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Filipino 2040
Environmental Resources, Shocks, and National Well-Being

by

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Environmental Resources, Shocks, and National Well-Being*

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Abstract

The contribution of the environmental-resource sector to national well-being is the sum of natural resource depletion and environmental degradation. Inasmuch as existing resource stocks are below efficient levels, better enforcement of existing laws as well as policies that incentivize sustainable use are needed. Similarly, progressive royalty assessment of mineral resources can incentivize exploration without transferring the bulk of resource rents to private interests. In the case of pollution, the key is to face firms with the full costs of their production, e.g. through emission taxes and/or cap and trade systems. Calculating total depletion and degradation (TDD) will facilitate the calculation of green national income (GNI), a more inclusive metric of national well-being. In the same way, simultaneous optimization of disaster management policies in the face of climate change can facilitate a further improvement in national well-being, this time measured as comprehensive national income (CNI).

Keywords: Well-being, risk, natural disaster, scenario-building, Philippines

JEL: N55, 013, 044, Q01, Q54, Q56, Q58

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Executive Summary

Increasing national well-being requires not only growing the ability of the economy to increase material consumption but stewardship of the country's natural and environmental resources. In the case of resource management, the challenge is to maximize the present value of existing resource stocks by policies that incentivize resource extraction and harvesting at efficient levels. Inasmuch as existing forest stocks are below efficient levels, this requires improved governance to reverse deforestation and policies that incentivize sustainable use of existing forest stocks. Similarly, existing laws that grant local government control over municipal-level fisheries can be complemented by national assistance in enforcing fishing regulations, such as the establishment of catch quotas and allocations thereof. Increasing royalty charges for mineral extraction and providing tax incentives for exploration can increase the contribution national well-being. In the case of pollution, the key is to face firms with the full costs of their production, e.g. through emission taxes and/or cap and trade systems.

What is not measured will not be managed. Inasmuch as GDP does not measure national well-being, there are a number of adjustments that must be made. Starting with Net National Income, one first subtracts the values of natural-capital depletion and environmental degradation to obtain *green national income* (GNI). We review previous attempts in the Philippines to approximate total depletion and degradation (TDD) and synthesize a partial benchmark, estimated to be 5% of net national income. In our optimistic scenario, we show that decreasing this partial measure from 5% to 0.6% by 2040, adds more than 0.18% per year to the growth rate of national well-being, thus helping to compensate for negative factors that slow down the growth of net national income, such as the falling growth rate of remittances. To the extent that our partial benchmark is lower than actual TDD, we are underestimating the potential for ecological management to further accelerate the growth of well-being.

In the future it will be useful to extend GNI further in order to include potential damages from natural disasters. We refer to this construct as *comprehensive national income* (CNI). Inasmuch as climate change is likely to decrease both the level and the growth rate of CNI, improved risk management practices can be an offsetting force. Moving forward, improved capacity is needed for evaluating investment priorities for improving long-run security. Another source of CNI growth is the removal of distortionary policies. We illustrate how distortionary policies such as inappropriate subsidies can reduce national well-being. For example, switching from mandates and subsidies to a policy of government facilitation of renewable energy will exert a positive effect on both the level and growth rate of national well-being.

Determining the effectiveness of alternative policy measures will also require improved capability to measure green and comprehensive national income. This is entirely in line with current initiatives to strengthen statistical agencies so that official statistics are more disaggregated, frequent, timely, and accessible and with capacity building for climate change modeling and damage assessment.

Beyond GDP:[3] The Natural Environment, Shocks, Energy and Economic Policy

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1. Introduction

This paper deals with promoting the common good through better energy, resource, and environmental policies as well as improved management of natural disaster risks, including climate change. Increasing GDP will be insufficient to meet the aspirations of the Philippine people for higher levels of living, inasmuch as GDP does not measure welfare. Largely because of the omission of these elements, we begin with a discussion of green accounting – the method of extending national income accounting to include the degradation of the environment and the depletion of natural resources.

As we discuss in section 3, comprehensive national income accounting can be further extended to include natural disasters and other shocks to the ecological-economic system. Even policy distortions can be accounted for by including them as constraints to the system. Thus environmental-resource conservation, disaster preparedness and policy reform all become potential sources of welfare growth.

Section 4 deals with the mission of sustainable development, in particular how the sustainable development goals relate to the mission of improving the welfare of Filipinos. Section 5 provides a brief synthesis.

2. Increasing levels-of-living in the face of environmental degradation and resource depletion

Stewardship of natural resources and the environment should not be treated as a separate objective from management of the economy (World Commission on Environment and Development 1987). The fundamental premise of sustainable income and green accounting, which have a long history in the Philippines and other countries, is that nature and the economy are part of the same system (the *environomy*) as shown in Figure 1. And one system requires one unifying measure of performance.

In order to convert the most common indicator of the size of an economy, Gross Domestic Product (GDP), into a measure of national well-being, a number of adjustments must be made.[4] It is well known that GDP overestimates public welfare by failing to deduct depreciation – that portion of investment that simply replaces capital which has worn out or become obsolete. Deducting capital depreciation from GDP yields Net Domestic Product (NDP). And since income is a better measure of welfare than production, we need to subtract the income earned in the Philippines by foreigners, add income earned by Philippine citizens abroad, and add remittances to the Philippines by non-

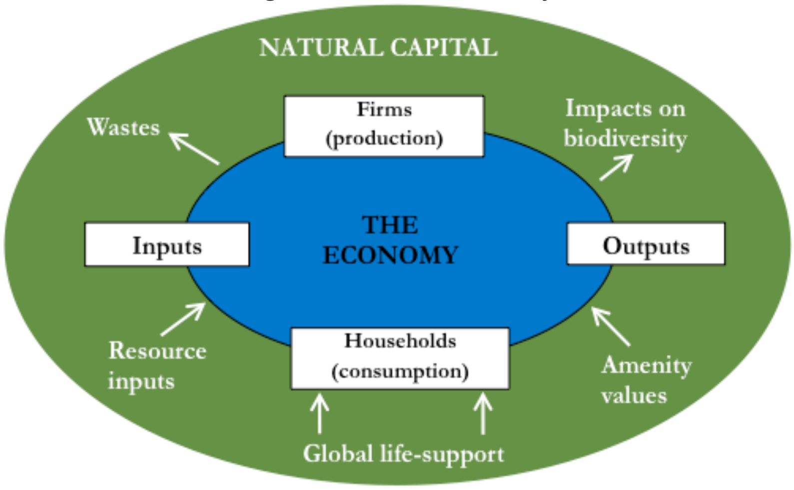
[3] "Beyond GDP: Measuring progress, true wealth, and the well-being of nations" is the name of a major European initiative to construct and quantify more accurate measures of national well being. http://ec.europa.eu/environment/beyond_gdp/index_en.html

[4] In this report, national well-being, public welfare, and levels-of-living are synonymous with the "common

[4] In this report, national well-being, public welfare, and levels-of-living are synonymous with the "common good" espoused in the 1987 Philippine Constitution. For a popular discussion of the need to move from GDP to a more genuine measure of national well-being, see e.g. Stiglitz et al. (2010).

citizens. The result is national income (NI). For the same reason that depreciation of plant and equipment has been subtracted, we also need to subtract depreciation of natural capital, i.e. the lost

Figure 1: The Environomy



present-value from mining, forest depletion/degradation, and extraction of other natural resources. Using appropriate prices and accounting for all goods and services that affect human welfare results in an improved index of national well-being -- Green National Income (GNI).

The ultimate vision of national accounting in the Philippines is to supplement the existing system of national accounts (http://www.nscb.gov.ph/sna/DataCharts.asp) so that depletion of natural resources and the degradation of the environment can be treated in a consistent fashion with capital depreciation and better approximate economic welfare.

2.1. Environmental degradation and well-being

As just discussed, Green National Income (GNI) is national income after deducting natural capital depletion[5] and environmental degradation. GNI also measures *sustainable income* in the sense that if total capital accumulation were converted to consumption, then that level of consumption could be sustained indefinitely (Lange et al. 2010). The same accounting framework is sometimes used to provide a criterion for sustainability: If net investment after deducting natural depletion and environmental degradation (yielding *genuine savings*) is positive, then the economy is said to be sustainable.

Appendix 1 provides a historical account of green accounting initiatives in the Philippines, which have been going on for 20 years. The early accounts were reckoned in terms of net domestic product after deducting environmental and resource degradation and are shown as EDP1 and EDP2 in Appendix 1 (see especially Figure A1 and Table A1). Due to data limitations, these accounts were partial in nature and underestimated the real cost of depletion and degradation. For example, deforestation and depletion of marine resources were not included.

This section reviews more recent attempts at green accounting and discusses the improvements in resource depletion and pollution that will be needed to be consistent with the vision of a 7% annual increase in welfare. Data limitations dictate that this study provide only a rough estimate of how much needs to be deducted from national income on the grounds of

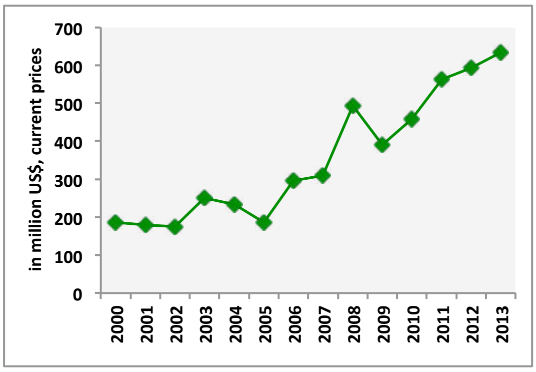
[5] *Natural* capital depletion is the counterpart of depreciation of *produced* capital (plant and equipment).

environmental-resource issues and natural disasters in order to convert national income into a measure of welfare. For example, in 2013, around 9% of national income was lost due to resource depletion, environmental degradation and damages from Typhoon Yolanda.

If prudent resource use and environmental policies are followed, the amount deducted from GNI shrinks as a percentage of national income such that environmental-resource management becomes a source of growth. This indeed appeared to be the case in the early 1990s as shown in Appendix Figure A1. However, subsequent statistics compiled by the World Bank and illustrated in Figure 2, suggest that the apparent worsening and subsequent improvement of GNI in the early 90s was a statistical aberration. GNI was computed by deducting natural resource depletion (minerals, forests, and energy resources) and environmental degradation (limited to carbon and particulate emissions) from national income.

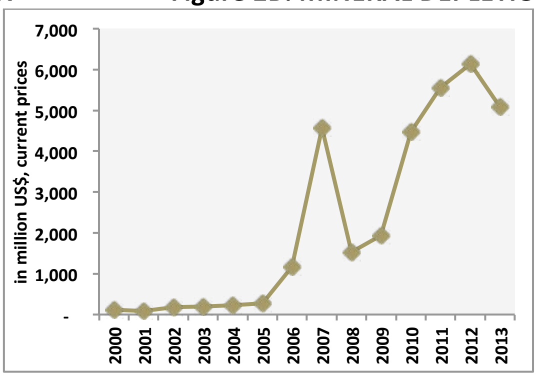
Figures 2A to 2D below show the available data on natural resource depletion and environmental degradation, expressed in nominal monetary values. The sum of these four factors plus particulate emissions[6] is the difference between National Income and Green National Income. As shown in Figure 3, total depletion and degradation increased slightly from 2008 to 2010 and then remained roughly constant until 2013.

Figure 2A: NET FOREST DEPLETION



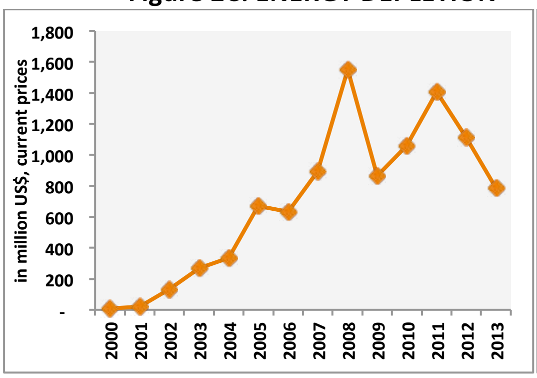
Source: World Development Indicators

Figure 2B: MINERAL DEPLETION



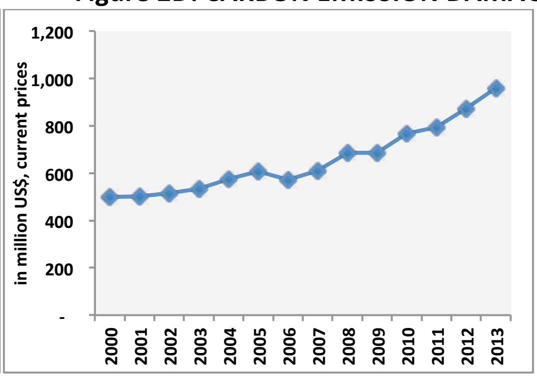
Source: World Development Indicators

Figure 2C: ENERGY DEPLETION



Source: World Development Indicators

Figure 2D: CARBON EMISSION DAMAGE

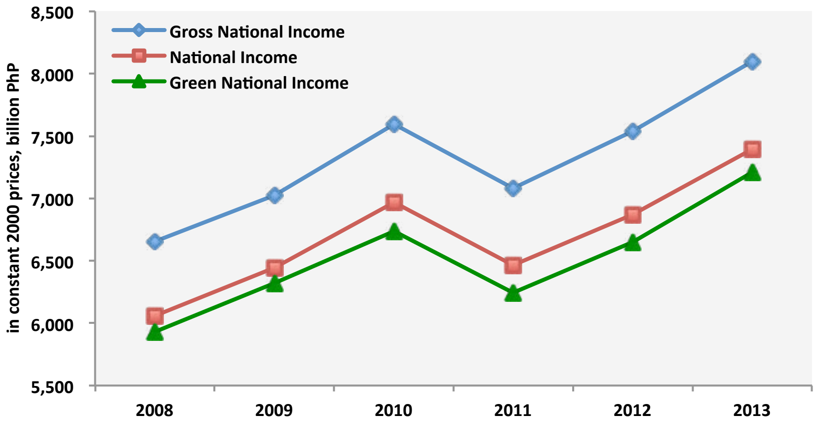


Source: World Development Indicators

[6] The value of damages from particulate emissions (PM2.5) was only available for 2010. For purposes of figure 2, we assumed that particulate emissions grew at the same rate as carbon emissions.

