one of the top mega-diversity countries in the world. Unfortunately, it is also considered the world's top biodiversity hotspot. This is mainly due to increasing human population and resource demand, habitat destruction and unsustainable development. [18] Climate change impacts constitute an additional pressure that could exacerbate the high rate of species extinction and current degradation of the Philippines' ecosystem.[19]

THE PHILIPPINES, Facts and Figures

DEMOGRAPHIC

Population: 76,504,077 as of 2000[20]
Population Density: 255 persons per square kilometer as of 2000[21]
Indigenous people: 8%[22]
Poverty Incidence Rating: 28.4% as of 2000[23]

ECONOMIC

Agricultural Sector[24]

- 47% of the total land area of the Philippines is agricultural land
- 2/3 of the population depends on agriculture for livelihood
- ½ of the labor force is engaged in agricultural activities

Fisheries Sector[25]

- Comprises at least 5% of the Gross National Product
- Employs about one million fishermen and fish farmers, mostly in the rural areas

Tourism Sector

- Anchor Destinations[26]: Laoag-Vigan, Baguio-Banaue, Manila, Subic-Clark, Palawan, Cebu, Bohol, Davao, Boracay
- Last 2004 the Philippines received 2.29 million visitors with a total receipt of $ 1.99 billion
- Projections show that the Philippines will receive 5 million visitors with a projected receipt of $4.59 billion by 2010

ECOSYSTEM

Total number of islands: 7,107 islands
Total Land Area: 300,000 square kilometer
Forest Cover: 7,168,400 hectares[27]
Coastal Area: 36,289 kilometer[28], roughly equivalent to the Earth's circumference
Coral Cover: 26,000 square kilometer[29], 2nd largest coral cover in the world

BIODIVERSITY

Terrestrial[30]:

- Plants: 9,253, 6,091 of which are endemic
- Birds: 535 identified species, 186 of which are endemic
- Mammals: 167 identified species, 102 of which are endemic
- Reptiles: 237 identified species, 160 of which are endemic
- Amphibian: 89 identified species, 76 of which are endemic

Freshwater:

- Fishes: 281 identified species, 67 of which are endemic[31]

Marine:

- Reef fishes: 915 identified species[32]
- Coral: At least 400 scleractinian coral species, 12 of which are endemic[33]
- Mangrove: At least 30 species[34]

CONSERVATION EFFORTS

World Heritage Sites[35]:

- Puerto Princesa Subterranean River National Park
- Tubbataha Reef Marine Park both in the province of Palawan

Conservation Priority Areas[36]: at least 206 sites, 170 of which are terrestrial and inland waters areas and 36 of which are marine based
Marine Protected Areas[37]: at least 330 Marine Protected Areas across the country

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Extreme Weather Events

The variability of extreme weather events such as storms and droughts, along with excessive precipitation, which certain areas in the country has experienced for the past decades, validates continental and regional trends of climate change impacts. Data from 1960 to the present indicate that "increasing [Philippine] trends in temperature, sea level rise and extreme climate event occurrences are consistent with ... global trends."[38] In fact, the "more frequent occurrence of severe El Nino and La Nina events, as well as deadly and damaging typhoons and other severe storms[,] floods ... [and] flash floods" in the Philippines are likely local manifestations of global climate trends, according to leading Filipino meteorologist Dr. Leoncio A. Amadore.

Dr. Amadore tracked several extreme tropical cyclones/southwest monsoon-induced extreme weather events from 1991 to late 2004 (Figure 1) and suggested that global warming may have likely exerted influence on these climatic occurrences. Amadore found in his study that the extreme events "have one thing in common--persistent torrential rains, causing landslides and flash floods, killing people and destroying properties and the environment along its path."

This trend was unfortunately echoed in 2006. The Center for Research on the Epidemiology of Disasters declared typhoon Reming, which triggered the Legazpi Mudslide, and the Guinsaugon, Leyte Lanslide as 2nd and 3rd of the World's Deadliest Disasters of 2006, respectively[39]. A total of 2,511 people were killed and almost 800,000 families were affected by these tragedies.

According to Dr. Amadore, from 1975 to 2002 intensifying tropical cyclones caused an annual average damage to property of Php4.5 billion (around US$90 million), including damage to agriculture amounting to Php3 billion (around US$ 60 million).[40] In 2006 alone, typhoons that passed the Philippines affected at least 11 million Filipinos and inflicted damage to agriculture and infrastructure amounting to almost Php20 billion (around US$400 million)[41]. This does not include the Php500 million worth of assistance and donations last 2006 and the Php10 billion that was allocated by the Philippine government in the 2007 national budget to rehabilitate direct-hit areas.

This reflects trends tracked in other places by leading reinsurance companies such as the Munich Re Group, which projected that, globally, climate change related damages could cost US$150 billion annually within less than a decade.[42] The company warned that unless action is taken today, the insurance industry could go bankrupt as extreme weather events such as storms and droughts increase in severity and frequency. According to Munich Re, in 2005, hurricanes in the Atlantic broke all meteorological and monetary records.[43]

Tragedies triggered by extreme weather events are not limited to areas that have a high risk to typhoons or variability in precipitation. Provinces that are landslide-prone and have a history of deforestation are also prone to such disasters. Based on a report prepared by Dr. Esteban Godillano for the Philippine Department of Agriculture, landslide prone regions that are highly at risk include the Cordillera Administrative Region, Region 4B, Region 6, Region 1, Region 8 and Region 5[44] (Appendix 1).

