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GRAD STUDENT PAPER:

Climate Change Impacts on Philippine Communities: An Overview of the Current Literature and Policies

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Abstract:
This paper aims to explore the impacts of industries and climate change on communities in the Philippines. This will be done through a review of relevant social and environmental literature and then the application of this to the current political, environmental, and economic state of the Philippines. The economy of the Philippines is unique, while a significant proportion is still from agriculture, mining, and other primary industries, the Philippines also has a significant proportion of income from a rapidly growing services sector, including tourism, business process outsourcing, and overseas Filipino workers. The article will discuss the expected impacts of climate change on the low-lying collection of islands, and the subsequent consequences this will have on Filipino industry. Further consideration will be given to the anticipated impacts climate change will have on public health, and how theoretically this could interact with the economy to play out for communities in the Philippines.

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Introduction

The Philippines is one of the countries most vulnerable to climate change in the world. An island nation which is heavily exposed to extreme weather events, the Philippines has little adaptive capacity. This article will begin by exploring the current and anticipated climatic changes as based on the most recent report released by the International Panel for Climate Change in 2014. After this, the economy of the Philippines is discussed; the main industries of which are agriculture, mining, and services (including tourism, business process outsourcing, and remittances from overseas Filipino workers). The primary industries of the Philippines, namely agriculture and mining, have varying yet significant detrimental impacts on the environment; these are explored, as are the risks of both these industries and macro scale anticipated climate change impacts to society. After this, current or proposed policies to improve the status quo of the mining and agriculture sectors are explored and critiqued. Following this, there is a discussion of the groups in the Philippine society who are most vulnerable to climate change and adverse industry impacts. A larger exploration of lower economic groups, particularly agriculture-based households is undertaken. The impacts on these marginalized groups are contextualized as forms of violence and reviewed in line with the themes of sustainable development and positive peace.

Overview of the Philippines

Geography and Climate

The Philippines is an archipelago with over 7500 islands comprising approximately 30 million hectares, nestled between the Philippines Sea, the South China Sea, and the Celebes Sea. The islands of the Philippines are grouped into three regions: Mindanao (10.2 million hectares), Visayas (5.7 million hectares), and Luzon (14.1 million hectares) where the capital, Manila, is located. The Philippines is a collection of half-submerged mountains, which were pushed up as a result of the subduction zone of the collision of the Eurasian and the Philippine plates. This subduction zone makes the Philippines prone to earthquakes and volcanic activity. The climate is tropical, with an average humidity of 80% and an annual rainfall of 80-450cm.[1] Two of the regions, Luzon and Visayas, are affected by typhoons each year, which account for half of their annual rainfall.

Demographics

Of the 102.8 million people who live in the Philippines, 44.2% live in urban centers, while the remaining 55.8% live in rural areas.[2] According to the International Monetary Fund (IMF), the current per capita GDP is 12,430 Philippine Pesos, an increase of 6.7% over the previous year.[3] Poverty has also dropped to 21.6% over the past year with unemployment dropping to a historic low of 4.7%. However, underemployment is still steady and significant at 18%. Underemployment reflects the number of workers who are working but would like to work more hours than they receive. This high value reflects the prevalence of informality, workplace corruption, and other job-related concerns.[4] Poverty and underemployment are directly related to undernourishment, at a rate of 13.8% of the population.[5] These are projected to worsen with the increased income inequality.[6]

Review of climate change and projected impacts

According to the National Aeronautics and Space Administration (NASA) climate change is defined as the change in the usual weather found in a place; specifically, it refers to the levels of precipitation or expected temperature of a month or season. This is a long-term alteration in the expected climate which usually takes hundreds or even millions of years.[7] The basis for the review of climate change impacts is taken from the International Panel of Climate Change (IPCC) fifth assessment report (AR5) which was released in 2014. The IPCC was established in 1988 by the United Nations Environmental Programme (UNEP) and the World Meteorological Organization (WMO) to provide unbiased and clear scientific research on the current state of knowledge in climate change and its potential environmental and socio-economic impacts.[8]

This review acknowledges climate change is a global phenomenon and one which affects all regions and sub-regions differently, however, it is outside the capacity of this paper to review the global impacts of climate change, the scope of this paper is limited to South-East Asia, most particularly to the Philippines. This section aims to discuss only the changes in climate resulting from global increases of atmospheric carbon. Climate change is anticipated to have many impacts on the status quo of the Philippines.