Inasmuch as the World Development Indicators only allow the aggregation of a very few components of resource depletion and environmental degradation, Appendix 2 provides additional information for other components. Outdoor air quality indicators show that PM2.5 levels in Baguio City has gone slightly worse, while Metro Manila, Cebu City and Cagayan de Oro City has maintained PM2.5, SO2 and NO2 levels within the Philippine National Air Ambient Quality Guideline Value. Around half of the Philippine population is exposed to pollution caused by fuelwood or charcoal use (World Bank, 2009). As of 2007, out of the 19 Priority Rivers identified by the Department of Environment and Natural Resources (DENR), 13 conformed with DENR water quality criteria regarding dissolved oxygen but only 8 conformed with standards for biochemical oxygen demand. A detailed breakdown of morbidity and mortality costs from air and water pollution can also be found in the Appendix.

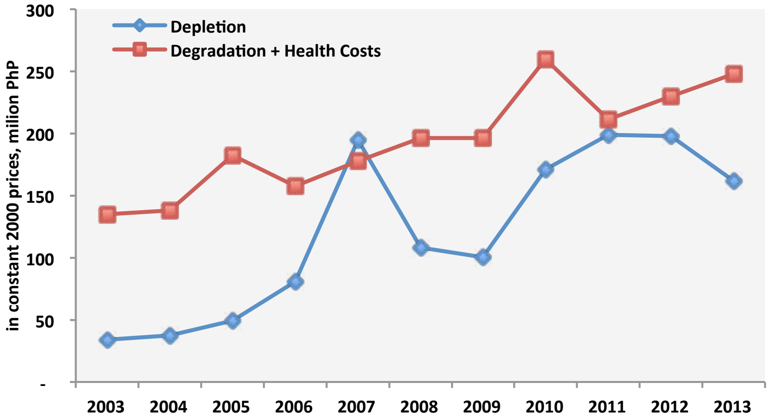
Figure 3: From Gross to Green National Income (GNI)



Source: World Development Indicators (*World Bank*)

Figure 4 augments the depletion and degradation data shown in Figure 3 with the additional data in Appendix 2. The blue line shows the natural resource depletion from 2003 to 2013. The red line is the adjusted environmental degradation measure, which now accounts for mortality and morbidity costs from Outdoor Air Pollution, Indoor Air Pollution and Water Sanitation and Hygiene. The result shows that resource depletion appears to have reached a turning point. This is presumably because forest depletion is self-limiting. Once depletion has sufficiently depleted forest stocks, remaining forested areas are less accessible, such that depletion slows even with inadequate governance. There is no such self-limiting effect with environmental degradation, which is still increasing.

Figure 4: Total Depletion and Degradation (TDD)



Source: World Development Indicators database and World Bank (2009)
Note: Resource depletion includes energy resources (coal, oil, natural gas), mineral resources, and forest resources from WDI. Environmental degradation includes carbon dioxide damages, particulate emission damages as well as mortality and morbidity costs from outdoor air pollution (OAP), indoor air pollution (IAP) and water, sanitation and hygiene (WSH), as obtained from World Bank (2009) and used to augment the World Development Indicators database.

Table 1 compares partial TDD values across ASEAN 5 countries.[7] In the Philippines, TDD as percent of National Income decreased from 3.08% in 2010 to 2.29% in 2013.

Table 1: TDD values across ASEAN 5 countries

	2010				2013			
current, in billion US$	Depletion	Degradation	TDD	TDD % of NI	Depletion	Degradation	TDD	TDD % of NI
Philippines	5.99	2.20	8.19	3.08%	6.51	0.96	7.47	2.29%
Malaysia	19.17	2.49	21.66	9.05%	20.91	2.55	23.47	7.76%
Indonesia	35.60	8.08	43.68	5.95%	32.52	6.46	38.97	4.41%
Thailand	12.11	3.55	15.66	5.13%	15.83	3.40	19.23	5.32%

Source: World Development Indicators

Figure 5A sets out two possible scenarios for both natural resource depletion and environmental degradation (including health costs of degradation). These are the business-as-usual (BAU) scenario represented by the red lines and the optimistic (Opt) scenario represented by the blue lines. The BAU scenario assumes that the share of natural resource depletion as percent of National Income will stay constant at 2% until 2040. On the one hand, the quantity of resource depletion will slow down (even without improved governance) for the simple reason that there will be less forests and marine resources to deplete. On the other hand, the scarcity value would increase due to both the physical scarcity and higher incomes by 2040. Without clear evidence on which force would dominate, our BAU scenario for resource depletion remains at current levels. Regarding environmental degradation, we assume in the BAU scenario that it stays constant at 3% of National Income by 2040, in association with the expected increases in gas and diesel consuming vehicles, electricity consumption, and size of the industrial sector.

On the other hand, the Optimistic scenario assumes improved natural resource management such that depletion falls to zero by 2040. In the medium-run, pursuit of efficient extraction policies can actually increase that portion of natural resource depletion, but increasing stocks of marine and terrestrial stocks of renewable resources can mostly offset this. In the long run the value of renewable stocks is assumed to be constant as sustainable fishing and forestry policies only harvest stock growth. Non-renewable reserves can also be held constant by offsetting extraction with exploration and discoveries of new deposits.

In accordance with the stated goal of stabilizing emission levels,[8] the optimistic scenario for environmental degradation holds the value of emissions constant at its current level (approximately PhP 275 billion). By 2040 this is 0.6% of National Income. That is, total depletion and degradation (TDD) as a percentage of national income optimistically falls by an order of magnitude by 2040.

[7] Since estimates for both depletion and degradation are only partial, these regional comparisons may be misleading in the sense that what is left out varies across countries. For both 2010 and 2013, depletion includes net forest depletion, mineral depletion and energy depletion. Degradation includes carbon dioxide damages and particulate emission damages. However, values for particulate emission damages were only available for 2010. TDD estimates are only partial and does not cover all categories such as marine resources. Health costs (morbidity and mortality) were not included. Also, pollution estimates only cover productivity losses and does not include the value of statistical life.

[8] Republic of the Philippines (2015).

Figure 5A: Depletion and Degradation - Possible Scenarios

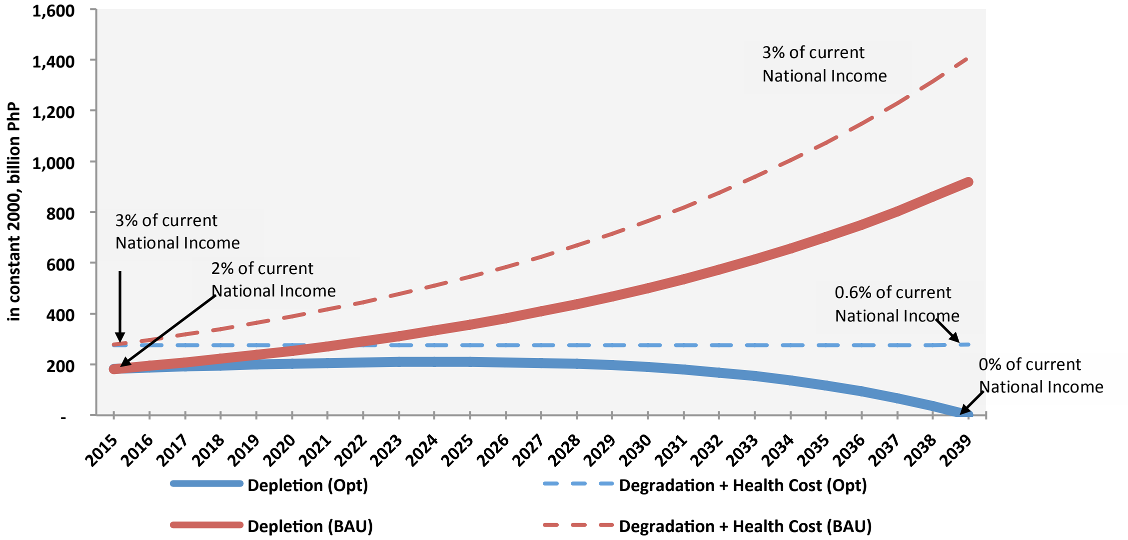
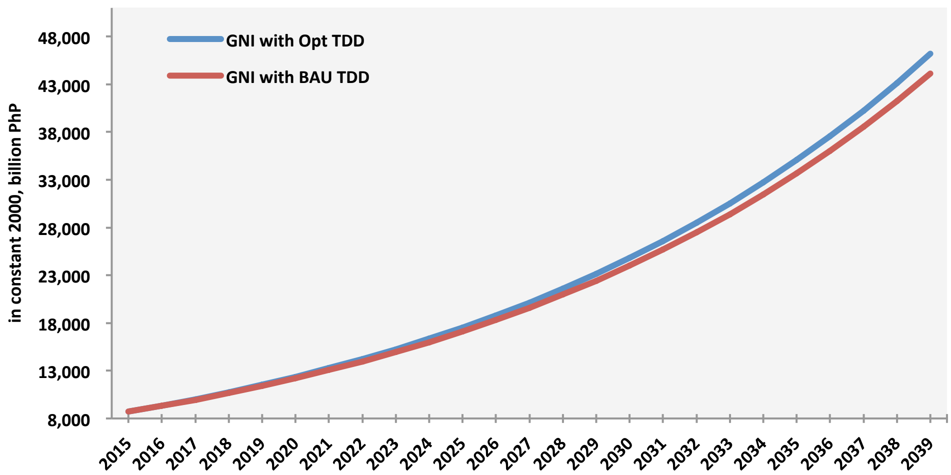


Figure 5B compares GNI with Optimistic and BAU projections for TDD. National income is assumed to increase at the optimistic rate of 7% for both cases. In the BAU case, TDD remains at 5% of national income, whereas it falls to .6% in the optimistic scenario. As shown, improved environmental and resource management results in a 4.4% increase in well-being (shift from red to blue line) and a slightly higher GNI growth rate (7% to 7.2%).

Figure 5B: Green National Income – Possible Scenarios



Nonetheless, since even a partial measurement of TDD was already 5%, amounting to PhP 407 billion by 2013 (in constant 2000 prices), well-being was substantially less than it would have been without that subtraction.[9] Reducing TDD from around 7% of national income to around one-tenth of that percentage means that GNI grows about .4% faster than national income from 2016 to 2040.

There are a number of factors that are currently impeding efficient environmental and resource management. One of the clearest is the failure to impose emission taxes according to the marginal damage costs of pollution. Similarly congestion charges (or HOTways) can internalize much

[9] The country's national income for 2013 (in constant 2000 prices) was PhP 8,169 billion (PSA). For the same year, depletion was estimated to be at PhP161 billion (2% of NI) while degradation and health costs was valued at Php246 billion (3% of NI).

of the spillover effects of driving that are currently causing enormous traffic delays in Manila and elsewhere. Another is the underpricing of forest and water resources, documented in the 80s and 90s (Repetto 1986, Roumasset 1991) and continuing to the present time.

While most of the focus in resource economics is on the over-exploitation of resources, the opposite may also be the case. Failing to pursue efficient investment in mining can be equally damaging to GNI. For example, consider a resource worth six billion dollars in present value terms after deducting extraction and environmental costs. Banning extraction of the resource reduces the country's wealth by six billion dollars. In green accounting this should be treated as a capital loss, commensurate with depletion. That is, GNI would fall by six billion dollars without any offsetting benefits from mining.

The basic principle of efficient mining is to extract minerals until the market price equals the foregone opportunity cost plus any environmental damage costs. This would indicate much higher royalties than are currently being collected. On the other hand, the royalties must not extract the rents from mineral exploration and development to the point where it is unattractive. The challenge is to develop incentives for mineral exploration and development, while at the same time capturing a large share of mineral rents such that environmental externalities are internalized and overexploitation is curbed (Garnaut 2010).

Similarly, deforestation policies can be improved, not so much by banning logging but by selection of logging concessionaires that obtain the highest present value from forest areas. On public forest lands, this can be done by charging logging royalties in accordance with the lost present value due to logging and auctioning the logging concessions.

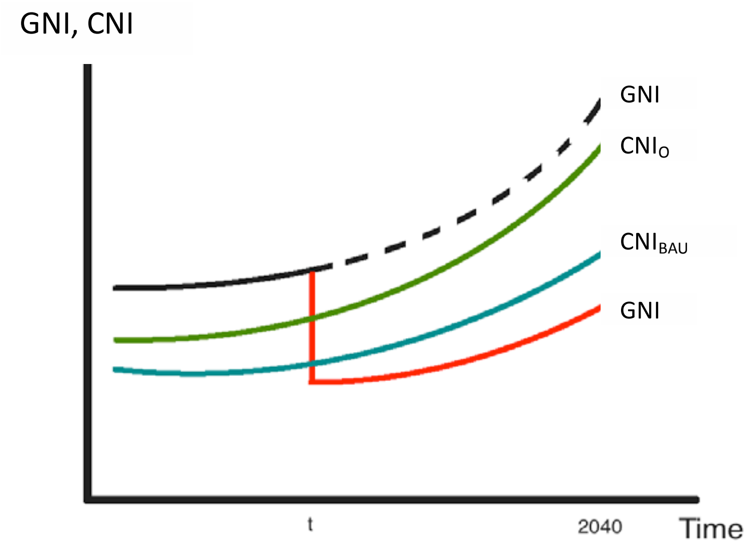
3. Natural Disasters and Policy Distortions Limit the Growth of Well-Being

3.1. Accounting for the likelihood of natural disasters

Due to the random occurrence of natural disasters such as typhoons, earthquakes, volcanic eruptions, tsunamis and other geological processes as well as the impact of climate change on rainfall patterns, rising sea levels and temperature, the importance of disaster preparedness and resiliency is becoming more crucial and could be a potential source of growth.

The theoretical construct underlying green accounting typically abstracts from uncertainty. Accordingly, GNI cannot measure the performance of a country's risk management. Before generalizing comprehensive welfare accounting to include uncertainty, it is useful to recall that GNI measures sustainable income – that hypothetical level of consumption that could be sustained into the future (Smulders 2008). Accordingly another name for GNI is *environmentally sustainable income*. By abstracting from the possibility of adverse shocks to the environomy, GNI overstates sustainable income. Just as GNI accounts for the extent to which falling stocks of natural capital reduce sustainable income (Weitzman and Lofgren 1997), we can account for the extent to which future adverse events reduce sustainable income as well. We call the resulting construct *Comprehensive National Income (CNI).* This is illustrated in Figure 6. As with GNI, CNI measures sustainable income. The difference is that CNI accounts for the possibilities of natural disasters and damages from climate change.

Figure 6: Comprehensive National Income (CNI)



The black (eventually dashed) line represents the projected growth of GNI, assuming that no disaster hits the country. The red line illustrates what happens to GNI when a disaster hits at time *t*. Since sustainable income has been overstated before the disaster hits, it suddenly records losses in physical and human capital and jumps downwards. In 2013, the impact of Yolanda alone amounts to Php 334 billion (in constant 2000 prices) in terms of damages and losses. This is almost 4.1% of National Income for that year.[10] This includes housing damages (PhP 190 billion), industry and services (PhP 68 billion) and infrastructure sectors (Php 20 billion). About 90% of these damage and losses hit the private sector. (Refer to Table A20 for a detailed breakdown).