Tragedies After Tragedies: Climate Change Impacts and the Philippines

According to Dr. Leoncio Amadore, although it cannot be conclusively proven that a single event, was or was not, affected by global warming, current scientific evidence strongly suggests that hurricanes and typhoons tend to become more destructive as ocean temperatures rise. Extreme weather events that our country has experienced recently "have one thing in common -- persistent torrential rains, causing landslides and flash floods, killing people and destroying properties and the environment along its path."

1991 – Ormoc Flashlood (Region 8)
Triggered by unusually heavy and continuous rains brought about by Tropical Storm Uring

1999 – Cherry Hill Landslide (Region 4)
Triggered by three consecutive days of persistent moderate to heavy rains

2000 – Payatas Garbage Slide (NCR)
Triggered by continuous moderate to heavy monsoon rains over Metro Manila

2001 – Baguio - La Trinidad Landslides (CAR)
Triggered by record breaking hour rainfall of 1,085.5 mm in Baguio City

2001 – Camuigin Flashflood (Region 10)
Triggered by continuous light to moderate rains brought about by Typhoon Nanang

2003 – Southern Leyte - Surigao Disasters (Region 8, ARMM)
Triggered by record-breaking hour rainfall of 1,119.0 mm in Surigao and 699.0 mm in Leyte

2004 – Aurora – Infanta Floods (Regions 3, 4)
Triggered by 20 days of persistent moderate to heavy rains brought about by Typhoon Unding, Tropical Storm Violeta, Tropical Depression Winnie and Typhoon Yoyong which also affected Regions 1, 2, 5, CAR, NCR.

2006 – Guinsaugon, Leyte Landslide (Region 8)
Triggered by five days of persistent moderate to heavy rains which is equivalent to almost three months of the area's average annual precipitation.

2006 – Legazpi Mudslide (Region 5)
Triggered by persistent moderate to heavy rains brought by Super Typhoon Reming which also affected Regions 1, 2, 3, 4, 8, CAR, NCR.

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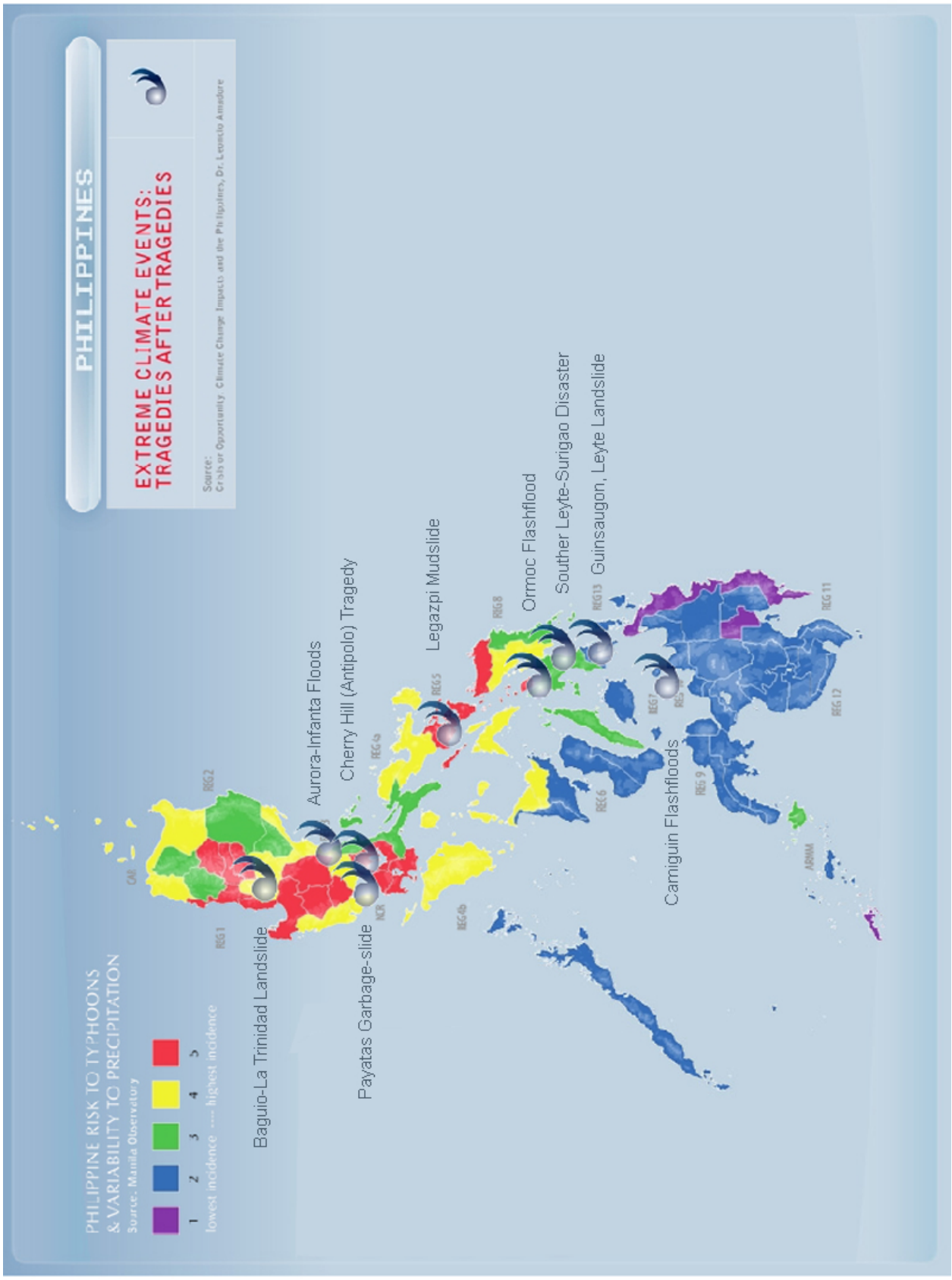
FIGURE 1: PHILIPPINE MAP ON EXTREME WEATHER EVENTS

This map indicates tragedies from 1991 to 2006 which were triggered by extreme weather events such as typhoons and variability in precipitation[45]. The symbols indicate directly affected areas.