Temperature Rise

As it stands, an increase of more than 3°C is expected throughout Southeast Asia.[9] This temperature increase will be reflected in ocean temperatures, particularly at the surface.[10] Not only will the temperature increase affect the oceans, but it will also affect terrestrial ecosystems in several ways. Temperature is quantitatively the most important driver of changes in fire frequency in terrestrial ecosystems.[11] It is not fully understood how this relationship works, however analysis of the past 21,000 years shows there is a positive relationship between temperature and fire frequency, more so than any other parameter. In addition to increased fire frequency risks, precipitation patterns will continue to be heavily impacted by the increased temperatures.

Precipitation

Overall, rainfall has only increased by 22mm per decade over Southeast Asia, which is not a significant increase; however the regularity of the rainfall has altered with 10mm of the measured increase being attributed to extreme rain days. This increase is predicted to continue over the coming decades.[12] The decreased regularity of precipitation has a two-fold consequence; firstly, longer and more intensive drought periods, and secondly, heavier rainfall once the droughts end. One part of the altered precipitation pattern is the increased level of precipitation occurring with tropical cyclones. Aside from the increased rainfall with each cyclone, there is less confidence in the knowledge surrounding the increase in frequency or intensity of these cyclones. Another weather pattern where precipitation will play a role is the monsoon season. Eighty-five percent of future projections show an increase in mean precipitation during monsoons, while more than 95% show an increase in heavy precipitation events.[13]

Fresh Water

Although the parameters to measure fresh water quality and quantity are heavily influenced by human activities, there is evidence to believe that climate change impacts not only the quantity of fresh water but also the quality. Delpla et al[14] showed that warming and extreme events were likely to modify the physical-chemical parameters, micropollutants and biological parameters of the water.[15] The physico-chemical parameters include measurements such as temperature, pH, dissolved oxygen, and total dissolved solids. Micropollutants are bioactive, non-biodegradable substances such as radioactive or biologically harmful metals (including mercury, lead, and arsenic),

pesticides, or pharmaceuticals, and biological parameters include the presence and volume of species such as algae and phytoplankton as well other microorganisms. Higher air temperatures increase evapotranspiration; when this occurs in tandem with increased frequency and intensity of droughts, then surface water quantity will be decreased. This can then increase the concentration of many of the physico-chemical parameters, micropollutants, and biological parameters listed above.

Oceans

As previously mentioned, the ocean is anticipated to increase in temperature, particularly at the surface.[16] The current state of warming has been implicated in the northward expansion of tropical and subtropical macroalgae and toxic phytoplankton.[17] This northward shift of species is anticipated to alter the marine ecosystems and provide new challenges for the species which have historically been present in and around the Philippines. With current predictions, the increased temperature combined with ocean acidification is expected to result in significant declines in coral-dominated reefs and other calcified marine species, such as algae, molluscs, and larval echinoderms.[18] Current trends in sea level rise are expected to be exceeded by the future predictions.[19] This, in combination with cyclone intensification, will likely increase coastal flooding, erosion, and saltwater intrusion into surface and groundwaters.[20] Unless they are provided with enough fresh sediment or are allowed to move inland, beaches, mangroves, saltmarshes and seagrass beds will decline also, and these declines will exacerbate wave damage.[21,22,23,24]

Philippine Industries: *Agriculture*

Agriculture – including forestry, fishing, and hunting – is one of the biggest sectors of the Philippine economy, accounting for 9.7% of the GDP[25] and employing 28% of the total workforce. The sizes of the agricultural ventures vary drastically, including a significant number of subsistence farmers as represented by the large proportion of the population who live rurally, and commercial ventures from multinational corporations. The large commercial agriculture ventures hold significant swathes of land and grow vast quantities of produce. In the Philippines the main crops are sugar, rice, and coconuts, each year producing hundreds of thousands of tons of each for export.[26] There is a drastic difference between the commercial ventures and the subsistence farmers in terms of yield, intensity of farming practice, and exports. It should be noted that fishing and farming are the two sectors with the highest incidences of poverty,[27] which I will discuss in more depth below.