Once we allow for the likelihood of natural disasters, sustainable income is considerably reduced, as illustrated by the business as usual CNI_{BAU} (blue line). There is no kink in CNI because sustainable income has already been reduced before the disaster hits. The green line represents a more optimistic scenario, CNI_O, wherein government takes cost effective precautionary and other risk managing measures that enable the economy to grow at a rate equal to, or even faster than the growth rate of GNI. In the business-as-usual scenario (CNI_{BAU}), the government only partially prepares for the disaster leading to a slower growth rate.

3.2. Managing disaster risk: the many levels of precaution and response

This leaves the question of how public policy can be designed to balance the available ex-ante and ex-post controls to maximize expected well-being, given the event distribution, with particular attention to natural disasters. The importance of managing disaster risk cannot be overemphasized. Investments in disaster preparedness have been shown to deliver very high rates of return. In a meta-analysis that compiles several case studies on disaster, Kelman and Shreve (2014) find that for every US$1 of investment in preparedness, US$3-30 worth of benefits (avoided damages) are obtained, depending on the nature of avoidance actions and the type of disaster or hazard.

Given the projected increase in both the occurrence and intensity of extreme natural events (Cinco et. al. 2013), improved institutional capability on disaster risk management is needed. The recent experience of natural disaster such as typhoons *Frank* (Fengshen) in 2008, *Ondoy* (Ketsana)

[10] NEDA (2013). Philippines' National Income for 2013 (in constant 2000 prices) was PhP 8,169 billion.

and *Pepeng* (Parma) in 2009, *Pablo* (Bopha) in 2012, and *Yolanda* (Haiyan) in 2013 have raised government and private sector awareness regarding the need for preparedness.

Disaster management in the Philippines dates from the 1930s. The lead agency then was the Civilian Emergency Administration (CEA), which was mandated to formulate and execute policies and plans for the protection and welfare of the civilian population under extraordinary and emergency conditions. CEA is the earliest precursor of what we know today as the National Disaster Risk Reduction and Management Council (NDRRMC). Republic Act 10121 of 2010 reconstituted the National Disaster Coordinating Council (NDCC) after more than three decades of its existence. NDRRMC is empowered with a mandate on policy-making, coordination, integration, supervision, monitoring and evaluation functions related to disaster risk management. The Secretary of the Department of National Defense is the Chair, the Secretaries of Department of Interior and Local Government (DILG), Department of Social Welfare and Development (DSWD), Department of Science and Technology (DOST), and Economic Planning Secretary/DG of the National and Economic Development Authority (NEDA) serve as Vice-Chairpersons.

NDRRMC was established after the Strategic National Action Plan (SNAP) on Disaster Risk Reduction (DRR) was formulated and Executive Order (EO) 888 was signed. SNAP provided a road map for sustaining disaster risk reduction initiatives in the country and promoting good practices of individuals, organizations, local government units and the private sector. Thru EO 888 and Administrative Order No. 1, local government units (LGUs) are mandated to adopt and use the DRR Guidelines. The experience from *Ondoy* and *Pepeng* provided the impetus to revisit and review the then existing set-up of disaster management in the country.

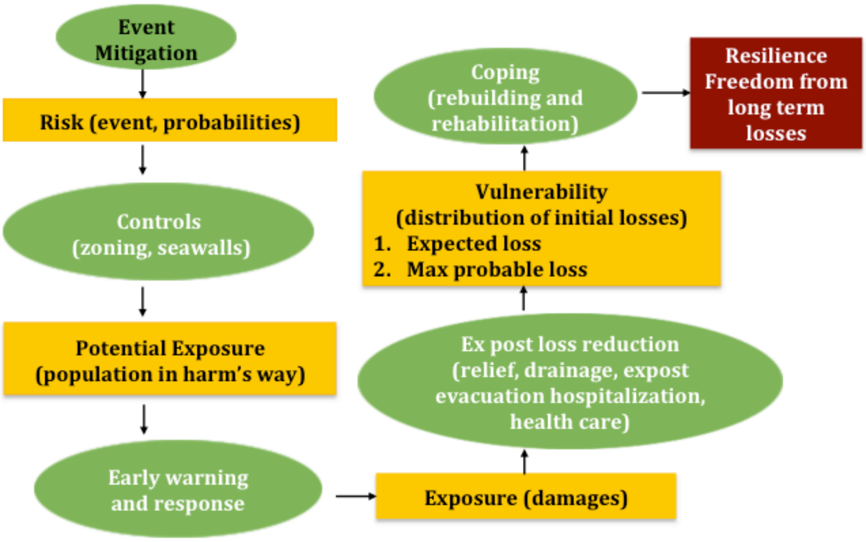
Prior to the formation of NDRRMC, RA 9729 of 2009 created the Climate Change Commission (CCC) with the mandate of coordinating, monitoring and evaluating government programs and action plans relating to climate change. The CCC has the status of a national government agency and is attached to the Office of the President. In principle, NDRRMC and the CCC have aligned their activities by harmonizing the Local Climate Change Action Plans and Local Disaster Risk Reduction Management Plans by the LGUs. As the coordinating agency, NEDA is tasked to build capacity among the local, regional, and national level government offices to integrate DRR in their respective plans. The Midterm Update of the Philippine Development Plan (PDP) 2011- 2016 (NEDA 2013) included spatial considerations in directing the focus of government interventions according to the following categories: 1) the number or magnitude of poor households in the province; 2) the provincial poverty incidence, or the proportion of poor individuals to the provincial population; 3) the province's vulnerability to natural disasters (floods and landslides, in particular).

Despite these institutional achievements, the country's ability to efficiently respond to disaster can be improved and is continually being tested by each disaster event. NDRRMC (2011) cited several constraints and issues that thwart efficient disaster management: 1) ineffective vertical and horizontal coordination among member agencies; 2) limited coverage by governmental and partner organizations due to resource constraints; 3) ineffective LGU capacities such as the lack of managerial and technical competencies; 4) limited funds, equipment and facilities for monitoring and early warning; 5) insufficient hazard and disaster risk data and information; 6) inadequate mainstreaming of disaster risk management in development planning and implementation; 7) poor enforcement of environmental management laws and other relevant regulations; and 8) inadequate socioeconomic and environmental management programs to reduce the vulnerability of marginalized communities.

Clearly, managing the risk of natural disaster is a complex job due to the nature of the disaster itself and the various stakeholders and actions involved in it. Improving national policies towards better disaster risk management requires a conceptual framework. We start with the illustration in Figure 7. The orange rectangles show the nature of the damage likelihoods before and after various actions have been taken. The green ovals illustrate the five levels of disaster management.

1. Mitigation, e.g. of climate change. (Inasmuch as earthquakes, volcanoes, and even climate change are largely exogenous to the Philippines, it may be appropriate to skip this step, except as a member of the community of nations.)
2. Ex-ante reduction of exposure (disaster prevention) includes risk and hazard mapping, rezoning, relocation of residences, public infrastructure (e.g., drainage and dikes), building strengthening (e.g., engineering design), education and awareness among communities, building capacity of DRR professionals and practitioners.
3. Early warning and response.
4. *Ex-post* loss reduction includes relief, timely information and communication, dredging, health care, relocation.
5. Coping is rebuilding, rehabilitation and recovery and the *ex-ante* financial preparation for same, e.g. through external or self-insurance.

Figure 7: Natural Disaster Risk Management Framework



Source: Ravago, Roumasset and Jandoc, 2015

In principle, if the likelihood distributions (orange rectangles) can be estimated for each configuration of actions (green ovals), then least-cost methods of achieving a particular resilience level can be computed. However, this task exceeds current administrative capabilities. In order to deliver improved disaster management that increases the growth rate of CNI, these modeling capabilities must be further developed. This is in line with the government's call for capacity building to strengthen statistical agencies, discussed further in part 3.

Table 2

	Levels of Disaster Management (Figure 7)	Thematic Areas (per NDRRMC Plan)	Responsible agencies (*Lead agency)
1	Event mitigation	Disaster prevention	
2	Ex-ante reduction of exposure	Harm mitigation	DOST*, DPWH, NEDA, OCD, DENR, DOF
3	Early warning and response	Disaster preparedness	DILG*, PAGASA, Project NOAH, Weather Philippines, PhilVocs, PIA, OCD
4	Ex-post loss reduction	Disaster response	DSWD*, DOH, DOTC, CAAP, NGCP
5	Coping (rebuilding, rehabilitation & recovery)	Disaster rehabilitation & recovery	NEDA*, OCD, NHA, DPWH, DOH, DSWD

Table 2 provides a matrix of the levels of disaster management as illustrated in Figure 7 against the thematic areas as provided for in the NDRRMC plan, including National Disaster Response Plan. The table also shows the government agencies in charge of the various thematic areas.

In the past three years, the country has made significant strides in terms of utilizing scientific knowledge in the delivery of early warning systems. The DOST's Project Nationwide Operational Assessment of Hazards (NOAH), have developed state-of-the-arts geo-hazard vulnerability maps and raised the level of awareness among the Filipinos. DOST's PAGASA has also upgraded its equipment in the last five years, enabling them to provide real time typhoon alerts and weather updates, thereby promoting improved disaster management.

Moving forward, the country and its multilateral partners are capitalizing on the experience and lessons learned from Typhoon *Yolanda* (Haiyan) in 2013. The extensive damage challenged capabilities for rebuilding, rehabilitation, recovery, and coordination. The government's commitment[11] is key to the sustainability of relief and rebuilding efforts inasmuch as the process concomitantly builds the capacity of government to respond to future disasters. The outpouring of aid, both technical and financial, from local and international donors was critical but also underscored the importance of having a single government agency with overall authority to coordinate the various stakeholders.

The *Yolanda* experience also clarified the need for financial preparation. The Department of Finance (DoF) has developed a Disaster Risk Financing and Insurance Strategy (DOF 2015) consisting of various financial instruments targeted at national, local, and household levels, with a view of reducing the impact of disasters on the poorest and most vulnerable sectors of the society. At the national level, $400Mn of Stand-by Emergency Credit for Urgent Recovery was put in place by the Japan International Cooperation Agency in 2015. Catastrophe bonds are also being considered. At the local government level, pilot projects for provincial government catastrophe insurance and city disaster-risk financing are being tested. At the household level, a potential residential disaster insurance pool is being studied.

In order to sustain the gains achieved thus far, further enhancement of disaster management capabilities, including at the local government level is needed. In particular, modeling

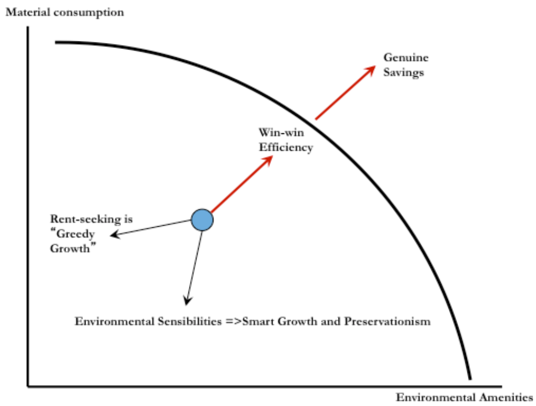
[11] The National Economic and Development Authority (NEDA) was tasked to prepare two planning documents for Reconstruction Assistance on Yolanda (RAY). The first was "Build Back Better," which provided initial estimates of the overall damage and loss caused by Yolanda (NEDA 2013). The second was "Implementation for Results," which presents an overall results framework for monitoring progress consistent with the Philippine Development Plan (NEDA 2015).

capabilities on the likelihood distributions for various configurations of actions as illustrated in Figure 7 will promote better disaster risk reduction and management and contribute to the growth of national well-being.

3.3. Policy Reform as a Source of Growth

The outer frontier in Figure 8 illustrates the feasible possibilities for producing material goods and environmental amenities. However all economies suffer from inevitable inefficiencies due to policy distortions and operate at some point inside the frontier as shown. The good news is that "greedy growth," the strategy of advancing the slice of the economic pie for special interests at the expense of both the environment and the general public is not necessary. Nor is extreme environmental protectionism that puts resources off limits and accordingly precludes and important source of growth. Instead, by removing policy distortions, it is possible to move in a "win-win" direction and improve both material consumption and environmental amenities (Ravago et al. 2010).

Figure 8



Source: Ravago, et al., 2010

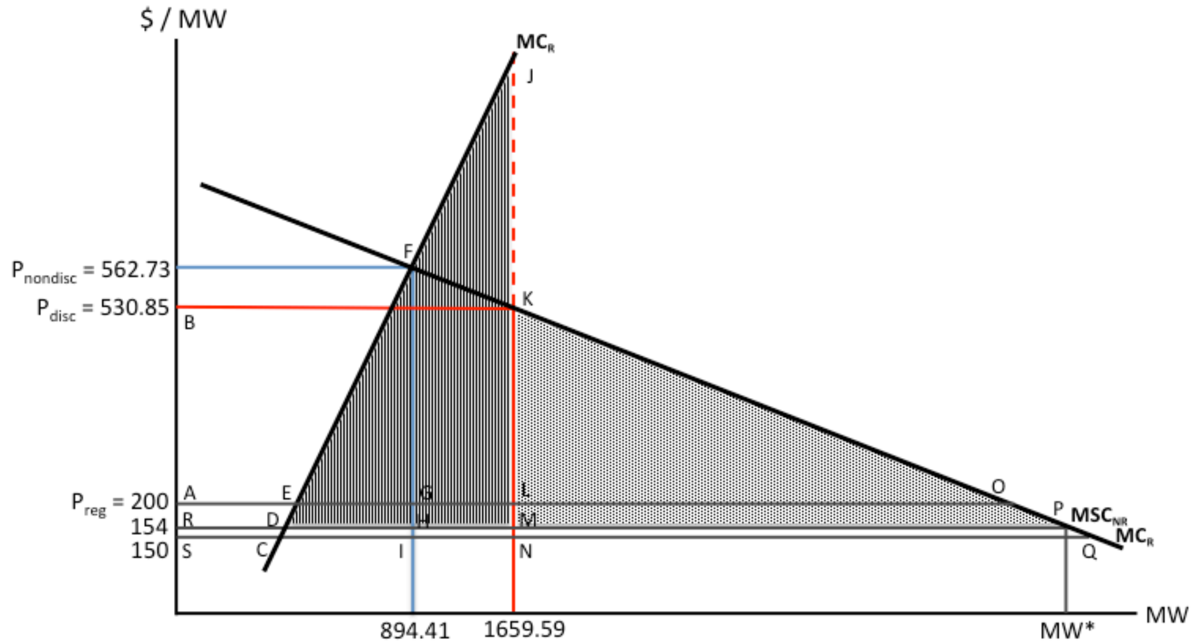
Conventional economics emphasizes moving the frontier out by increases in produced and human capital (learning). As discussed in the previous section, the correct measure of total capital accumulation is *genuine savings*, which nets out resource depletion and environmental degradation as well as conventional depreciation. Unfortunately, economic theory tells us that the growth rate of per capita income in a closed economy converges to the growth rate of technological change. Inasmuch as 2% is considered as a rapid rate of technological change, convergence theory suggests that a per capital income growth rate of 5% (considered elsewhere in the 2040 Visioning Report) is unattainable in the long run. Fortunately, convergence theory leaves out two important sources of growth (in addition to the prospects for improved environmental and disaster management discussed above). First, since the Philippine economy is an open one, domestic savings can be supplemented by foreign investment as a source of capital growth. Second (and the concern of this section) sustained efficiency improvements can be a source of growth, as the economy moves from the interior point in figure 8 to a point closer to the frontier.