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Sea Level Rise

As the global average temperature increases, sea water itself will expand in size. This effect, combined with the partial melting of sea-ice and land-based glaciers, will result in a rise of sea level that threatens coastal areas, island ecosystems and low-lying communities. Sea level rise is a threat to human population and livelihood, and to coastal and marine ecosystems. It is an additional pressure which will further exacerbate socio-economic and environmental concerns as well as threaten present and future development initiatives of a country.

Using the projected global average surface temperature based on six emission scenarios and the rate of thermal expansion of the ocean, the IPCC was able to create different model cases of sea level rise until the end of the 21st century. By the year 2090, the projected rise in sea level ranges from at least 0.18 meters to 0.59 meters while 2300 models project a rise that ranges from at least 0.3 meters to 0.8 meters. These projections, however, do not include the partial melting of the Greenland and West Antarctica Ice Sheets.

Although, IPCC data shows that these major ice sheets "have very likely contributed to sea level rise over 1993 to 2003", it is not yet certain how fast these ice sheets will melt. What is known is that the partial melting of the Greenland and West Antarctica Ice Sheets can result in an accelerated sea level rise of an additional two to four meters, and finally its whole deglaciation which could reach up to a rise of twelve meters if global average temperature increases from 3˚ to 5˚ Centigrade. According to the IPCC, if the world is to continue with its business-as-usual practices, global average temperature can increase from 1.1˚ Centigrade to 6.4˚ Centigrade by 2095[46].

To determine the vulnerability of the Philippines to an indicative one meter eustatic rise in sea level, Greenpeace mapped out and analyzed data using geographic information systems (GIS) and resulting spatial databases (Appendix 2).

A eustatic rise in sea level indicates change in the ocean volume due to the melting of glaciers and ice sheets and the expansion of ocean waters that is accelerated by the increase in global average temperature. This is different from an isostatic increase in sea level which implies no real change in the volume of water in the oceans and is caused by factors like tectonic movement, soil compaction and subsidence.

The Philippine elevation data was derived from the Shuttle Radar Topography Mission (SRTM)[47], an international project spearheaded by the National Geospatial-Intelligence Agency (NGA) and the National Aeronautics and Space Administration (NASA), while the coastline was extracted by eliminating null values from the elevation data. The administrative boundaries were taken from the 2002 Philippine Biodiversity Conservation Priority-Setting Program dataset. All data were converted to a common GIS database using Geographic Resources Analysis Support System[48] (GRASS) GIS.

The data (Figure 2) showed that even with a partial and conservative projection of a one-meter rise in sea level, it is projected to affect 16 regions, 64 out of 81 provinces (Appendix 3), covering at least 703 out of 1,610 municipalities[49], inundating almost 700 million square meters of land and potentially displacing at least 1.5 million Filipinos[50].

Provinces that are highly vulnerable to a one meter sea level rise (Table 1) include Sulu (Figure 3), the land of treasures and farers of the sea (79,728,300 square meters); Palawan which is considered as the Philippines' last frontier (64,281,600 square meters); and the culturally-rich province of Zamboaga del Sur (37,817,900 square meters). At least 90% of the land area of the Municipality of Pata and 34% of the Municipality of Marunggas, both in the province of Sulu, are at threat, potentially displacing communities, damaging infrastructure, and affecting livelihood.

FIGURE 2: PHILIPPINE MAP ON SEA LEVEL RISE

This map indicates that a one-meter rise in sea level is projected to affect 64 out of 81 provinces (Appendix 2), covering at least 703 out of 1,610 municipalities[51], and inundating almost 700 million square meters of land. The red mark indicates provinces that are at threat.