Services

Services are a highly profitable and diverse sector for the Philippines, and one which has expanded greatly over the past few years. Tourism is included in the services sector and provided 8.6% of the nation's GDP in 2016, up 0.4% from the previous year.[28] Another major part of the services sector is the rapidly growing business process outsourcing, where call centers and other such infrastructure are exported to places like the Philippines to exploit their lower labor costs. In the Philippines, this employs over 1.3 million people. A last significant part of the services industry –which isn't always accounted for but is nevertheless a crucial source of income for many families – are the remittances sent home from overseas Filipino workers (OFW). In the year 2016 there were 2.2 million OFW spread globally working in a large variety of roles. The remittances these workers returned to the Philippine economy added 146,029 million Philippine pesos, or roughly USD$2.78 billion in the year 2016.[29]

Industry

There is great variety of industries in the Philippines, including vast manufacturing outputs. These range from one of the largest shipbuilding industries in the world, to a growing automotive

and aerospace production. Construction is also a major employer as the country develops its economy and its population continues to grow, requiring more infrastructure. One of the main and more controversial industries of the Philippines is the mining and extraction industry. The Philippines has significant reserves of gold, nickel, copper, chromite, silver, coal, sulphur, and gypsum. While there has been significant debate over the legality of overseas mine ownership and mining procedures (as will be discussed later) the industry has continued to grow over the past year. The main contributors to the 8.8% expansion were stone quarrying, clay, and sandpits which grew by 17.7%, gold which grew by 16.5%, and crude oil, natural gas and condensate which grew by 7.4%. [30]

Impacts of industries on environment

The impacts of many industries on the local environment make it very challenging to detect and disentangle the impacts of climate change from the surrounding pressures, which the literature relfects.[31]

Fresh Water

Many industries require access to fresh water, as a result, overexploitation of groundwater systems can result in land subsidence. When this is combined with the climate change driven impacts of coastal inundation and sea level rise, there is an increasing risk of worsened water quality.[32] Mining, in particular, poses a significant risk of water contamination. Mine tailings – the excess earth and chemicals used to obtain the target metal – are often permanently stored in large lakes or used to create structures such as dam walls and piers. However, if the tailings are not treated or sealed correctly, poisonous contaminants can leachate out and pollute the water surrounding them. As mining is such a prevalent industry in the Philippines, and with choices being made to economize the handling of these tailings (often at the expense of long-lasting safety), there have been examples of significant water contamination, including from the Palawan Quicksilver mine,[33]along the Naboc River area near Mindanao,[34] and in the water supplies to the villages of Sta. Lourdes and Tagburos.[35]

Deforestation

Between 1990 and 2005, the Philippines lost a third of its primary forest cover.[36] This was due to a number of factors, one of which is the conversion of forest lands to promote growth and development. This is combined with high levels of poverty and landlessness in rural and urban populations, causing poorer families to move into less farmable uplands. This poverty is compounded by uncertain land rights, resulting in lack of long term investment in land and over-exploitation of its resources for short-term economic benefits. There is also a lack of policy and improper pricing of the land which results in poorly managed forestry practises, resulting in high capital intensity, low employment generation, and low investments in forest regeneration and protection.

There is an alarming feedback from forest cover to rainfall. Of course, without rain there is very little sustainable agriculture, including forestry. However, when forest cover is removed, it has been anticipated that rainfall patterns will also significantly change.[37] Consider that 25-56% of all rainfall in highly forested regions can be recycled in the ecosystem as tropical trees extract water from the soil and, through evapotranspiration, release it into the atmosphere, thus inducing rainfall. With the high rates of deforestation in the Philippines, we can assume that historic rainfall patterns will be significantly different in the future, not only through the broader forces of climate change, but also on a micro scale as a result of deforestation.

Land degradation

According to a report prepared by the Food and Agriculture Organization in 1999, approximately 75% of land in the Philippines is severely or very severely degraded. Due to the age of the report,

significant changes have occurred since its release; but in many cases, soil degradation has worsened. Land degradation is associated with accelerated soil erosion, siltation of irrigation systems, flooding, and water pollution. Land effects are intricately linked with the previously discussed issues of fresh water and deforestation. Land degradation can occur through two main pathways: firstly is erosion, the removal of soil. Erosion occurs naturally through wind and water moving particles of soil, but is accelerated through human activity, particularly deforestation. Steeper lands are more erosion prone than lowlands, hence, as deforestation of the uplands became so prevalent in the last few decades, steep slope erosion is a serious issue.[38] Official estimates show a slow rise of erosion from 340 million t/year in the late 1980's to nearly 350 million t/year in the early 2000s.