One source of efficiency gains is distortions and unnecessary frictions inhibiting international trade, such as NFA restrictions on grain trade (e.g. Clarete 2008). Similarly, removing policies that inhibit mutually beneficial exchanges in the domestic market, such as restrictions on land sales, can increase efficiency (Fabella 2014). An example of a distortion in energy policy that is currently inhibiting welfare growth is the policy of subsidizing renewable sources of power generation through a feed-in-tariff (FIT), discussed in the following section.

3.4. Stimulating renewable energy: high cost vs. efficient methods

As a dramatic illustration of how well-intentioned policies can reduce efficiency and welfare, suppose that the Renewable Energy Act of 2008 were further strengthened so as to mandate that all power in the Philippines were generated from renewable sources. Figure 9 provides an illustration of how policy distortions shrink the economy in the context of subsidizing renewables. Electricity can be produced by a non-renewable fuel (coal) or by renewable sources such as wind and solar. The marginal cost of non-renewably-sourced power, MC_{NR}, is based on the import price of coal. The higher marginal social cost of the non-renewable power, MSC_{NR}, is due to carbon and other emissions from burning coal. The cost of renewably-sourced power, MC_{NR}, is rising, largely because of the differential suitability of different locations. The optimal solution in this case is at MW*where the demand, D, intersects MSC_{NR}, which can be simply achieved by setting an emission tax equal to the difference between MSC_{NR} and MC_{NR}. Suppose the policy is instead to displace all non-renewable power with renewable power. This can be done setting a uniform FIT price equal the price that equates demand with renewable supply, minus MC_{NR}. This is the non-discriminating price, $P_{nondisc}$, in the figure.

Figure 9: The Economic Cost (Waste) of a Feed-in-Tariff



Notes:
For a ***discriminatory*** monopsonist,

JMD: Additional Production Cost	= $ 1,712,328 / hour	
KMP: Lost Consumer Benefits	= $ 570,776 / hour	
Total Economic Waste	= $2,283,104 / hour = $ 20 billion/year	

Demand as function of price: Q = 14400 – 24P
Supply as function of price: Q = -96 + 1.76P

Since setting a uniform FIT may have an unacceptable impact on prices, suppose that instead the regulatory authority acts as a perfectly discriminating monopsonist and pays every supplier the marginal cost. The perfectly discriminating monopsonist sets the price such that the revenue represented by the rectangle BKNS in Figure 9 just equals the subsidy outlays represented by the triangle JNS. The loss in consumer surplus by this perfectly discriminating monopsonist equals the area defined by the triangle KMP. Note that moving from a non-discriminating to a discriminating monopsony reduces the loss in consumer surplus from the triangle FHP to triangle KMP. However, doing so also increases the excess burden from the supply side from the area FHD to a larger triangle JMD. Thus, there is no ex-ante reason to prefer one over the other.

In order to illustrate the magnitude of these excess burdens from both consumer and producer sides, we undertake a numerical exercise that takes into account plausible numbers from the current electricity market. We assume that the elasticity of supply and demand at the currently observed points are 0.5 and 1.1, respectively. We assume that for a typical hour the demand for non-renewable energy at the regulated price of $200/MW is around 9,600MW and that the marginal cost of non-renewables is $150/MW.[12] The marginal social cost of non-renewables is assumed to be

[12] Assuming a marginal cost of around 7 cents/kWh for generation from coal (Meller and Marquadt, 2013). We then divided this by 45% since around 45% of the retail price is due to generation cost.

$4 more than marginal cost, reflecting damages from both carbon and sulfur dioxides.[13] With these assumptions, the excess burden on the producer side from a perfectly non-discriminating monopsonist (triangle FHD) is $147,015 for a typical hour (around $1.2 billion a year) while the excess burden from the consumer side (triangle FHP) is $2,004,750 for a typical hour (around $17 billion a year). These two excess burdens sum up to more than $18 billion in a year, which is around 6% of GDP for the Philippines in 2014.

The shaded areas of Figure 9 represent the economic costs (waste) of a perfectly discriminating monopsony. The excess burden from the producer's side is around $15 billion a year, while the excess burden on the consumer side is around $5 billion a year. The sum of these amounts equals roughly $20 billion, or 7% of GDP in 2014. Interestingly, the attempt to mitigate against the price increase, while decreasing the loss of demand-side excess burden, increases supply-side excess burden even more, due to the greater amount of power that must now be produced by renewables.

Since regulatory authorities are unable to act as discriminating monopsonists, however, the excess burden could well be more than 7%. Not knowing the costs of different types of renewable energy in different locations, the authorities tend to assign a uniform price to each type of renewable. This means, for example, that the higher subsidies for solar power will displace some amount of more cost effective wind power.

This exercise shows how moving toward a policy of energy self-sufficiency and 100% renewability can have a major downward effect on welfare and its growth rate. But moving in the opposite direction (toward lower subsidies) will have the opposite effect.

By facilitating an efficient transition to a greater reliance on renewable energy without the use of high-cost subsidies, policy reform can improve levels-of-living as indexed by sustainable income. Since there are inevitable forces that will tend to make national income growth slower than GDP (e.g. a declining growth rate of remittances as Philippine incomes increasingly converge towards those in developed countries), policy reforms as well as improvements in environmental and disaster management can assure that levels-of-living increase at the same or greater rate than GDP.

3.5 **Political economy and institutional reform**

It is one thing to articulate policies that can increase the growth of well-being and another thing to render those policies politically feasible. To the extent that reforms can be packaged as in approximately win-win combinations, their political feasibility is enhanced (Buchanan 1985). For example the opponents of a major mining deal will be less influential if the use of royalties paid to the government from that venture are transformed into expenditures that transparently promote the common good such as investments in education. Part of the royalties can also be invested into a Conservation Trust Fund such that residual environmental costs (after appropriate safeguards) are offset by commensurate environmental benefits.

Institutional reform is also needed to render efficiency enhancing policies effective. For example, management policies for public forest lands need to provide incentives for selection of concessionaires that will maximize the long run value of the resource (including carbon

[13] The difference between the marginal cost of electricity and its marginal social cost is the marginal damage cost. The marginal cost to the Philippines of an additional unit of global carbon was taken as double the share of the Philippines in world population times the world social cost of carbon. (See Gayer and Viscusi 2014 on the necessity of using the domestic as opposed the global cost of carbon). The cost of particulate matter and sulfur dioxide from producing electricity from coal was taken to be twice the social cost of carbon.

sequestration and ecosystem services). This can be done with the combination auctions for selection of concessionaires, royalty assessments on the basis of lost present value from harvesting, payments for ecosystem services, and performance bonds for enforcement against excess depletion. While marine resource management has already been devolved to local government, technical and financial assistance from national government are needed to for determination of optimal catch rates, enforcement, and assessment of governance mechanisms such as individual transferable quotas.

At the present time, further conclusions regarding these higher levels of analysis are unwarranted. Institutional design and political feasibility are components of the economics of the second and third best (Roumasset 2015). While there are some broad principles that can be further developed and applied, e.g. regarding the comparative advantage of national and local governments (Roumasset 1989; 1997), these only become useful once the more fundamental first-best policies have been articulated as discussed above. For example, one cannot meaningfully propose to "transform" mineral royalties into human capital and conservation accounts, without first determining what percentage of the *in situ* resource price (net of extraction costs) should be paid in royalties.[14]

4. Sustainable Development and the U.N. Sustainable Development Goals

The Philippines has very recently acceded in principle to the United Nations' 2030 Agenda.[15] Part of the Agenda's aims is to "protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations."[16] As a testament to this focus, out of the 17 goals embodied in the Agenda, 9 are specific to climate change, the environment and disaster management.[17]

By themselves, these goals do not provide a guide for formulating public policy. As shown in section 2, some of the goals may be in conflict with others. In other cases, prioritization among goals remains ambiguous. The main challenge for the Philippine government is to interpret and operationalize these goals for environmental protection, disaster-risk mitigation, and climate change policies in ways that do not contradict the primary government responsibility of promoting the common good as provided for in the 1987 constitution. The government has already signified its intention to achieve some of these goals, for instance, in its Intended Nationally Determined

[14] The proposition that government should specify how resource royalties shall be *transformed* into productive investments derives from the now-defunct Hartwick rule that resource depletion should be governed by the Hotelling principle and that resource royalties should be reinvested in capital formation in order to sustain consumption levels indefinitely. We know now that optimal resource depletion and capital accumulation should be governed by separate equations (Endress et al. 2005).

[15] See, for instance, the Philippine Statement at the UN Summit for the Adoption of the 2030 Agenda for Sustainable Development.

[16] https://sustainabledevelopment.un.org/post2015/transformingourworld

[17] These goals are namely: ensure availability and sustainable management of water and sanitation for all (Goal 6); ensure access to affordable, reliable, sustainable and modern energy for all (Goal 7); promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (Goal 8); build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (Goal 9); ensure sustainable consumption and production patterns (Goal 12); take urgent action to combat climate change and its impacts (Goal 13); conserve and sustainably use the oceans, seas and marine resources for sustainable development (Goal 14); protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (Goal 15); strengthen the means of implementation and revitalize the global partnership for sustainable development (Goal 17).

Contributions (ROP 2015) to the United Nations Framework Convention on Climate Change (UNFCCC). The Philippine government has committed to prioritize investments that will contribute to disaster adaptation, mitigation of associated risks, and even to global efforts towards mitigating climate change. [18] The government has prioritized adaptation over mitigation of climate change, noting that mitigation can be a function of adaptation. For example, adaptation investments that improve the robustness of forest and marine ecosystems will also sequester carbon from the atmosphere, thereby aiding global mitigation.

In the same document, the Philippine government has recognized that the country should not drastically sacrifice the common good and only contribute "its fair share in global climate action."[19] This means that climate mitigation efforts that do not result from adaptation efforts must emanate from global agreements, and, in order that Philippine efforts do not undermine its own development goals, that reduction of greenhouse gas emissions in the Philippines be aided by financial and technical assistance from developed countries.

However, the problem in public policy formulation in many countries, as well as in the Philippines, emanates from the plethora of ill-defined and often contradictory objectives. For example, policies regarding farmer and food security, land reform, electricity, and disaster management, include the objectives of sustainability, self-sufficiency, renewability, affordability, reliability, inclusivity, security, and resiliency. Inasmuch as each of these objectives may subtract from others, the pursuit of too many objectives is likely to lead to a *mission impossible*. Goal 7 for example calls for ensuring "access to affordable, reliable, sustainable and modern energy for all." And Goal 13 requires taking "urgent action to combat climate change and its impacts". Advocates of renewable energy may interpret these goals as requiring subsidies of renewable energy to reduce carbon emissions from fossil fuels. These subsidies, however, make electricity more expensive, creating a contradiction between the goals of affordability and sustainability (see discussion of FIT in the previous section).

Moving forward, the key is to find ways to reconcile these goals without sacrificing the common good. For instance, in the context of the affordability vs. sustainability paradox, there can be ways to reduce carbon emission without increasing the price of electricity through renewable subsidies. For instance, a carbon (along with other emissions) tax that is commensurate with the damage those emissions to the Philippines can be implemented.[20] Compared to the high economic costs of subsidized FIT rates, we compute the carbon tax just to be around 2.5% of current electricity rates. Even if damages of carbon emissions and correlated air pollution in the Philippines were 4% of worldwide carbon damages,[21] the Philippines should only pay 4% of the global social cost of carbon, estimated at \$88/MT, i.e. \$3.52/MT, absent a global agreement.[22] Since a Megawatt of electricity requires 1.43 tons of CO_2, the tax per megawatt is should be around \$5/MW (3.52 x 1.43). This is only 2.5% of the current price of around \$200/MW. Hence, there can be alternative policies that

[18] As contained in the document "REPUBLIC OF THE PHILIPPINES: Intended Nationally Determined Contributions Communicated to the UNFCCC on October 2015". Although the unilateral commitment to reduce GHG emissions by 70% in 2030 relative to the business-as-usual scenario seems to be excessive and beyond any conceivable notion of the country's "fair share" in GHG emissions.
[19] Per the INDC. Although the unilateral commitment to reduce GHG emissions by 70% in 2030 relative to the business-as-usual scenario seems to be excessive and beyond any conceivable notion of the country's "fair share" in GHG emissions.
[20] If the implementation of the carbon tax is part of a global coalition, then the tax should be commensurate to the damages contributed by the country to that coalition.
[21]This is generous since this number (4%) is more than twice the share of Philippine to World population (around 1.4%) or the proportion of Philippine GDP to World GDP (less than 1%).
[22] Even with a global agreement, a carbon tax should be proportionately less than the share of the global coalition in world GDP (Nordhaus 2014).

could achieve the same goal of reducing emissions without increasing the price of electricity too much.

5. Conclusions

Other reports in this compendium have targeted 7% growth in GDP to meet Philippine aspirations. Inasmuch as GDP does not serve as an index of well-being, what needs to be done so that comprehensive national income also grows at 7%? First, note that a robust economy will reduce the extent of net out-migration and retard the growth of remittances. This force will tend to make national income, and therefore GNI, grow more slowly than GDP. In order to offset this negative force, total environmental degradation and the depletion of natural capital (TDD) must decline as a percentage of NI. Even a partial accounting of depletion and degradation shows that GNI is almost 6% less than national income. Gradually reducing this rate towards zero in the optimistic scenario thus becomes a source of growth. For example, if the true depletion and degradation is 8% of national income, reducing TDD to .6 by 2040 would add an average of almost a third of a percent to the growth rate of well-being. This would be enough to offset the declining growth rate of remittances inasmuch as remittances are also about 8% of GNI. On the other hand, if TDD were to worsen, it may make attaining a 7% growth of well-being unattainable.