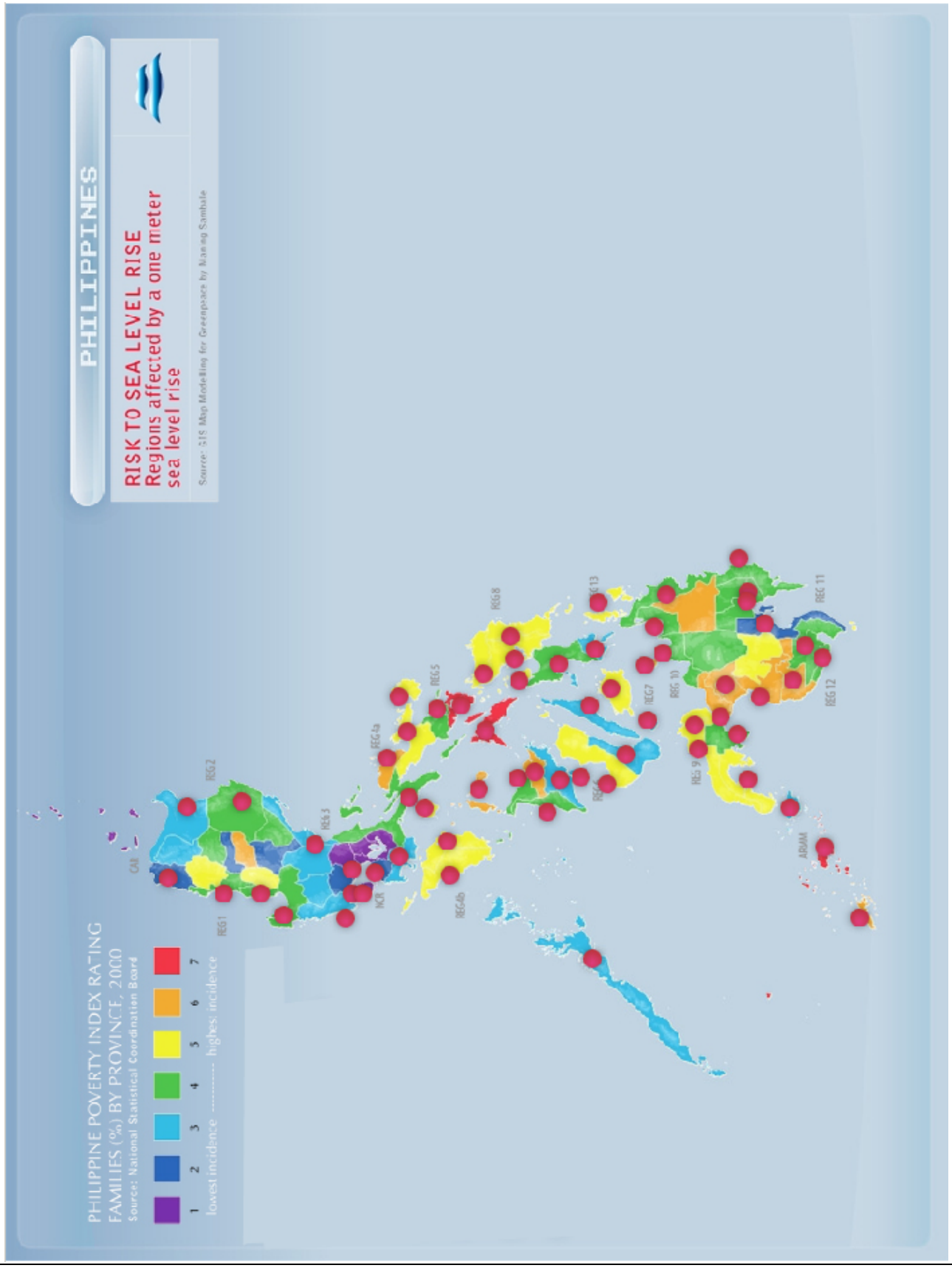

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TABLE 1: TOP 20 PROVINCES IN THE PHILIPPINES WHICH ARE VULNERABLE TO A ONE METER RISE IN SEA LEVEL

RANK	Province	Region	Area vulnerable to a 1 meter sea level rise (in square meters)
1	Sulu	ARMM	79,728,300
2	Palawan	Region 4B	64,281,600
3	Zamboanga del Sur	Region 9	37,818,900
4	Northern Samar	Region 8	33,882,300
5	Zamboang Sibugay	Region 9	32,740,200
6	Basilan	ARMM	30,294,000
7	Cebu	Region 7	27,888,300
8	Davao	Region 11	27,005,400
9	Bohol	Region 7	23,895,000
10	Camarines Sur	Region 5	22,680,000
11	Quezon	Region 3	21,124,800
12	Tawi-Tawi	ARMM	17,390,720
13	Masbate	Region 5	14,256,000
14	Negros Occidental	Region 6	13,996,800
15	Camarines Norte	Region 5	13,591,800
16	Capiz	Region 6	10,748,700
17	Catanduanes	Region 5	10,643,400
18	Samar	Region 8	10,635,300
19	Zamboanga del Norte	Region 9	10,570,500
20	Maguindanao	ARMM	9,169,200