The second type of land degradation is in the changes to the chemical, biological and physical parameters of the soil, such as nutrient loss, salinization, acidification, and compaction. Nutrients leave the soil either through adherence to water and traveling over the surface or gravitating down through the soil to water bodies below. This consequently makes nutrient loss a relative issue; nutrients tend to accumulate elsewhere, causing downstream damage, either through blocking water pathways with sediment build up, or adding too many nutrients that promote algae growth and polluting water bodies. Through continuous cropping, extensive submergence, and high chemical usage, the production of one crop in particular – rice – has led to declined organic matter content, nutrient supply capacity, nutrient imbalance, water logging, soil salinity and alkalinity and forming of hardpans at shallow depths.[39] These impacts combined have led to a slowdown of overall yield growth.

Risks to society

The impacts of climate change and industry will likely manifest themselves through impacts on water resources, agriculture, coastal areas, resource dependent livelihoods, and urban settlements and infrastructure. These will have implications for human health and well-being. This section will explore food security, disease prevalence, and income and settlements. There are many links and feedback loops between each of these concepts, thus making a clear discussion a challenge. A lack of food security will lead to increased vulnerability to disease, as malnutrition reduces the immune system's ability to resist infection and viruses. Poor housing can also increase vulnerability to disease, through exposure to cold, damp, or unsanitary living conditions. All three of these interacting factors are affected by income, as without sufficient funds, households cannot afford adequate nutrition, medicine, or quality housing.

Food Security

As temperature rises, the growth period of many crops – including rice – is shortened. It is already shown that current temperature in parts of Asia – including the Philippines – are reaching critical levels during the susceptible stages of the rice plant.[40] Extreme weather events have significant destructive capacity, which when combined with increased precipitation events lead to higher flood risks, yields could drastically fall.[41] Furthermore, with increased sea level rise, many coastal areas will lose agricultural lands due to submersion or increased salinization from a rising salt water table.

Added to the risks of climate change are those from industry. Unsustainable agricultural practices leading to land degradation have been previously discussed, but some industries also have negative impacts on the environment of other industries, one of which is mining. As previously mentioned, tailings from mines can leach out and pollute water sources. These water sources can be used for a number of purposes, including agriculture. The case of the Naboc River in Mindanao is one such example. Here, water from the river is being used to irrigate rice fields. This combined with high consumption levels of local fish (from the same polluted river) has led to high levels of mercury

exposure in the population, resulting in 38% of the local inhabitants being classified as mercury intoxicated.[42] Further, tailings from the Palawan Mine, used to construct a jetty into Honda Bay, have leached out into the water, creating another food source pathway of mercury to humans which is particularly pertinent in the high-fish-consuming population. The last example is in the towns of Sta Lourdes and Tagburo, where a health crisis has been declared and residents exposed to mercury through similar pathways as those previously discussed are being evacuated and receiving medical treatment. These are just three examples with definitive literature; there are many more similar situations of contamination from mine tailings which further threaten food security in the Philippines.

Disease

Epidemics are often reported after floods and storms, both of which are set to increase as a result of climate change and unsustainable land clearing and farming practise, as previously discussed. These epidemics can come as a result of decreased drinking water quality, amongst other reasons. According to the Philippine Statistics Authority the main source of drinking water in the Philippines is bottled water with 27.2%, and cooking water sourced from community water systems with 43.4%.[43] While it may be assumed that bottled water is safe and unaffected in quality by floods or storms, the population which does not have access to this security is at risk from reduced water quality. Further contributing causes of epidemics after floods are mosquito proliferation and exposure to rodent-borne pathogens.[44]

There are also links between heat and human health, showing that high temperatures subsequently increase mortality, particularly in the elderly and people with cardiovascular and respiratory disorders.[45] In addition to heat, droughts also have health impacts. Increased heat and drought frequency, as previously discussed, are the primary causes of increased frequency of wildfires, which in turn increase incidences of smoke exposure. Drought can also impact agriculture, as mentioned above,threatening food security and having further renders people susceptible to disease.[46]