The prospect of natural disasters and economic policy distortions can be accounted for in the same spirit. Less than optimal risk management and economic policies are reducing our welfare index below its potential. Improving risk management and resiliency policies can similarly increase the growth rate of national well-being (as measured by CNI), as the economy moves closer to its potential.

Likewise, the removal of policy distortions is a potential source of economic growth. For example the replacement of distortionary subsidies of renewable energy with the correct economic instrument can move the economy closer to the economic frontier and thereby increase the growth rate of well-being.

In the case of resource management, the challenge is to maximize the present value of existing resource stocks by policies that incentivize resource extraction and harvesting at efficient levels. Inasmuch as existing forest stocks are below efficient levels, this requires improved governance to reverse deforestation not only by reforesting prospective forestlands but by incentivizing the sustainable use of existing forest stocks. Similarly, existing laws that grant local governments control over municipal-level fisheries can be complemented by national assistance in enforcing fishing regulations, such as the establishment of catch quotas and allocations thereof. Mining policies should incentivize exploration through tax incentives at the same time that royalty charges prevent excessive extraction. In the case of pollution, the key is to face firms with the full costs of their production, e.g. through emission taxes and/or cap and trade systems.

In summary, growing well-being at an average of 7% is a daunting task. It is unlikely to be achieved unless environmental-resource, resiliency, and other economic policies are reformed. In particular, since a falling growth rate of remittances will reduce the growth rate of comprehensive income, the size of TDD will need to fall so that a 7% increase in GDP will be consistent with a 7% increase in welfare. To the extent that risk-management is improved and policy constraints are relaxed, it is even possible for welfare to increase at 7% while GDP grows at a slightly slower rate. If they are not reformed, for example if pollution and congestion continue to worsen, the goal of 7% welfare growth may not be feasible.

Inasmuch as "what gets measured gets managed" (Heal 2012), there is a pronounced need to improve the capability to measure green and comprehensive national income (GNI and CNI) as described in sections 1 and 2. Fortunately the Philippine government is already committed to strengthening of statistical agencies and improved institutional capability for official statistics to be more disaggregated, frequent, timely, and accessible (Balisacan, 2015) and for climate change modeling and damage assessment (ROP, 2015).

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Appendix 1: The History of Green Accounting in the Philippines

A1.1 The *Environment and Natural Resources Accounting Project (ENRAP)*

In 1991, ENRAP was handled by the Department of Environment and Natural Resources (DENR) and funded by United States Agency for International Development (USAID). ENRAP aspired to follow the "Peskin approach" which is said to follow economic theory (Hecht, 2000). The objective was to provide estimates of natural capital depreciation for forest and mineral resources.

ENRAP, being the first initiative measuring natural capital depreciation in the Philippines, focused on forest and mineral asset accounts, costs of preventing pollution, costs imposed by pollution, and valuing non-marketed household use of the environment (Hecht, 2000).[23] The environmental accounts produced by this study could in principle be used to adjust net domestic product so that natural capital depreciation is treated consistently with the depreciation of produced capital (plant and equipment). Unlike the SEEA approach that adopts the SNA's conventional definitions of productive sectors, ENRAP explicitly recognized "nature" as a separate productive economic sector. Estimated shadow prices were used to approximate the monetary value of the expected goods and services produced by non-marketed services from "nature." Examples of these non-marketed services include waste disposal services, pollution, and recreation and aesthetic services (Peskin and de los Angeles, 2001). ENRAP was hampered by data constraints and unable to produce reliable policy implications (Hecht, 2000).

A1.2 *Integrated Environmental Management for Sustainable Development- Environment and Natural Resources Accounting (IEMSD – ENRA)*

In 1995, this subsequent green accounting initiative began implementing the UN System of Integrated Environmental and Economic Accounting (SEEA) framework. The project was headed by National Statistical Coordination Board (NSCB)[24] and received financial support and technical assistance from UN for the accounting work (Hecht, 2000). This effort on green GDP concentrated on developing accounts for environmental assets measured in physical and monetary terms.[25] The accounts considered adjustments relating to depletion, defensive expenditures and degradation (Virola and Lopez-Dee, 2005).

The resulting IEMSD-ENRA project built resource accounts for minerals, fishery, forestry and soil, and estimated costs of preventing air and water pollution. NSCB statisticians working on this project expressed reluctance to publish preliminary calculations of SEEA's Environmentally Adjusted NDP (EDP) as official statistics, unconvinced that such aggregates are meaningful indicators. Nevertheless, the results were still published and spread to various government agencies involved with the project. (Refer to Table A1 and Figure A1 below.)

NSCB used two concepts in extending net domestic product (NDP). Depletion and degradation costs, taken from physical asset and emission accounts compiled by NSCB, were used to compute for EDP. EDP is adjusted NDP after deducting the estimated resource depletion and environmental degradation costs of soil erosion and air/water pollution from the conventional NDP.[26] Due to data limitations, resource depletion only covered water resources (groundwater and

[23] Refer to Table A18 in Appendix 3 for a list of various phases of ENRAP.
[24] NSCB is now part of the Philippine Statistics Authority (PSA), which consolidated the various statistical agencies of the Philippines since 2013.
[25] For a detailed comparison of Peskin and SEEA framework, refer to Table A17 in Appendix 3.
[26] Degradation to water includes nitrogen loading of and nutrient loss from off-site erosion, biological oxygen demand, suspended solids, nitrogen and phosphates. Air emissions include particulate matter, sulfur oxides

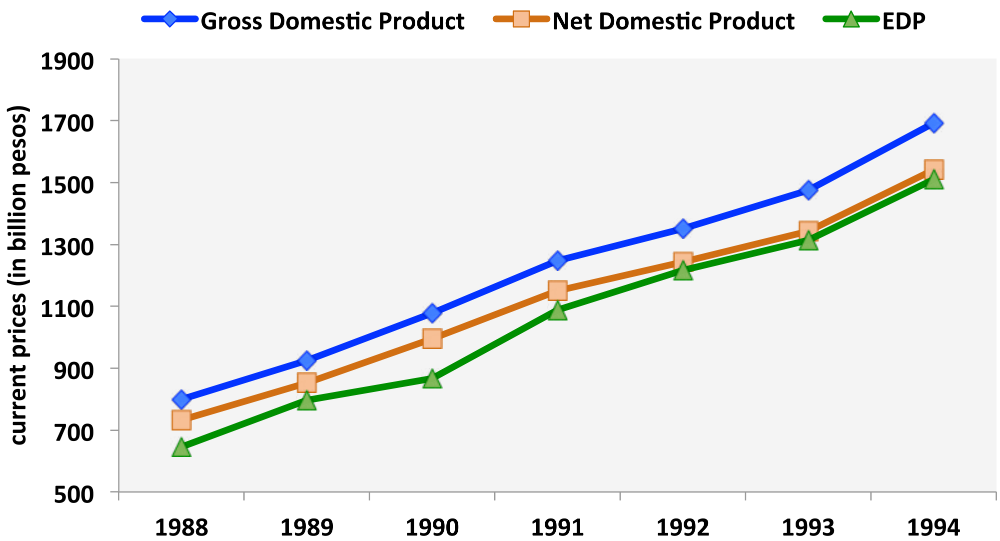
surface water). Water resource estimates for each region were used to derive the accounts at the national level. This account was used to measure depletion costs. Depletion was estimated as the difference between water volume that recharges the ground and surface water reservoirs and the volume of water withdrawn or pumped. The value of depletion is said to have been derived by applying the market price or estimated/imputed values the quantity of depletion (Virola and Lopez-Dee, 2005), but it is unclear where those prices or values came from. The correct method is to estimate a shadow price of water equal to the weighted average of the marginal benefits (e.g. revenue produced an extra unit of water) and the marginal user cost (e.g. the change in present value from a marginal unit of groundwater depletion). Monetary estimates for emission accounts were valued using defensive expenditures, including both treatment costs for air and water pollution and engineering structures (e.g. scrubbers for air pollution and walls or bench terraces to retard soil erosion). This underestimates pollution costs, however, inasmuch as the correct method adds defensive measures and residual pollution.[27] The results are shown below.

Table A1. Gross Domestic Product (GDP), Net Domestic Product (NDP) and Environmentally Adjusted NDP (EDP) at current prices in billion pesos. 1988 to 1994

Year	GDP	NDP		Depletion	Degradation	EDP	
		Level	GR (in %)			Level	GR (in %)
1988	799	732		81	6	644	
1989	925	853	16.5	50	7	796	23.5
1990	1,077	995	16.6	121	8	866	8.8
1991	1,248	1,150	15.6	52	9	1,089	25.8
1992	1,352	1,242	8.1	17	8	1,217	11.8
1993	1,474	1,343	8.1	18	11	1,314	8.0
1994	1,693	1,541	14.8	19	13	1,510	14.9
Annual Growth Rate			13.2				15.3

Source: National Statistical Coordination Board (1998) from Virola and Lopez-Dee, Table 3

Figure A1. Resource Kuznets Curve from ENRA Study (1988 to 1994)



Source: National Statistical Coordination Board, 1998

and nitrogen oxides among many others (Virola and Lopez-Dee, 2005). Soil erosion was regarded as "emissions" from upstream activities such as logging and the resulting land degradation was estimated as downstream losses such as sedimentation of irrigation facilities.

[27] Inasmuch as conventional accounts include them on the plus side of national income, defensive expenditures mush be subtracted twice in computing green national income (GNI).

Note: Only water resource asset accounts and emission accounts (land, air, water pollution) were included.

From Table A1 and Figure A1, we see that natural resource depletion (water) shows a sizable increase until 1990 and then a dramatic decrease until 1994. This beneficial turnaround evidences a "natural resource Kuznets Curve" (Roumasset et al. 2008, Jones 2014) and accounts for EDP growing faster than NDP from 1990 to 1994. (While environmental degradation is growing over the whole period, it is dominated by natural resource depletion.) However, NSCB provides no explanation for the value of water depletion declining from Php121 billion in 1990 to Php19 billion in 1994, however, and the estimate seems unreliable in light of the World Bank estimates to follow. The closeness of EDP and NDP by 1994 is similarly unreliable, inasmuch as depletion costs are based only on water and environmental degradation costs have been underestimated.[28] These observations indicate a need for a re-examination of methods for the incorporation of natural capital depletion and environmental degradation into standard national accounts.

A1.3 *ENRA II Project*

Following the end of ENRA's first phase was the launch of the second phase. The objective of the ENRA II Project was to institutionalize the Philippine Economic–Environmental and Natural Resources Accounting (PEENRA) System. Executive Order No. 406 was signed on March 1997 and provided the legal and institutional framework for establishing PEENRA units in National Economic Development Authority (NEDA), the DENR and the NSCB thus contributing to recognize environmental concerns in policy formulation, planning and decision-making (Virola and Lopez-Dee, 2005).[29]

A1.4. *Philippine Wealth Accounting and Valuation of Ecosystem Services* (*Phil-WAVES)*

Existing PEENRA units in NEDA, DENR and NSCB continue to work on updating, revising and expanding environmental indicators and accounts including land, mineral, water, forest and fishery. However, results of these accounting efforts have not been integrated to GDP accounts and have not produced green GDP accounts. Instead they aim to produce separate accounts of natural capital depletion. It is not known what efforts to measure pollution damages are ongoing.

A more recent effort on green accounting is the Phil-WAVES project, which began in 2012. It aims to provide national asset accounts for minerals and mangroves, as well as ecosystem services accounts based on studies from project sites in Southern Palawan and Laguna Lake employing the UN SEEA framework. Results of the study will be published in December 2015.

Inasmuch as all these measures are incomplete, Appendix 2 provides supplementary figures on both pollution and resource degradation.[30] These include both physical measures and economic costs (mortality and morbidity) of air pollution, water pollution and forestry.

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[28] Environmental analysis conducted by the World Bank and DENR show that pollution indicators have mostly grown worse over time.

[29] Refer to Table A19 in Appendix 3 for a list of PEENRA publications.

[30] These data were drawn mostly from the World Bank 2009 and the UNDP 2009 study.

Appendix 2: Other measures of environmental degradation and natural resource depletion

A2.1. Outdoor Air Pollution[31]

A2.1.1 Concentration levels

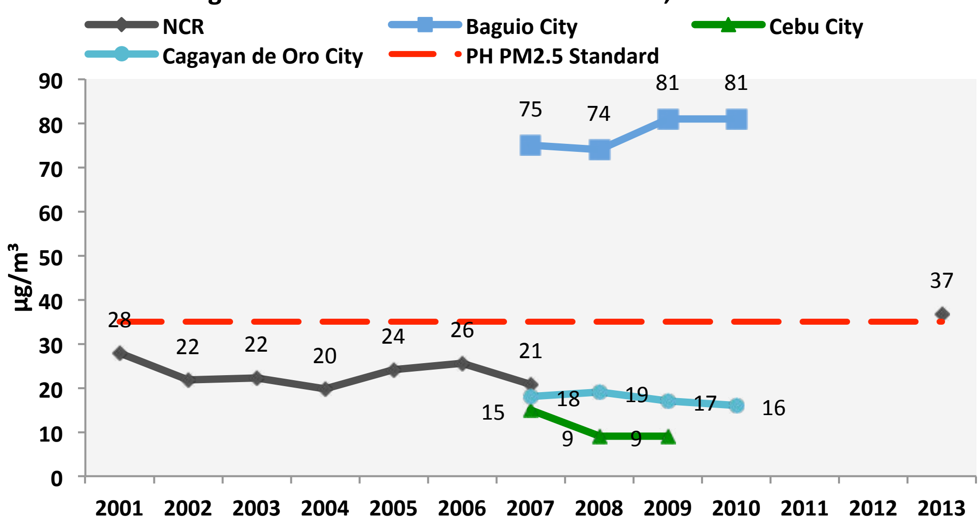
The main indicators for outdoor air pollution (OAP) can be classified into indicators of quantity (concentrations) and indicators relating to cost (mortality/morbidity). We focus on three pollutant types, namely: Particulate Matter 2.5 (PM 2.5), sulfur dioxide (SO2) and nitrogen dioxide (NO2) and identify observable trends in concentration levels.[32] The cost indicators can also be categorized into those that pertain to the number of people affected (e.g. incidence of disease, number of deaths) as well as the monetary value of these incidences.

Particulate Matter 2.5

The Philippine National Ambient Air Quality Guideline Value (NAAQGV) for $PM_{2.5}$ (particulate matter with 2.5 micrometers in diameter) is 35 µg/m³ annually.[33] Figure A2 shows extremely high $PM_{2.5}$ concentration in Baguio, which are way above the country's standards. We observe no clear trend in the $PM_{2.5}$ levels. However, there are slight improvements in Cebu and Cagayan de Oro starting 2007, while $PM_{2.5}$ levels in Baguio became worse in 2008. $PM_{2.5}$ levels have fallen from 2000-2004 in several sites across Metro Manila but worsened again in 2013 with a $PM_{2.5}$ concentration of 37 µg/m³.