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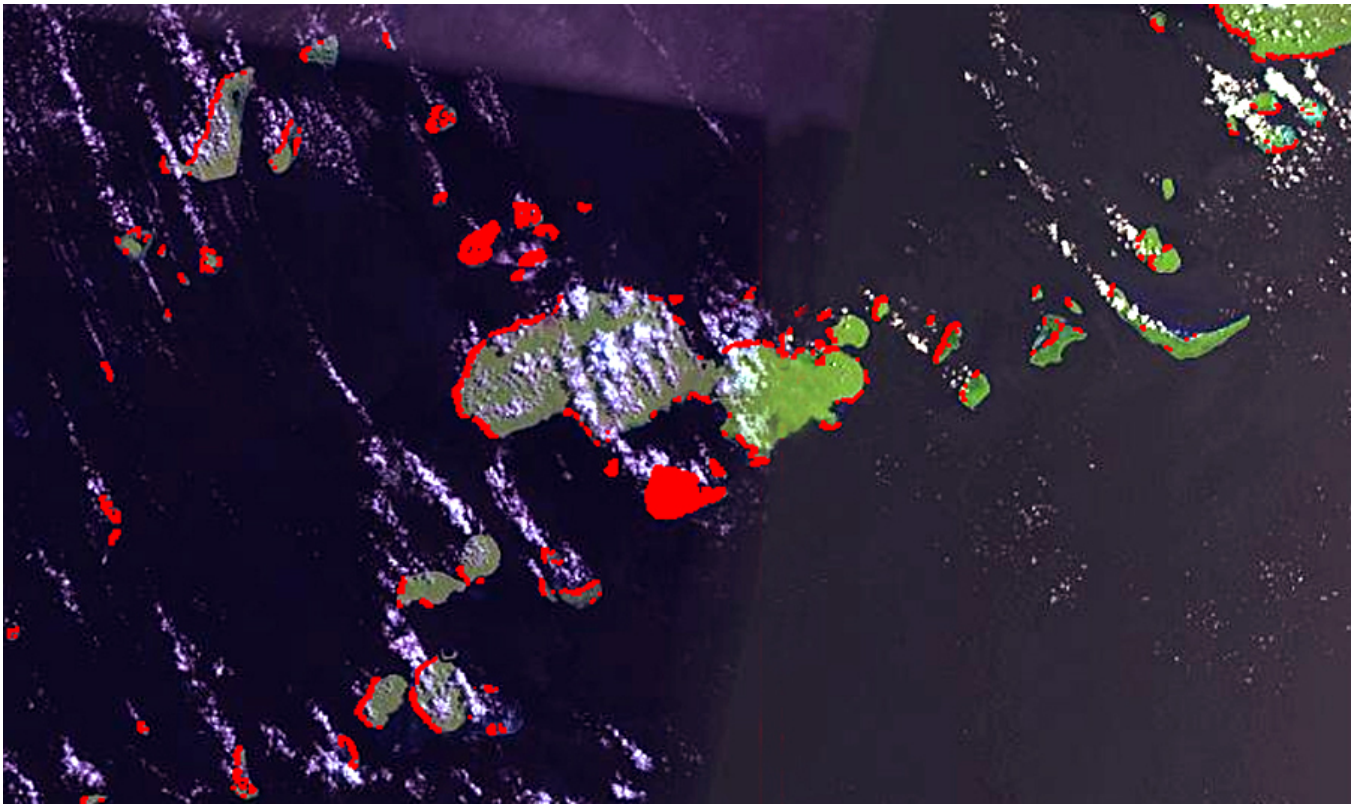
FIGURE 3: SATELLITE MAP OF THE PROVINCE OF SULU, PHILIPPINES

The province of Sulu is considered as the province with the highest land area that is vulnerable to a one meter eustatic rise in sea level at 79,728,300 square meters. Ninety percent (90%) of the land area of the municipality of Pata and 34% of the municipality of Marunggas is vulnerable to a one meter rise in sea level. The red markings indicate areas that are threat.



Based on the data that indicated affected areas, Greenpeace identified vital ecosystems, economic and tourism hubs and human settlements that will be most at risk to a eustatic sea level rise.

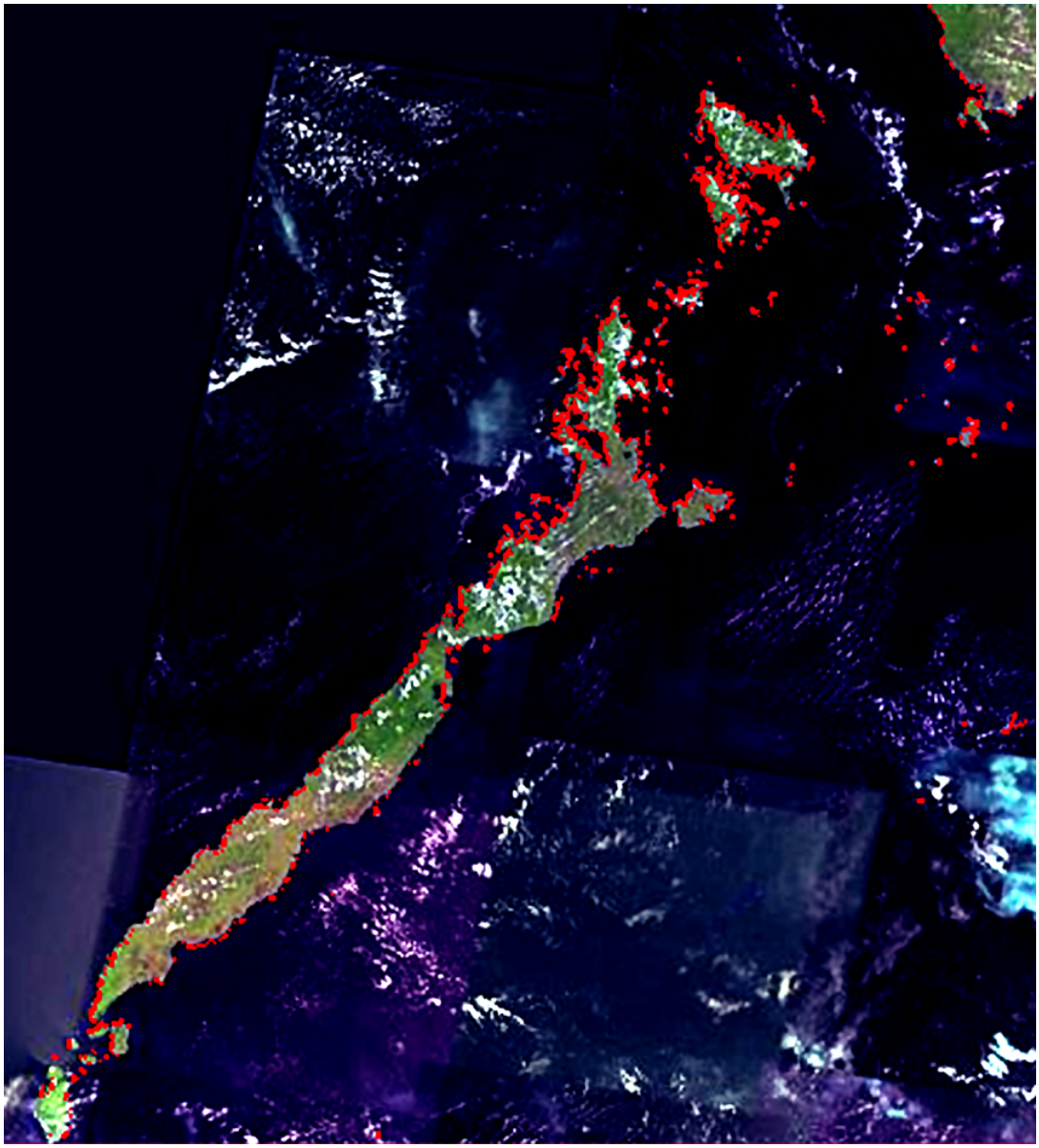
World Heritage sites[52] which are valued for their biodiversity and on-site conservation efforts, such as the Puerto Princesa Subterranean River National Park and the Tubbataha Reef Marine Park, both in the province of Palawan (Figure 4), are vulnerable to inundation and storm surges.