As previously mentioned, floods and storms may increase mosquito proliferation and exposure to rodent-borne pathogens. We can anticipate that increased temperatures will also affect vector-borne pathogens. This could be through shorter vectors life-cycles and extrinsic incubation periods, resulting in larger vector population sizes. This would enhance the spread of disease between the vector species and humans. One such example is that of dengue fever, which has a time-lagged positive correlation with increased temperature and rainfall.[47] Among all the impacts anticipated with climate change, the broadest impact on human health is the traumatic psychological effect these changes will have. Many mental disorders as well as post-traumatic stress syndrome have been observed in disaster-prone areas.[48]

Income and Settlements

The Philippines is a country of rapid development and urbanization. However, more than half of its inhabitants still live rurally and still suffer disproportionate rates of poverty.[49] It is expected that impacts of environmental degradation and climate change will impact those below the poverty line with more vigor than those above it. In the national economy, agriculture is anticipated to be a key driver of growth over the coming years. Southeast Asia is the third poorest region (in regard to human development indicators) after sub-Saharan Africa and Southern Asia.[50] Considering its current situation, with anticipated global increase in food prices for staples such as rice, the Philippines stands a chance to improve its economy if it can manage the negative climatic impacts anticipated for the agricultural industry.[51]

Many settlements in the Philippines are in low elevation coastal areas which are particularly vulnerable to climate change hazards, such as sea level rises, storm surges, and typhoons. One

group, in particular, is those living in peri-urban areas who face particular risks. These peri-urban areas are often of lower socioeconomic standing, which consequently increases inhabitants' risks regarding food security, but also increased land title insecurity and price pressures. Secondly, peri-urban areas often serve as sinks for urban wastes, holding landfills and sewage treatment facilities which can pose local biophysical risks. Lastly, as they are outside of the inner-urban area, peri-urban areas are often not included in disaster risk management planning, even though they will most likely suffer just as much as inner-urban areas.[52]

The risks of extreme weather events to industries are multi-faceted. Particularly regarding infrastructure, climate change poses many direct and indirect challenges to industrial production and enterprise. There is no doubt that climate change will deteriorate infrastructure, which can disrupt basic services such as water supply, sanitation, energy provision, and transportation systems, which can lead to mass migrations.[53] With increased frequency and intensity of cyclones and other extreme weather events, this can create an unsustainable cost for a developing economy. Over the past four years, climate-induced disasters have cost the Philippine economy 0.3% of its GDP.[54] This is anticipated to increase up to 2.2-5.7% of the GDP by the year 2100.[55] Furthermore, climate change can also exacerbate current socioeconomic and political disparities and add to the vulnerability of the Philippine people.[56]

Current policies on the most environmentally damaging industries: *Mining*

In 2016, the previous environmental secretary of the Philippines, Regina Lopez, spearheaded an environmental audit of the mines in the Philippines, finding "serious environmental violations" at 23 of the 41 operating mines.[57] This audit resulted in a "ban of mining" which prevented new mining ventures.[58] Mining contributes less than 1% of the countries GDP;[59,60] however, it also produces 8% of the world's supply of nickel, and 97% of China's supply, the decrease of which could result in serious international consequences.[61] Appeals have already been made to lift the ban and release Lopez's audit for transparency.[62,63,64] This international pressure could damage the ability of the Philippine administration to make clear and logical policies which consider both the economic and employment benefits of mining for the people of the Philippines, but also consider the longevity of the environment and any other economically beneficial alternative land uses.

Recently, the Duterte administration signed the Canadian Towards Sustainable Mining (TSM) initiative. This program was developed to facilitate the extraction of minerals, metals and energy products in the most socially, economically, and environmentally responsible way.[65] There are three core pillars which uplift this program: accountability, transparency, and credibility. Accountability is achieved through regular assessments at the facility level where the mining takes place, providing local communities with accurate and honest knowledge as to the health of the mine. Members of the TSM provide progress reports, measuring 23 set indicators; this is done annually and is audited every three years. These results are publicly available, thus providing transparency. The last pillar, credibility, is fostered through ongoing consultation with a national Community of Interest Advisory Panel, which is a multi-stakeholder group comprising aboriginal groups, community leaders, environmental and social NGOs, and labor and financial organizations. There are also members of the Mining Association of Canada board to provide a mining industry perspective.[66] There are still issues to resolve – including the open pit ban – before any growth can be expected from the industry.[67] Duterte said that while he would not lift the ban on new ventures, he would give current firms time to adapt to less environmentally harmful practices as opposed to enforcing their immediate closure.[68]