A 2007 study on $PM_{2.5}$ levels in Baguio found that traffic intensity between 4:50am – 6:30am is a significant factor explaining the high concentration levels. The combination of pollution sources and the local topography make Baguio City's ambient air quality worse than that seen in most locations throughout the world (Cassidy *et.al.*, 2007). The main driver of outdoor air pollution is the rapid urbanization, transport and increasing expansion of manufacturing activities and industrial production in the country (Arcenas, 2009).

Figure A2. PM 2.5 Concentration Levels, 2001 - 2013



[31] For this section, data on morbidity and mortality costs were drawn from a 2009 World Bank study "The Philippines: Country Environmental Analysis". Data on pollutant concentration levels were taken from the Department of Environment and Natural Resources Compendium of Environment Statistics 2014.

[32] Findings from the DENR- National Air Quality Status Report 2014 regarding Total Suspended Particles (TSP), Carbon Monoxide (CO), Ozone (O_3) and Volatile Organic Compounds (VOC) were not included in this report. Instead we focus on three pollutants th health: $PM_{2.5}$, SO_2 and NO_2.

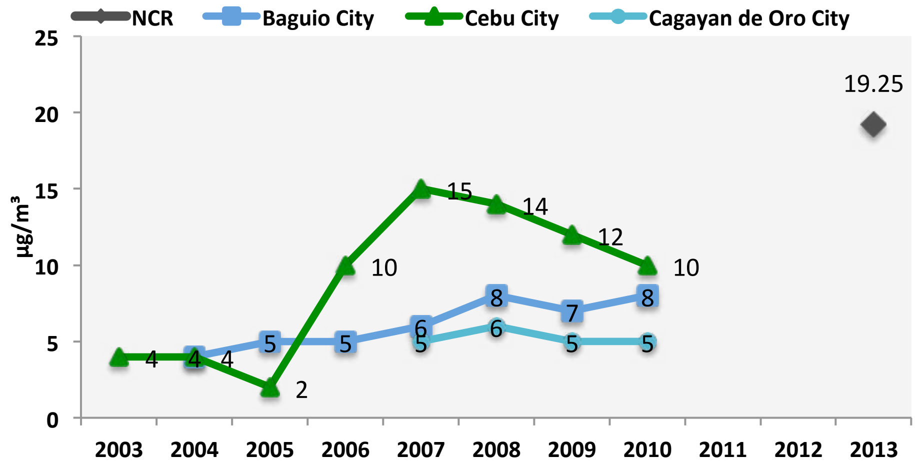
[33] Philippine Clean Air Act 1999, section 12.

Note: NCR value is the average value of PM2.5 values reported for all stations located in NCR
Source: Philippine Nuclear Research Institute (for NCR values 2001-2007) and EMB Compendium on Environmental Statistics 2014 (for NCR value in 2013 and all values for Baguio, Cebu, and Cagayan de Oro)

<u>Sulfur dioxide</u>

From 2006 onwards, SO_2 levels in Cebu are higher compared to Baguio and Cagayan de Oro. However, Figure A3 shows there was a steady decline of SO_2 concentration in Cebu from 2007 until 2010. The relatively higher SO_2 concentrations can be attributed to higher number of diesel vehicles burning sulfur-containing diesel fuels and industrial facilities that burned high sulfur (3%) fuel oil in these areas (EMB, 2004). In all stations, SO_2 levels are able to meet the Philippine NAAQGV standard of 80 μg/m³ annually.

Figure A3: Sulfur Dioxide Concentration Levels, 2003 - 2013

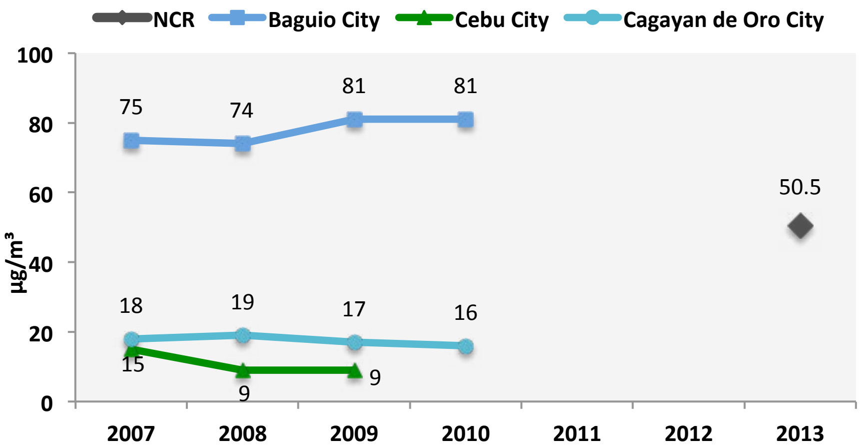


Source: EMB Compendium on Environmental Statistics 2014

<u>Nitrogen dioxide</u>

One major source of nitrogen dioxide comes from burning of fossil fuels: coal, oil and gas. Most of the NO_2 in cities comes from motor vehicle exhaust. Figure A4 shows high and increasing levels of NO2 in Baguio City ranging between 74 μg/m³ and 81 μg/m³ from 2007 to 2010. Within the same period, NO2 levels in Cebu and Cagayan de Oro showed a declining trend.

Figure A4: Nitrogen Dioxide Concentration Levels, 2007 - 2013



Source: EMB Compendium on Environmental Statistics 2014

A1.2 Economic Costs

Morbidity Costs

The Department of Health attributes almost 55% of morbidity cases to outdoor air pollution.[34] A 2009 World Bank study estimates that in 2003 more than a million people get sick every year due to outdoor air pollution in urban areas, with an associated morbidity cost of Php 950 million (in 2007 prices) per year. Of this amount, about half (Php 502 million) is accounted for by productivity loss (i.e., income and time loss due to absence from work and household activities). Personal costs for treatment of disease and government subsidies were 38% and 9% of total morbidity cost, respectively.

Table A2: Annual cost of Morbidity from OAP (2007 prices)

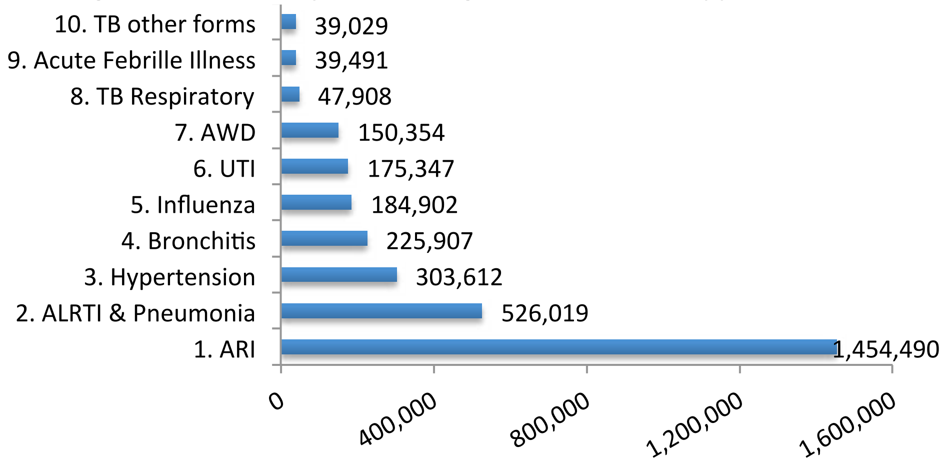
Morbidity Source	Annual Cases from OAP	Average Cost per Case (Php)	Total Annual Cost (Php million)
Acute bronchitis (children < 15 years)	623,523	486	303
Hospital admissions for respiratory disease			
Acute bronchitis (15+ years)	79	11,018	0.9
Other ALRI (all ages)	22,179	13,427	298
Respiratory symptoms (all ages)*	392,258	890	349
Total morbidity cost		**916**	**950**

*Non-hospitalized cases of ALRI (other than acute bronchitis)

Source: World Bank (2009), Table 2.3

In 2011, OAP-related diseases such as acute respiratory infection, ALRTI and pneumonia, bronchitis and TB respiratory continue to be on top of the leading causes of morbidity in the Philippines. (Refer to Figure A5)

Figure A5: Morbidity Ten Leading Causes in the Philippines, 2011



Source: Department of Health

Mortality Costs

It is estimated that a little over 15,000 people died in 2003 due to the main diseases linked to OAP (lung cancer and cardiopulmonary diseases). Depending on the estimation method, total annual cost of OAP-related premature mortality vary tremendously from HCA or VSL approach and

[34] Based on Table 2.1 of WB 2009 study, the attributable fraction values are as follows: acute bronchitis, under 15 (42%), hospital admissions for respiratory disease (2.6%) and occurrence of respiratory symptoms, all ages (11%).

ranges from about US$122 million (Php 5.5 billion) to more than US$1.6 billion (Php 75 billion pesos) per annum in 2007 prices (World Bank, 2009).[35]

Due to lack of sufficient studies on VSL in the Philippines, estimates of VSL from Mrozek and Taylor (2002) are applied. Mrozek and Taylor conclude that when "best practice" assumptions are invoked, a range of US$1.5-2.5 million can be reasonably deduced. Scaling down this estimate in proportion to income differences, we get a value of about US$105,000 (close to Php5 million) for the Philippines in 2007.

On the other hand, Cropper and Sahin (2009) estimate a VSL of US$110,000 for the Philippines in 2005 (based on PPP dollar GDP per capita differentials) using an income elasticity of 1.5 and a VSL of US$5.4 million in high-income countries from a study conducted by Kochi et. al (2006).

Table A3: Summary of Economic Costs of OAP

Cost (in million pesos)	Total Annual Cost for 2003, in 2007 prices
Morbidity	950
Mortality	
HCA (human capital approach)	5,500
VSL (value of statistical life)	74,800

Source: World Bank, 2009

A2. Indoor air pollution (IAP)[36]

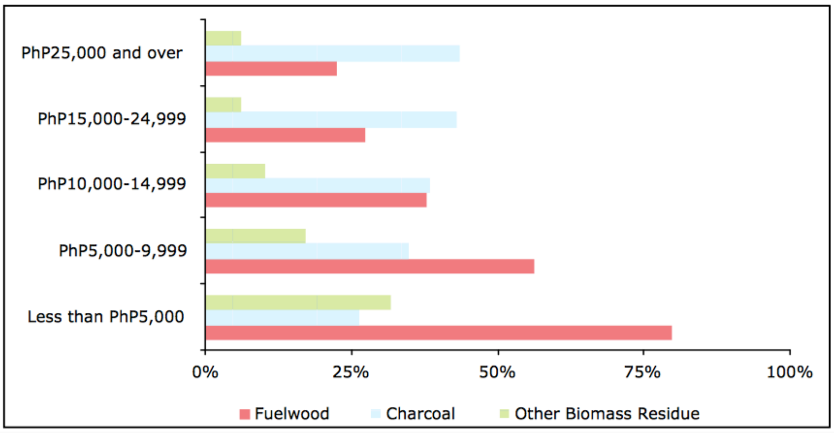
A2.1 Concentration Levels

There are no direct indicators for indoor air pollution available in recent literature. However, the amount of concentration of indoor air pollutants may be proxied by the number of households using solid fuel (fuelwood, charcoal and other biomass residue). Information of solid fuel use can be found in the Household Energy Consumption Survey (HECS). The use of solid fuel is skewed towards poorer households: 75% of poor households earning Php 5,000 a month use fuelwood while only 25% of households with higher income (earning Php 25,000 and over) use fuelwood (Refer to Figure A6). This suggests that solid fuel has negative income elasticity due to the substitution of other sources of energy. Providing electricity to a larger percentage of the population, especially in rural areas, is accordingly likely to be pro-poor.

[35] The Human Capital Approach or HCA provides a measure of value in terms of the individual's lost contribution to economic activity. The VSL or value of statistical life is measure by how much individual's willingness to pay to marginally reduce the risk of dying. (World Bank, 2009)

[36] Data used for IAP section was drawn from the World Bank 2009 study.

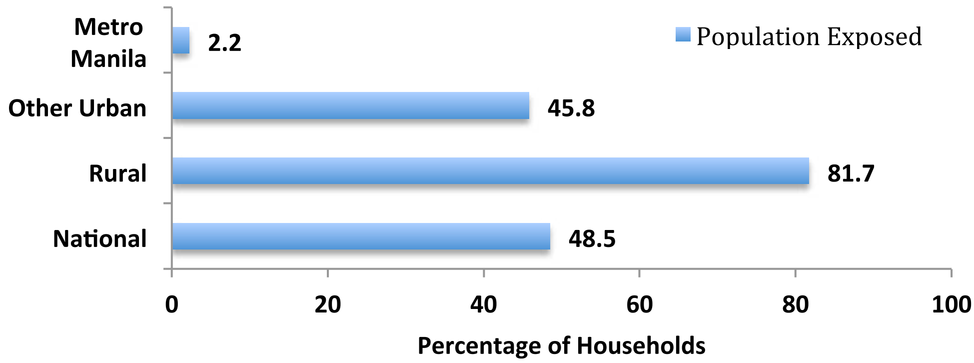
Figure A6: Household Use of Solid Fuel by Income Level, 2004



Source: World Bank (2009), Figure 3.1. Original data from HECS 2004

Figure A7 (from World Bank 2009) below shows that around half of the Philippine population is exposed to pollution caused by fuelwood or charcoal use. It is even higher in rural areas, where the rate of exposure is 82%.[37] Given the high damage costs, the cost effectiveness of reducing outdoor pollution should be compared with that of indoor pollution. Studies elsewhere show that, at current levels, reducing indoor pollution is several times more cost-effective (Roumasset and Smith 1990, Smith and Jantunen 2002).

Figure A7. Households Exposed to Indoor Air Pollution from Solid Fuels



Source: World Bank (2009). Original data from HECS 2004.

A2.2 Economic Costs

Morbidity Cost

Diseases linked to indoor air pollution include acute bronchitis, acute lower respiratory infection (ALRI) and pneumonia, chronic obstructive pulmonary diseases (COPD) and tuberculosis. Around 450,000 cases of these diseases are reported in 2003, with the bulk of cases occurring among the youngest age group (0-4 years).

The economic cost of morbidity associated with indoor air pollution is estimated to be around Php 1.5 billion annually, with 80% of the cost attributed to ALRI (refer to Table A4). The bulk of the cost is attributable to productivity losses.