The tourism industry, which is recognized by the Philippine government as a vital economic engine, is also at threat. Eight out of the twelve provinces of the Department of Tourism's Anchor Destinations[53] are vulnerable to permanent or episodic flooding. These sites include premier beaches, mangrove forests and world-class dive spots.

An increase in sea level will accelerate and worsen flooding in the northwest delta plain of Manila Bay which is already experiencing subsidence at an alarming rate of at least three centimeters a year due to groundwater extraction[54]. This situation is similar in key cities such as Legazpi City, Davao City, and Jolo which are experiencing subsidence at a rate of 5.9mm per year, 3.2mm per year, and 0.4mm per year, respectively[55].

FIGURE 4: SATELLITE MAP OF THE PROVINCE OF PALAWAN, PHILIPPINES

The province of Palawan is considered as the province with the second highest land area that is vulnerable to a one meter eustatic rise in sea level at 64,281,600 square meters. Human settlements, tourist hubs and vital ecosystems such as estuaries, mangroves and coral reefs are at threat. The red markings indicate areas that are at threat.



But there is much more to sea level rise than water encroaching on dry land. Sea level rise also provides a higher base for storm surges due to typhoons, increasing the destructiveness of floods and storms[56] to coastal settlements and infrastructure such as piers and ports[57]. End-of-the-pipe remedies for coastal protection such as the building of sea-walls are costly options. For example, a concrete sea-wall three meters high and one meter thick with an underwater base that is 1.5 meters high and three meters thick will cost US $0.6 million per kilometer[58].

Increase in the salinity of groundwater aquifers, estuaries, and coastal farmlands will also affect the agricultural and aquaculture sector. Salt water intrusion aggravates scarcity of potable water and the conversion of rice paddies to aquaculture ponds[59].

According to the IPCC, a centimeter rise in sea level erodes at least a meter of beach horizontally, threatening critical ecosystems. These include beaches that are primary nesting sites for sea turtles[60], wetlands that are used by millions of migratory birds as a resting place[61], as well as the remaining 117,000 hectares of mangrove forests[62] in the Philippines. Estuaries such as the Aparri Delta where the Cagayan River meets the China Sea are vulnerable to flooding and erosion. With more than a meter of sea level rise, the country's entire coastline will be irrevocably changed.

TABLE 2: REGIONS IN THE PHILIPPINES THAT ARE VULNERABLE TO A ONE-METER RISE IN SEA LEVEL

RANK	Region	Number of Municipalities vulnerable to a 1 meter sea level rise	Land area vulnerable to a 1 meter sea level rise (in square meters)
1	ARMM	39	137,635,200
2	Region 9	40	81,129,600
3	Region 4b	64	75,807,900
4	Region 8	92	75,662,100
5	Region 5	86	74,277,000
6	Region 7	68	52,747,200
7	Region 6	68	38,118,600
8	Region 11	20	30,107,700
9	Region 4a	46	23,805,900
10	Region 1	48	20,322,900
11	Region 12	19	16,232,400
12	CARAGA	40	12,611,700
13	Region 10	31	12,109,500
14	Region 2	18	6,439,500
15	Region 3	23	4,252,500
16	NCR	1	380,700
	PHILIPPINES	**703**	**661,640,400**

Ironically, regions that are highly vulnerable to a one meter rise in sea level (Table 2), such as the Autonomous Region of Muslim Mindanao (ARMM), the Zamboanga Peninsula (Region 9), Eastern Visayas (Region 8) and the Bicol Region (Region 5) are also areas that have the highest Poverty Incidence in the Philippines. This reality, combined with factors such as the armed conflict in ARMM and the landslide tragedies in Regions 8 and 5, further decreases the ability of these regions to cope with climate change impacts.

III. The Way Forward

Our understanding of the climate system and our impact on it has improved immensely. Unfortunately, the more we know, the more precarious the future looks. The ever-worsening climate change impacts that we face send a clear message to governments around the world: the window for action is narrowing fast. A balanced portfolio of adaptation and mitigation measures must be set in place in order to reduce present manifestations and avert the worst impacts of climate change.

Adaptation

Climate change impacts have a potential "domino" effect. Direct-hit areas are not the only regions affected; climate change impacts can indirectly affect other provinces, and increase the burden of misery of more Filipinos. Yet, even with the emerging trends of climate variability and the acceptance that there are already manifestations of climate change, many provinces are still not prepared to cope with its impacts.