Tourism

In early 2018, the new secretary for the environment, Roy Cimatu, visited one of the largest tourist destinations in the Philippines. During this visit he witnessed significant and widespread

environmental violations,[69] predominantly amongst the locally owned and run hostels and housing for migrants who work in the more established and well-endowed global hotel-chains.[70] This is mainly due to the well-financed position of many global chains who can ensure their facilities connect to water treatment systems and meet the requirements of the law. It should be noted, however, that while enforcing strict environmental security is of utmost importance to ensure the self-sustainability of local populations, it should not be done with disregard. Not only does the hard-line approach hamstring productivity and potentially frighten future overseas investors, in regard to both the tourism example and the previous open-pit mining ban, it also has significant repercussions for employment. Households who have migrated for work, such as in Boracay, or who are solely dependent on one industry, will face significant losses to livelihood in the event of a hard-line indefinite closure.

Agriculture

The primary goal of the agriculture policy in the Philippines is to achieve self-sufficiency in rice production, in the hope that it will effectively combat food insecurity and poverty through a stable food supply at an affordable cost.[71] The interference of the government in the agriculture industry has ebbed and flowed over the past few decades. The level of intervention was particularly heavy in the 1970s and '80s before easing off to allow increased private sector control until the turn of the millennium.[72] In the early 2000s Philippine agriculture refocused on rice, and there was a subsequent increase in government subsidies. This was more pertinent after the 2008 global food crisis, which further strengthened the drive for self-sufficiency in rice.[73] There were many suggested pathways to achieving this self-sufficiency, three of which will be discussed in more depth.

Traditionally, subsidizing input costs has been the main instrument in achieving self-sufficiency in the Philippines.[74] This includes preferential tax policies exempting agricultural enterprises from import duties on agricultural equipment and machinery. Furthermore, the government subsidizes ongoing and recurring inputs such as seeds and fertilizers. More recently, these subsidies have been tailored to increase planting of hybrid rice strains, with varying success. Many of these strains do not produce seeds of their own, so farmers are required to repurchase stock every year, unlike traditional inbred varieties. This combined with often a heightened fertilizer requirement, resulted in a low uptake of the new technology.[75]

Since the turn of the millennium, there has been increased pressure to provide general services to the whole industry. These include investment into an extensive irrigation network, primarily to benefit rice farmers. A further priority intervention is the construction and maintenance of a road network, better connecting farms to markets. This increases agricultural productivity and reduces post-harvest losses. To further future-proof agriculture productivity, the Philippine government invests substantially in research and development. This research should pass through local level government, with reinvestment by the government.[76]

The most powerful agricultural policy instrument used by the Philippines government to move towards rice self-sufficiency is price supports. These measures are placed mainly on rice and sugar; they include a support price, release price, government procurement and import restrictions. Government procurement stabilizes consumer price levels through buffer stocks, ensuring adequate and continuous supply.[77] Import restrictions regulate foreign trade, particularly on the import of rice. While it is crucial for self-sufficient industry not to import more rice than they produce, this is proving to be detrimental in the case of the Philippines. Self-sufficiency requires gross yield to match or exceed the requirement of the population. As the Philippines has undergone sustained population growth, particularly in recent times, in combination with decreased land availability and land productivity, the result is a significant gap between what is produced and what is required. In tandem

with high import tariffs on rice, prices go up, resulting in recent increases in malnutrition and poverty.

The budgetary transfers to subsidize agriculture from the government are five times higher than those of other regional countries.[78] This inefficiency is made clearer when comparing percentages of the total; employment in agriculture is almost three times the GDP produced by agriculture. This low labor productivity is one of the reasons explaining the low incomes of agriculture-dependent households.[79] Considering that more than 60% of poor Filipino households' income is spent on food,[80] low labor productivity rates are not financially sustainable. This seems to have started a reduction of the laboring population in agriculture. This movement from agriculture to non-agricultural sectors has provided overall economic growth. The movement of labor from low productivity to high productivity has increased incomes for families through the diversification of income sources. Furthermore, it has also raised the wage rate of agricultural labor as the supply shrinks, and reduced pressures on land and water availability.[81] However, this is not spread in a uniform manner as will be discussed below.