[37] The same study estimates that ventilation reduces effective indoor pollution by 70% nationally. Nonetheless, damages are found to be high.

Table A4: Annual IAP-related Morbidity Costs (2007 prices)

Morbidity Source	Annual Cases from IAP	Average Cost per Case (PhP)	Total Annual Cost (PhP million)
Acute lower respiratory infections, children younger than 5	446,913	2,809	1,255
Chronic obstructive pulmonary diseases, women and men over 30	4,228	47,195	200
Tuberculosis, women and men over 15	6,631	13,577	90
Total morbidity cost			1,545

Source: World Bank (2009), Table 3.3

<u>*Mortality Cost*</u>

The major deadly IAP-related diseases include tuberculosis, lung cancer, pneumonia, acute bronchitis and COPD. In 2003, these diseases caused about 6,000 deaths with COPD, TB and pneumonia being the leading killers.

Table A5: Mortality Incidence due to IAP by Specific Age Group, 2003

Age	Respiratory Tuberculosis	Lung Cancer	Pneumonia	Acute Bronchitis	COPD
0-4	NC	NC	1,273	12	NC
5 to 14	NC	NC	NC	NC	NC
15 to 19	19	NC	NC	NC	NC
20 to 29	82	NC	NC	NC	NC
30 to 64	937	59	NC	NC	894
65 and older	707	60	NC	NC	1,725
Not Reported	2	0	NC	NC	1
Total	1,745	119	1,273	12	2,620

Source: World Bank (2009), Table 3.4

As with outdoor air pollution, the economic cost will vary depending on the computation methodology. This ranges from Php 4.6 billion (HCA approach) to around Php 28 billion pesos (VSL approach), as shown below.

Table A6: Annual Cost of IAP-related Premature Mortality (in 2007 prices)

Mortality Source	Annual Cases*	Average Cost per Case (PhP thousand)		Total Annual Cost (PhP million)	
		HCA	VSL	HCA	VSL
Acute lower respiratory infections, children younger than 5	1,286	2,050	4,867	2,635	6,257
Chronic obstructive pulmonary diseases, women and men over 30	2,620	291	4,867	764	12,752
Tuberculosis, women and men over 15	1,747	661	4,867	1,155	8,505
Lung cancer, women over 30	119	405	4,867	48	577
Total	5,771			4,602	28,090

* The average cost of mortality per case using the HCA varies in relation to age of death.

Source: World Bank (2009), Table 3.5

Table A7: Summary of Economic Costs of IAP

Cost (in million pesos)	Total Annual Cost for 2003, in 2007 prices
Morbidity	1,545
Mortality HCA (human capital approach) VSL (value of statistical life)	 4,602 28,090

Source: World Bank, 2009

A3. Water Pollution[38]

2.3.1 Water Quality Indicators

Fresh surface water

There are currently 19 priority rivers being monitored by the DENR regarding compliance to water quality standards. The major indicators being monitored include Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD). Of these 19 rivers, 13 conformed with DENR water quality criteria regarding DO but only 8 conformed with standards for BOD.

Table A8: Summary of DO and BOD Results for the 19 Priority Rivers, 2007

Region	Water Body	Class	Average DO (mg/L)		Average BOD (mg/L)	
			2007	Passed/Failed	2007	Passed/Failed
III	Meycauayan River	C	5.05	Passed	56.00	Failed
	Marilao River	A	5.39	Passed	21.17	Failed
	Bocaue River	C	5.78	Passed	8.83	Failed
IV-A	Imus River	C	5.16	Passed	10.13	Failed
	Ylang-ylang River	C	4.47	Failed	29.79	Failed
IV-B	Mogpog River	C	7.49	Passed	-	-
	Calapan River	C	3.86	Failed	5.88	Passed
V	Anayan River	D	5.92	Passed	3.85	Passed
	Malaguit River	C	6.56	Passed	2.73	Passed
	Panique River	C	7.08	Passed	1.05	Passed
VI	Iloilo River	C	5.36	Passed	3.64	Passed
VII	Luyang River	C	7.86	Passed	2.31	Passed
	Sapangdaku River	C	6.84	Passed	0.54	Passed
X	Cagayan de Oro River	A	8.27	Passed	4.00	Passed
CAR	Balili River	-	6.17	Passed	25.36	Failed
NCR	Marikina River	C	2.20	Failed	25.43	Failed
	San Juan River	C	1.63	Failed	40.42	Failed
	Paranaque River	C	1.39	Failed	39.90	Failed
	Pasig River	C	2.41	Failed	15.45	Failed

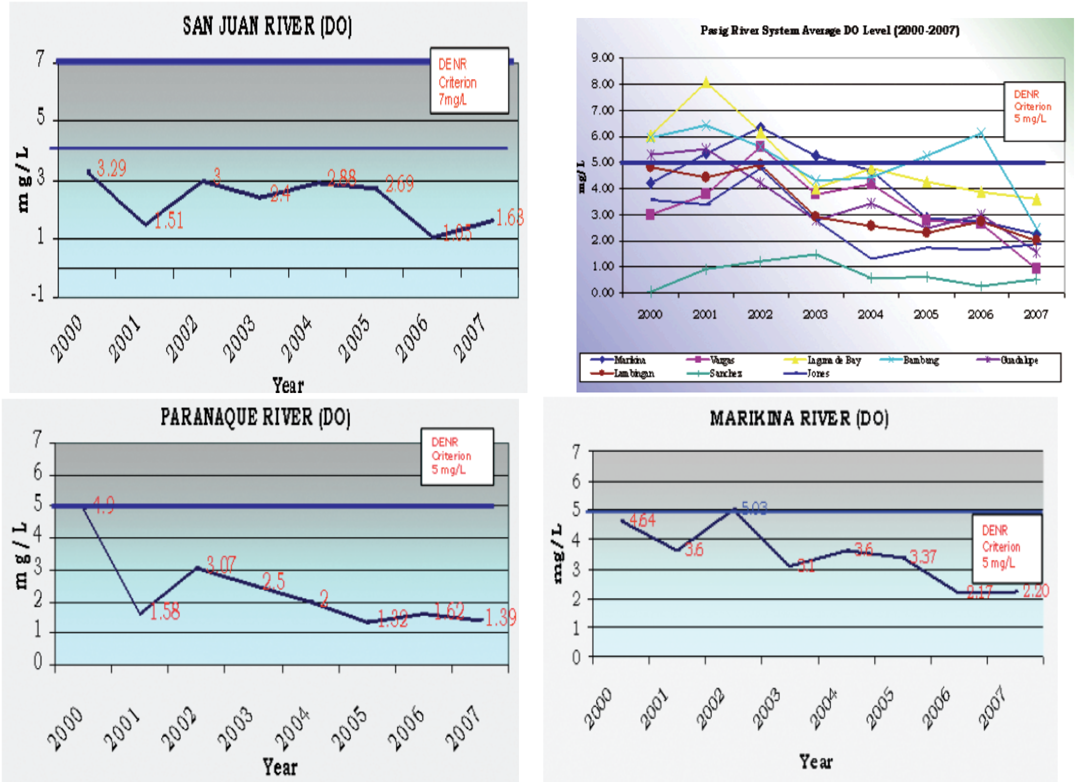
Source: EM-DENR (2009), Table 2-7

Note: According to the DENR AO 34(1990), DENR Water Quality Criteria for DO are as follows, in mg/L: for Class A (5); for Class C (5); for Class D (3). Meanwhile, for BOD, these are, in mg/L: for Class A (5); for Class C (7); for Class D (10).

[38] This section on water pollution uses data from the UNDP study (for water quality indicators) but uses costs indicators based from WB study.

For Metro Manila rivers, the quality is deteriorating over time. DO levels have been decreasing for these rivers from 2000 to 2007 according to data from DENR-EMB. The same story is true if we look at BOD levels, where we observe an increasing trend over the same period.

Figure A8. DO levels for different Metro Manila Rivers



Source: EMB-DENR (2009)

<u>*Marine Waters*</u>

Manila Bay is the major marine water body monitored in the UN (2009) study due to its economic significance. Quality indicators include bacteriological content (coliform counts), physico-chemical indicators (pH, oil and grease, ammonia, nitrates and other trace elements). Coliform data shows that Manila Bay fails the DENR water quality criteria. Over time, 8 out of 14 test sites showed improvement in total coliform content (Table A9).

Table A9: Geometric Mean of Total Coliform Counts (MPN/100 ml) in Manila Bay 2005- 2007

STATION	2005	2006	2007
1. Navotas Fishport	43682	43694	20068
2. Luneta Park	74086	62586	40552
3. Bacoor – Cavite	4426	1733	4878
4. Noveleta, Cavite 1	1834	9249	1055
5. Noveleta, Cavite 2	1593	2243	1174
6. Rosario, Cavite	17731		4914
7. Tanza, Cavite 1	28232	18400	9075
8. Tanza, Cavite 2	1863	3949	2635
9. Naic, Cavite 1	6184	2931	7510
10. Naic, Cavite 2	7621	2234	5779
11. Mariveles, Bataan 1	*490	*795	*517
12. Mariveles, Bataan 1	*737	3631	*634

13. Limay, Bataan 1	4106	23315	6268
14. Limay, Bataan 2	*674	11805	2865
DENR WQ CRITERION	***1000***	***1000***	***1000***

Source: EMB-DENR (2009), Table 2-10

Regarding physico-chemical indicators, Manila bay passed water quality criteria related to pH, oil and grease, and ammonia but failed in nitrates and orthophosphates. Over time, EMB-DENR (2009) showed that DO levels are deteriorating.

Table A10: Physico-chemical parameters

Parameters	Concentration Range	Criteria	Remarks
DO	0.05 – 6.6 mg/L	5 mg/L	Bottom Surface Passed/Failed
pH	7.03 – 8.06	6.0 – 8.5	Passed
Oil and grease	Nil – 3g mg/L	5 mg/L	Passed
Ammonia	Nil - .064 mg/L	0.07 mg/L	Passed
Nitrate	Nil - .107 mg/L	0.06 mg/L	Failed
Orthophosphate	.002 - .032 mg/L	0.015 mg/L	Failed

Source: EMB-DENR (2009), Table 2-10

A3.2 Economic Costs

Morbidity Cost

Diseases typically attributed to poor water quality, sanitation and hygiene include diarrhea, schistosomiasis, typhoid, paratyphoid, cholera, viral hepatitis (hepatitis A), and helminthiasis. In 2003, more than 33 million people fell ill with water-quality diseases, the bulk of which is accounted for by diarrhea.

Table A11 : Estimated Annual Cases of Illness from WSH, by Age, 2003

Age	Diarrhea	Cholera	Viral Hepatitis	Schistosomiasis	Typhoid and Paratyphoid Fever
0-4	19,456,631	477	2,405	1,230	9,480
5 to 14	6,125,743	349	7,649	17,114	20,045
15 to 19	264,366	41	2,216	4,889	6,113
20 to 29	433,304	67	3,631	8,010	10,018
30 to 64	6,567,969	142	6,603	17,788	17,675
65 and older	473,119	70	667	2,653	2,018
Total	33,321,133	1,144	23,172	51,684	65,439

Source: World Bank (2009), Table 4.3

The economic cost of morbidity associated with water quality is estimated to be around Php 21 billion annually, with around 97% of the cost attributed to diarrhea.

Table A12: Annual Cost of Morbidity from Poor Water Quality (in 2007 prices)

Morbidity Source	Annual Cases from WSH	Average Cost per Case (PhP)	Total Annual Cost (PhP million)
Diarrhea	33,321,133	605	20,172.3
Typhoid and Paratyphoid	65,349	4,511	294.8

Fever			
Schistosomiasis	51,684	3,092	159.8
Viral Hepatatis	23,172	3,632	84.2
Cholera	1,144	3,842	4.4
Total			20,715

Source: World Bank (2009), Table 4.4

Mortality Cost

The major deadly water quality-related diseases include diarrhea, typhoid, helminthiasis, viral hepatitis and cholera. In 2003, these diseases killed 11,000 children under 5 years old.

Table A13: Annual Cost of Mortality in Children under 5 from Poor Water Quality (in 2007 prices)

Mortality Source	Annual Cases*	Average Cost per Case (PhP thousand)		Total Annual Cost (PhP million)	
		HCA	VSL	HCA	VSL
Diarrhea	9,251	2,050	4,867	18,964	45,024
Typhoid and Parathyphoid Fever	1,023	2,050	4,867	2,097	4,978
Helminthiasis	247	2,050	4,867	506	1,201
Viral Hepatitis	25	2,050	4,867	52	124
Cholera	5	2,050	4,867	10	24
Sub-Total	10,550	2,050	4,867	21,628	51,351
Malnutrition-related deaths**	7,616	2,050	4,867	15,613	37,068
Total	18,166	2,050	4,867	37,241	88,419

* No deaths in children under 5 from schistosomiasis and filariasis were recorded/reported in 2003.

** ALRI, malaria, measles, protein energy malnutrition, and other infectious diseases (not including HIV).

Source: World Bank (2009), Table 4.5

For the rest of the population who are 5 years and older almost 4,000 deaths were reported, 75% of which were caused by diarrhea and typhoid (Table A14).

Table A14: Annual Cost of Mortality in Population Age 5 or Older from Poor Water Quality (in 2007 prices)

Mortality Source	Annual Cases	Average Cost per Case (PhP thousand)		Total Annual Cost (PhP million)	
		HCA*	VSL	HCA	VSL
Diarrhea	1,866	1,495	4,867	2,789	9,081
Typhoid and Parathyphoid Fever	1,147	1,572	4,867	1,802	5,581
Viral Hepatitis	418	1,195	4,867	500	2,034
Schistosomiasis	319	911	4,867	291	1,554
Helminthiasis	77	1,504	4,867	115	373
Cholera	22	1,172	4,867	26	107
Filariasis	8	973	4,867	8	38
Total	3,856	1,434	4,867	5,530	18,768

* The average cost of mortality per case using the HCA varies in relation to age of death.
Source: World Bank (2009), Table 4.6

The total economic costs for these deaths range from Php 42 billion to Php 107 billion, substantially higher than those related to air pollution.