A pro-active climate change adaptation policy framework that goes beyond building sea walls is therefore needed for the Philippines to cope with present and projected impacts of climate change. These can include measures such as:

- a comprehensive climate change vulnerability assessment and mapping;
- the improvement of nationwide and localized forecasting and modeling capabilities;
- the improvement of hazard mapping with the addition of new components that identify areas and frequency of weather-related hazards such as tropical cyclones, floods, storm surges, extreme rainfall, and others;
- the development of a comprehensive land-use and coastal development plan that integrates risk reduction;
- the establishment of community-driven coping strategies in adaptation and disaster preparedness and management;
- the development of a sustainable resource (food, water, etc.) management and distribution; and
- effective and sustained programs to enhance the level of climate change awareness among policy or decision makers, and the various stakeholders – media, students and the academe, general public, etc – for their own empowerment.

Mitigation

To maintain the global mean temperature below 2°C, the world must reduce its greenhouse gas emissions by 50% by 2050[63]. This is only possible through a massive uptake of renewable energy combined with aggressive energy-efficiency measures.

From a moral, legal and practical perspective, the initial burden of emissions reductions has to fall on industrialized countries. However, developing countries like the Philippines must also immediately stabilize their carbon dioxide emissions even as developed countries must make drastic cuts.

While it is true that the Philippines faces many challenges in the formulation of its energy policy for the coming years—security of energy supply, economic growth, climate change and sustainable development, employment and technological development—these issues can be successfully addressed by a strategic approach to the development of the country's new renewable energy resources.

A fundamental change in the way the country uses energy must take place within this decade in order to make a real difference in the fight to save the climate. The Philippines must start reducing its dependence on fossil fuels, particularly coal, for its energy source and embrace renewable energy and energy efficiency to cut carbon dioxide emissions by as much as 30% by 2050.

Political will, however, is of paramount importance to initiate this necessary change. As a start, the national government must commit to increase the share of renewable sources in the energy mix through clear, binding targets. It must then develop a strong renewable energy policy that will provide defined and stable returns for investors as well as guarantee priority access to the grid for renewable power generators.

Second, the government must stop the construction of new coal-fired power plants and phase out the existing ones. Coal plants are among the major sources of greenhouse gases. As the most carbon intensive fossil fuel, coal emits 29% more carbon than oil and 80% more than gas. The Philippines currently has seven coal plants, and another nine are already in the pipeline. The coal plants are set to increase the share of carbon-intensive energy capacity to 40% in the country's energy mix over the next several years.

Third, on the energy efficiency side, the government must pursue demand-side management and establish stringent standards for all energy-consuming appliances, buildings and vehicles. This can result in energy savings of as much as 30%.

Lastly, the government must eliminate all direct and indirect subsidies to fossil fuels to create a level playing field for new renewable energy players.

The Challenge

The Philippines' critical vulnerability to the grave impacts of climate change will be among the country's major challenges in the years, and even decades, to come. And although the effects of this catastrophe—stronger typhoons, rising sea levels, and corresponding effects on Filipinos, the national economy and the environment—are not inescapable, they are projected to continue and worsen, especially if strong solutions are not implemented.

But while it is true that the Philippine government has taken a step forward in addressing this global threat, the risks our country faces are too great and call for much greater leaps toward pro-active and lasting solutions. Thus, while the government must anticipate and squarely face the worst of the impacts, it must above all choose an energy development path built on clean and renewable sources of energy and which promotes energy efficiency for a truly secure and sustainable future.

APPENDIX

APPENDIX 1
Land-slide prone Regions[64]
From the report "Geospatial Technology in Disaster Prediction and Agricultural and Natural Resource Management" of Dr. Esteban Godillano for the Department of Agriculture, 2004.

RANK	REGION	AREA AT RISK TO LANDSLIDE (in hectares)
1	CAR	507,666
2	4 B	486,442
3	6	293,427
4	1	280,704
5	5	272,279
6	8	265,558
7	11	255,540
8	2	229,112
9	4 A	189,386
10	CARAGA	167,516
11	10	152,811
12	3	152,518
13	9	45,154
14	12	32,345
15	ARMM	4,937

APPENDIX 2
Methodology for deriving Greenpeace Sea Level Rise Maps

1. Elevation data is derived from elevation data of the Shuttle Radar Topography Mission[65] (SRTM) at 3 arc-second resolution (approximately 90 meters at the equator).
2. Coastline is extracted by eliminating NULL values from the elevation data. This was used as the reference coastline to ensure consistency with the elevation data.
3. Administrative boundaries were taken from the Philippine Biodiversity Conservation Priority-Setting Program (2002) dataset. All non-coastal provinces were eliminated to avoid excessive data processing.
4. All data were converted to a common GIS database using Geographic Resources Analysis Support System[66] (GRASS) geographic information systems. Data were available as raster and vector formats.
5. The projection is at Geographic (lat/lon) and WGS-84 datum. The relative vertical accuracy is approximately 10 meters.
6. The sea-level-rise script was derived from a series of raster map calculator in GRASS. Starting from the coastline, the "module uses a 3x3 moving window approach to find all cells that match three criteria and to define the area:
    - cells are below the specified elevation;
    - cells are connected with an initial cell;
    - cells are not NULL or masked.

The resulting raster map contains cells with values representing water depth.
7. Local statistics are then derived for each affected area.