Some of the government's agricultural policy instruments bring hope to the struggling sector, such as subsidized input costs and improved general services. However, as I have discussed, there is still real and significant water contamination from the mining industry, which has the potential to continue and worsen. While the government has invested in irrigation systems to stabilize and increase crop yields, these funds would be better invested in ensuring that the water used for irrigation is not contaminated. There is still positivity in the criticism of the general services investments; any investment to improve road connectivity will decrease vulnerability. Having clear and easy access between towns and cities will not only reduce post-harvest losses of crops as mentioned above, it will also increase accessibility to rural communities in the event of increasingly frequent natural disasters. Having this increased accessibility will allow emergency services and humanitarian aid into townships further afield, which would previously have been cut off.

Reducing input costs can also have detrimental impacts to the longevity of the agricultural sector. Tapering these subsidies to only a few crops, such as rice and sugarcane, will restrict diversity and increase vulnerability. Similar to the concept of having all one's eggs in one basket, having a lack of diversity in the agricultural sector reduces resiliency to crop specific diseases or market price fluctuations, particularly for rice, which is becoming dangerously vulnerable in to increased temperature and reduced precipitation during its growth period. Moreover, reducing input costs into agriculture can increase intensification. While this intensification is necessary in the name of self-sufficiency, it is detrimental long term, as it often reduces land productivity, stripping the soil of nutrients and its necessary micro biodiversity. One suggestion, put forward by the OECD director of trade and agriculture, is to move away from the concept of self-sufficiency to move towards increased productivity and profitability in a way which is environmentally sustainable.[82]

Vulnerable Groups

The current and predicted state of the environment can be expected to have disproportionate repercussions for marginalized groups in society. In addition, research has shown an exacerbation in gender inequality. Chandra et al have explored the impacts of climate change and conflict on rural women in the wider Mindanao area[83] finding that climate change and conflict have been shown to disadvantage women to greater rates than men. According to Chandra women are more likely to farm smaller plots of land, work shorter hours, or limit their farming to cash crops.[84] Additionally, adult women frequently sacrifice their own food to ensure their children or the elderly in their care eat enough first – worsening food insecurity. Furthermore, should abandonment of the farm prove necessary – which is increasingly common – women tend to find work more easily in urban centers than men.[85] This can also lead to increased risk of sex trafficking.[86,87]

A group that is similarly vulnerable to climate change and adverse industry impacts is indigenous peoples. The UN Economic and Social council released a report in 2003 exploring human rights and indigenous issues occurring in the Philippines.[88] This report detailed many issues concerning resource management and sustainable development, poverty, and militarization. One case which is referred to throughout the report is that of the Bugkalot indigenous people who have been fighting for their rights over the OceanaGold Corporation and Didipio mine. Although the Bugkalot elected anti-mining parliamentary members and local councils, the military systematically raided the townships of the Bugkalot, using tactics of torture, harassment, and grave coercion.[89] The indigenous people, joining forces with local peasants, still work towards closing the mine. A few years ago, the Didipio Earth Savers Multi-purpose association successfully rolled back some of the mining operations in Nueva Viscaya.[90] However, the OceanaGold mine is still operating and last year won the ASEAN award for best practices in mineral processing, citing community investment as a main bonus.[91] There should be serious concerns raised when a transnational corporation, such as Oceana Gold, has the political power to manipulate the military to act against the people. Looking forward, similar concerns should be raised with the open-pit mining ban regarding the ability of the Philippine administration to withstand heavy pressure from the appeals that have already begun. Not only did the indigenous group suffer land losses, they also suffered the political corruption of having their elected officials ignored and having the military turn against them. Though this is only one example, generally indigenous communities are more vulnerable to climate change. As I will discuss, the more reliant a community is on natural resources, the more susceptible they are to the negative impacts on the degradation of those resources. As many indigenous communities live wholly within the capacities of their environment, they witness the changes firsthand and feel them more intensely.