Table A15: Summary of Economic Costs of WSH

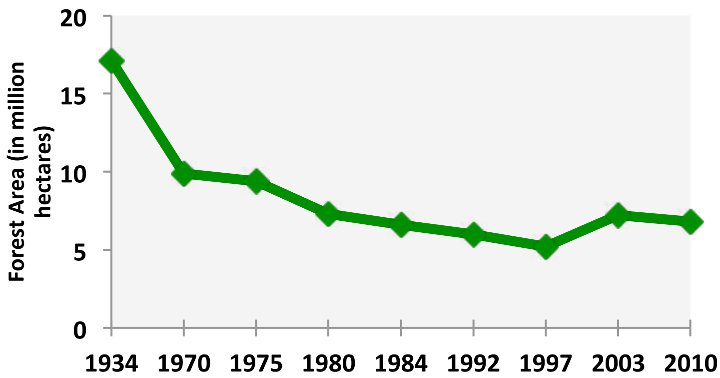
Cost (in million pesos)	Total Annual Cost for 2003, in 2007 prices
Morbidity	20,715
Mortality HCA (human capital approach) VSL (value of statistical life)	 42,771 107,187

Source: World Bank, 2009

A4. Forestry

Figure A9 shows rapid deforestation until 1970 followed by a reduced, but still substantial, deforestation rate until 2010. The apparent increase from the 1997 value was due to the re-definition of forest cover according to international conventions (Carandang 2008).

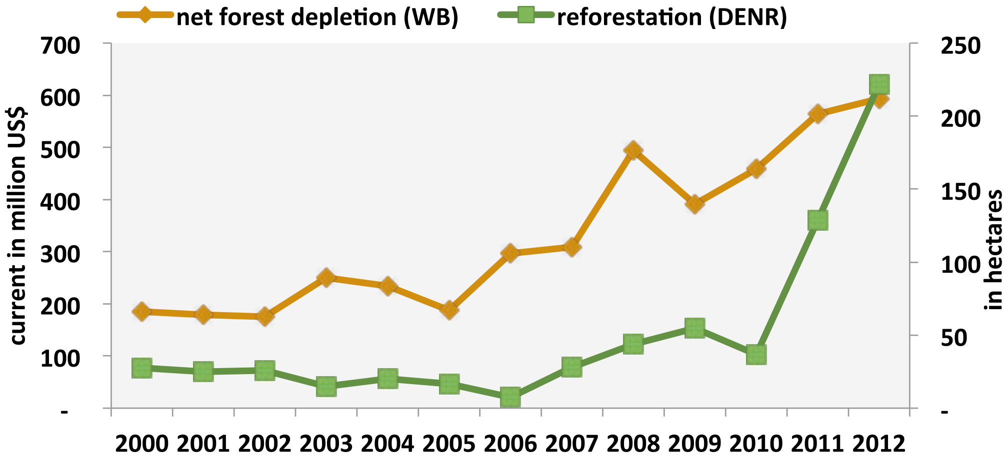
Figure A9: Philippine Forest Cover, 1934-2010



Source: Forest Management Bureau

Because of measurement difficulties, some of which originate in conceptual ambiguities, different estimates of resource depletion and environmental degradation sometimes appear to be in conflict. According to World Bank (2009), the rate of deforestation during 1990 to 2005 was about 2.2 percent annually, which is quite high compared to international rates. However, ENRAP (2000) found that forest depreciation switched to appreciation starting 1996. The reversal may have been because secondary forests were recovering from 1992 to 2003, even though old growth forests were still losing ground, albeit at a slower pace. These changes have been attributed to due to 1) the decreased use of forestlands for fuelwood extraction and 2) a shift from large-scale users of forest resources to small-scale community users (Carandang, 2008).

Figure A10: Net Forest Depletion and Reforestation (2000-2012)



Source: Forest Management Bureau and World Bank

Figure A10 gives another example of apparently conflicting accounts. The upper line shows the value of forest depletion, as computed by the World Bank, trending upwards from 2000-2012. The lower line shows a contrasting picture of a "massive reforestation" program by DENR. But the reforestation effort does not show up in the World Bank statistics even as a significant reduction in the rate of depletion, let alone reversing depletion. The correct method of environmental accounting calls for the present value of reforested areas to be subtracted from depletion. The reason this was not done was presumably because the present value was not known. The usual proxy for the benefits of public projects is their cost. But since the cost of reforestation has already been included in national income, it is likely the World Bank did not include it in forest depletion, inasmuch as those figures were intended to be used elsewhere in computing green national income. This illustrates another problem with green accounting. One convention is suitable where the accounts are meant to stand alone and another when they are meant for integration with conventional accounts.

The National Greening Program implemented by DENR in 2011 and 2012 largely contributed to the huge increase in total reforested areas.[39] (Refer to Table A16 and Figure A10)

Table A16: Total Reforested Area (in hectares), 2000 - 2012

	Government	Private
2000	21,740	5,892
2001	19,927	4,920
2002	20,681	4,939
2003	13,195	1,893
2004	12,436	7,902
2005	7,187	9,311
2006	4,476	2,747

	Government	Private
2007	25,024	2,813
2008	27,752	15,857
2009	53,842	950
2010	32,384	4,493
2011	128,539*	
2012	221,764*	

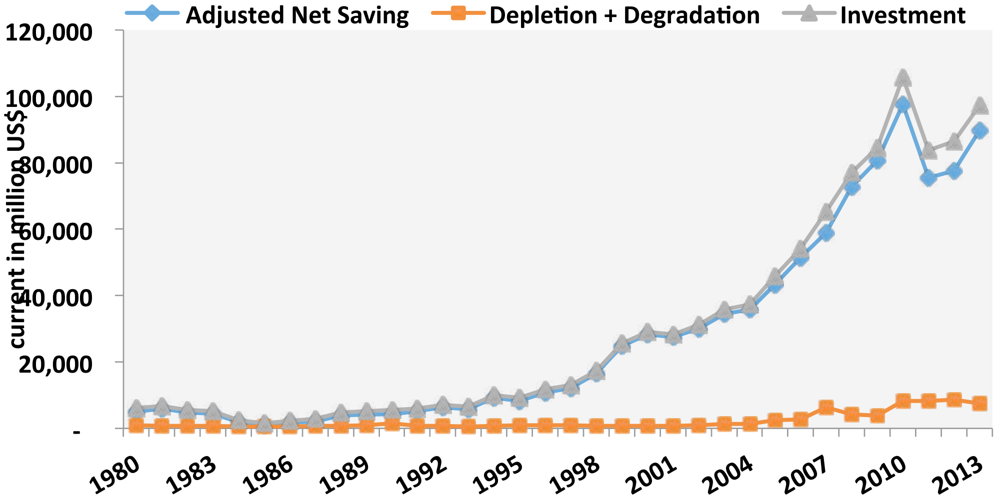
* National Greening Program (NGP) accomplishment involving DENR and other partners.
Source: Forest Management Bureau

A5: Is the Philippine Environomy Sustainable?

[39] The National Greening Program (NGP) is a massive forest rehabilitation program of the government established by virtue of Executive Order No. 26 issued on Feb. 24, 2011 by President Benigno S. Aquino III. It seeks to grow 1.5 billion trees in 1.5 million hectares nationwide within a period of six years, from 2011 to 2016.

The most commonly used measure of sustainability is *adjusted net savings*, i.e. conventional net investment minus total depletion and degradation. If that measure is positive, the economy is said to be on a sustainable path. As shown in Figure A11 the Philippine economy is highly sustainable by that measure inasmuch and conventional capital growth swamps TDD.

Figure A11: Net Investment Swamps Total Depletion and Degradation



Source: World Development Indicators, World Bank

Appendix 3:

Table A17: Comparison of Peskin and SEEA Framework (according to Peskin and de los Angeles, 2001)*

FACTOR	PESKIN'S/ENRAP	SEEA
1. Framework	Consists of a generic scheme that has been development and implemented outside the SNA	A satellite of the System of National Accounts (SNA) whose 1993 version has been accepted worldwide
2. Concepts and Definitions	Differ from SNA standards. For instance, on capital formation and accumulation, changes in assets from natural growth, discovery, disasters and price changes are lumped together in value changes even though they are not brought about by economic production – contrary to SNA conventions.	Consistent with SNA definitions and accounting principles. A clear distinction is made between the value changes in the assets that are due to production activities – which is depreciation, and those that are due to natural causes - which becomes part of "other volume changes" in the balance sheet. Note: Conventional indicators of capital, capital formation, value-added, net domestic product, income, saving, consumption, etc. in the SNA, will only be comparable to environmentally adjusted ones if the same SNA principles are applied to the newly introduced assets to the environment.
3. System Boundaries	Expands both the asset boundary (though without clear indication of where and when, beyond the SNA definition of 'economic assets"), and the production boundary. The latter is achieved by introducing a new economic agent, "nature". Nature generates outputs of environmental services and receives inputs of environmental damage.	Expands only the asset boundary by incorporating and clearly distinguishing non-produced economic and environmental assets from SNA's produced economic assets.
4. Valuation	Output of environmental services generated by nature, is valued at prevention and similar costs, and environmental damage is valued by contingent valuation and related valuations.	Different valuations are clearly distinguished (e.g. market valuation vs. maintenance costs) and applied to different "versions" of the SEEA. Note: Prevention costing is not directly comparable with damage valuation since current damage can be caused by environmental impacts (e.g. emissions) from previous accounting periods and from abroad. Similarly, current impact may generate damage in the future. Also, it is hardly possible to link unequivocally impact and effects (damage) at the national accounting level. Arbitrary assumptions have to be made about scope and coverage of impacts and effects, pathways and chemical reactions of pollutants, exposure of human and ultimate effects on health and welfare.

		Statements that “waste disposal services (at maintenance cost) exceed greatly pollution damage” (assessed by controversial contingent valuation) are thus very dangerous as they might encourage the reduction or abandonment of environmental protection at a time when some of the worst future (and possible irreversible) damage might still be avoided. Finally, mixing valuations might lead to double counting for economic and non-economic functions of the same natural assets (e.g. timber and flood control of forests).
5. Objective	Uses neoclassical equilibrium framework or welfare measurement	Extends the SNA to measure the interaction between the environment and economy with a view to assessing the sustainability of economic performance and growth. Note: Even if some “economists” are more concerned with welfare than with economic performance and growth, the fact is that national accounts provide the generally accepted indicators for decision making (policy) on the environment, notable from a “sustainability” (of both produced capital and non-produced natural capital point of view, environmentally adjusted and conventional indicators need to be compiled in a common, rigorously defined format which is without doubt the national accounts system. Deviations from this format or neglect of the standard economic indicators may be of limited interest (beyond ad- hoc analyses) and cannot be used for continuous monitoring of economy-environment interaction.

*Source: * Project Document – Environment and Natural Resources Accounting (ENRA) II: Institutionalization of the Philippine Economic-Environmental and Natural Resources Accounting (PEENRA) System. National Statistical Coordination Board*

Table A18. List of various phases of ENRAP

Period	Phase
January 1991– February 1992	Accounting for depletion of various forest resources and its effects on the SNA
December 1992 – March 1994	General accounting of environmental and natural resource activities
April 1994 – March 1996	Refined and updated the results and methodologies in previous phases. There is a higher degree of depreciation for renewable rather than non-renewable resources. Established a need for pollution management efforts
May 1996 – March 2000	Institutionalization and policy uses and applications of environmental accounts

Source: Based from Virola and Lopez-Dee, 2005

Table A19: List of Updated, Revised and Expanded Accounts (National)

Asset	Coverage
Land/Soil*	
Physical and Monetary Estimates for Agricultural Land Resource	1988 – 1998
Physical Estimates for Forest Land Resource	1988 – 1998
Mineral	
Physical and Monetary Estimates of Metallic Minerals Particularly Gold and Copper	1988 – 1996
Physical and Monetary Estimates of non-metallic minerals particularly Chromites	1988 – 1996
Physical and Monetary Estimates of non-metallic minerals particularly Coal.	1988 - 1998
Water**	
Physical Estimates of the Withdrawal (demand) of Water	1994 -1998
Forest	
Physical and Monetary Estimates of Rattan	1988 – 1998
Physical and Monetary Estimates of Plantation Forest	1988 – 1998
Fishery	
Physical Estimates of Marine Fishery Resources	1995 - 1999
Physical Estimates of Freshwater Fishery Resources	1988 - 1999
Activity Account	
Agriculture/Fishery	
Physical and Monetary Estimates for Poultry Industry (Chicken)	1988 -1998
Physical and Monetary Estimates for Upland Palay Farming	1995 - 1999
Physical and Monetary Estimates for Intensive Shrimp Aquaculture	1995 - 1999
Physical and Monetary Estimates for the Hog Industry	1995 - 1999
Energy/Electricity	
Physical Estimates of Coal Energy	1988 - 1998
Physical Estimates for Electricity Generation	1996 - 1998
Household	
Drafted List of Parameters, proposed Methodology and Framework	1988 - 1998
Manufacturing	
Physical and Monetary Estimates of Paint Industry Physical and Monetary Estimates of Tuna Industry	1994 - 1998
Physical and Monetary Estimates of Sugar Industry	1994 - 1998
Physical and Monetary Estimates of Cement Industry	1994 - 1998
Physical and Monetary Estimates of Petroleum Industry	1994 - 1998
Services Sector	
Government Services Environmental Protection Expenditures	1994 - 1998
Private Sector Environmental Protection Expenditures	1994 - 1998

* An updated version of the Land and Soil accounts was published in 2003 entitled State of the Philippine Land and Soil Resources.

** An updated version of the Water Accounts was published in 2003 entitled The Philippine Water Resources.

Source: Virola and Lopez-Dee, 2005. Annex 2

Table A20: Yolanda Impact

Sector	Damage and Loss (current PhP Million)				
	Damage		Loss		Total
	Public	Private	Public	Private	
Infrastructure Sectors	16,024.30	4,285.00	7,108.40	6,565.40	33,983.00
Electricity	5,329.30	1,500.00	4,575.20	4,126.40	15,530.90
Roads, bridges, flood control and public	4,255.20	-	322.90	-	4,578.10
Transport	6,010.80	216.00	24.30	-	6,251.10
Water and sanitation	429.00	2,569.00	2,186.00	2,439.00	7,623.00
Economic Sectors	3,743.50	67,560.00	87.00	106,716.60	178,107.10
Agriculture	3,743.50	27,560.00	87.00	30,716.60	62,107.10
Industry, Services	-	40,000.00	-	76,000.00	116,000.00
Social Sectors	23,175.30	305,472.10	3,442.30	22,628.80	354,718.50
Education	17,953.50	3,726.20	1,303.90	916.30	23,899.90
Health	1,170.80	1,959.90	1,932.40	510.50	5,573.60
Housing	4,051.00	299,786.00	206.00	21,202.00	325,245.00
Cross-sectoral	4,000.00	-	300.00	-	4,300.00
Local Government	4,000.00	-	300.00	-	4,300.00
Total (PhP Million)	**46, 943.00**	**377,317.10**	**10,937.10**	**135,910.80**	**571,108.50**
Total (US$ Million)	1,063.60	8,549.20	247.80	3,079.40	12,940.00

Note: Data from some sectors are incomplete due to ongoing field assessments. These are indicated in the sectoral sub-sections.

Source: Reconstruction Assistance on Yolanda, NEDA 2013.