APPENDIX 3
Provinces in the Philippines that are vulnerable to a one meter rise in sea level

REGION	PROVINCE	POPULATION, 2000[67]	TOTAL AREA (in square meter)	Area vulnerable to a 1 meter sea level rise (in square meters)
PHILIPPINES				**661,640,400**
REGION 1			48 MUNICIPALITIES	20,322,900
	ILOCOS NORTE	514,241	1,042,340,400	4,981,500
	ILOCOS SUR	594,206	847,308,600	7,808,400
	LA UNION	657,945	781,690,500	3,790,800
	PANGASINAN	2,434,086	1,563,389,100	3,742,200
REGION 2			18 MUNICIPALITIES	6,439,500
	CAGAYAN	993,580	4,748,098,500	4,932,900
	ISABELA	1,287,575	3,125,198,700	1,506,600
REGION 3			23 MUNICIPALITIES	4,252,500
	BATAAN	557,659	734,443,200	664,200
	BULACAN	2,234,088	118,025,100	145,800
	PAMPANGA	1,618,759	195,056,100	348,300
	ZAMBALES	433,542	2,900,593,800	3,094,200
REGION 4A			46 MUNICIPALITIES	23,805,900
	BATANGAS	1,905,348	1,142,829,000	1,125,900
	CAVITE	2,063,161	178,143,300	1,555,200
	QUEZON	1,679,030	7,202,382,300	21,124,800
REGION 4B			64 MUNICIPALITIES	75,807,900
	AURORA	173,797	1,247,197,500	81,000
	MARINDUQUE	217,329	880,704,900	1,150,200
	MINDORO OCCIDENTAL	380,250	5,601,490,200	4,981,500
	MINDORO ORIENTAL	681,818	1,927,937,700	2,025,000
	PALAWAN	755,412	13,535,918,100	64,281,600
	ROMBLON	264,357	1,122,287,400	3,288,600
REGION 5			86 MUNICIPALITIES	74,277,000
	ALBAY	1,090,907	1,659,090,600	6,609,600
	CAMARINES NORTE	458,840	1,099,704,600	13,591,800
	CAMARINES SUR	1,551,549	3,464,880,300	22,680,000
	CATANDUANES	215,356	1,269,091,800	10,643,400
	MASBATE	707,668	3,747,999,600	14,256,000
	SORSOGON	650,535	1,749,041,100	6,496,200
REGION 6			68 MUNICIPALITIES	38,118,600
	AKLAN	451,314	675,410,400	1,344,600
	ANTIQUE	471,088	1,285,866,900	3,952,800
	CAPIZ	654,156	576,420,300	10,748,700
	GUIMARAS	141,450	552,889,800	834,300
	ILOILO	1,559,182	1,127,584,800	7,241,400
	NEGROS OCCIDENTAL	2,136,647	5,576,420,700	13,996,800
REGION 7			68 MUNICIPALITIES	52,747,200
	BOHOL	1,137,268	1,456,185,600	23,895,000
	CEBU	2,377,588	3,358,017,000	27,888,300
	NEGROS ORIENTAL	1,126,061	1,750,450,500	769,500
	SIQUIJOR	81,598	152,701,200	194,400
REGION 8			92 MUNICIPALITIES	75,662,100

	BILIRAN	140,274	501,373,800	4,625,100
	EASTERN SAMAR	375,822	3,379,684,500	13,672,800
	LEYTE	1,592,336	3,266,762,400	10,926,900
	NORTHERN SAMAR	500,639	2,369,914,200	33,882,300
	SAMAR	641,124	3,792,517,200	10,635,300
	SOUTHERN LEYTE	360,160	750,610,800	1,919,700
REGION 9			40 MUNICIPALITIES	81,129,600
	ZAMBOANGA DEL NORTE	823,130	4,303,270,800	10,570,500
	ZAMBOANGA DEL SUR	1,333,456	2,417,112,900	37,818,900
	ZAMBOANGA SIBUGAY	537,594	2,279,785,500	32,740,200
REGION 10			31 MUNICIPALITIES	12,109,500
	CAMIGUIN	74,232	223,875,900	1,344,600
	MISAMIS OCCIDENTAL	486,723	345,748,500	834,300
	MISAMIS ORIENTAL	664,338	2,136,707,100	9,930,600
REGION 11			20 MUNICIPALITIES	30,107,700
	COMPOSTELA	580,244	858,559,500	672,300
	DAVAO	743,811	477,632,700	27,005,400
	DAVAO DEL SUR	758,801	4,090,410,900	1,255,500
	DAVAO ORIENTAL	446,191	3,503,817,000	1,174,500
REGION 12			19 MUNICIPALITIES	16,232,400
	LANAO DEL NORTE	473,062	1,398,116,700	4,568,400
	SARANGANI	410,622	2,247,677,100	2,535,300
	SOUTH COTABATO	690,728	575,877,600	40,500
	SULTAN KUDARAT	586,505	1,501,140,600	9,088,200
ARMM			39 MUNICIPALITIES	137,635,200
	BASILAN	332,828	1,245,885,300	30,294,000
	LANAO DEL SUR	669,072	329,346,000	1,053,000
	MAGUINDANAO	801,102	1,735,530,300	9,169,200
	SULU	619,668	1,283,015,700	79,728,300
	TAWI-TAWI	322,317	927,539,100	17,390,700
CARAGA			40 MUNICIPALITIES	12,611,700
	AGUSAN DEL NORTE	285,570	1,550,202,300	1,174,500
	SURIGAO DEL NORTE	481,416	2,236,709,700	8,496,900
	SURIGAO DEL SUR	501,808	2,767,915,800	2,940,300
NCR		9,932,560		380,700
	METRO MANILA		603,774,000	380,700

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