The largest and most widespread vulnerable group are those lowest in economic status, including women and indigenous groups. Currently the most poverty-stricken group in the Philippines are the rural poor whose livelihoods depend almost entirely on subsistence agriculture, as previously discussed. The low economic capacity of this group makes them the most vulnerable group for a number of reasons. During extreme weather events, economically marginalized families are not able to escape, do not have food supplies saved up, nor are they able to afford medicine should an epidemic follow an extreme weather event. For the predominantly agriculture-reliant families from the poorest decile, the low-labor productivity of agriculture, and difficult economic policies enforced to achieve rice self-sufficiency are partially the cause of their plight. While the open-pit ban and any developments under the TSM initiative will hopefully stem the ongoing resource degradation, any mining venture has the risk of going wrong and causing disastrous and often irreversible impacts. Those communities who are most dependent on these natural resources are the most vulnerable to their change, also do not have the economic capacity to withstand or financially absorb any detrimental impacts. Further, these communities often do not have expendable income for medication, or treatment of the contamination, which prolongs and exacerbates their suffering. For example, leachate from tailings with mercury and other physical-chemical pollutants has already been linked to contamination and intoxication of local populations.

Many of the current or suggested policies for some of the most environmentally damaging industries of the Philippines have disproportionate consequences for marginalized groups of society. This disproportionality represents violence, using Galtung's definitions.[92] Violence can be direct from one individual to another, such as from a soldier to an indigenous villager who is protesting the illegal mining in their homeland. Structural violence, as Galtung defines it, is the violence exerted by one group upon another, such as the contamination of water from poor mining practice which results in mercury intoxication in significant numbers in a village. This is violence committed by both the mining companies who failed to ensure their practices were safe, and the government, who failed to enforce safe practices on the company to protect their citizens. Galtung defines cultural violence as

the parts of society which allow the previous two violences – direct and structural – to continue. This could be due to pressure from transnational mining corporations, or the economic benefits of cutting corners, which make society and government blind to the suffering of a marginalized group.

The problems faced by communities in the Philippines – be they land seizures, water contamination, increased malnutrition, mercury intoxication, sea level rise, or sex trafficking – have complex intersections and interactions. This means that dealing with an issue using an isolated and symptomatic approach cannot result in long term solutions; a systematic approach is required. Here is where the concept of sustainable development must be explicitly discussed. The Brundtland Commission[93] defines sustainable development as that which improves people's life-enabling habits to meet needs in the present without compromising the ability of future generations to meet their needs. In this context it is only when economic security, ecological integrity, and social equality intersect can sustainable development be achieved.[94] With this in mind, human well-being is essential in combating environmental degradation, or adapting to adverse climatic changes. This is because poverty is both a cause and an effect of environmental degradation. As has been illustrated previously, negative impacts on the environment – whether caused directly by poorly managed industries or by macro climatic changes – have equally adverse consequences for society. The environment is the basis of our existence, and without nature's capacity for regeneration or waste absorption, we would not be able to survive; this is most pertinent for those with a more direct interaction with the environment, and those with higher levels of poverty.

Ecological integrity is a critical component of sustainability and a requirement for poverty reduction. Without it, positive peace cannot be achieved. Positive peace, as defined by Harris[95] is defined as peace which is not only an absence of any of Galtung's[96] three types of violence; it is also social justice and ecological sustainability. Hence, a lack of ecological sustainability results in risks that will consequently lead to more explicit and widespread violence and conflict. Homer-Dixon[97] links environmental degradation to increased risks of conflict. This takes an indirect pathway through economic struggles as a result of decreased primary industry capacity. Rural economic struggles result in migration to urban centers, increased social tensions and a greater risk of conflict. The situation in the Philippines is not too dissimilar from the theoretical pathway observed by Homer-Dixon.[98]

In the Philippines, resource degradation, such as reduced water quality, and damage to crops from increased extreme weather events have led to a decrease in agricultural yield. This has led to migration to urban centers, as previously discussed, and has consequential impacts on increased sex trafficking and other horrifying realities. At this point, many non-agriculture sectors, such as tourism, business process outsourcing, and remittances from overseas Filipino workers, provide welcome opportunity and change for those who are currently most affected by the degradation of the environment. This helps struggling newly urban migrants and reduces the risk of conflict. However, Jasparro and Taylor[99] have theorized how the anticipated climate changes occurring in Southeast Asia will reduce state capacity and human security to the point where states may fail and produce non-state threats and conflicts. This, they suggested, would be a result of marginalized groups resorting to violence, warfare, and raiding in order to cope with increased environmental and climatic pressures.

There is one question left to consider though: is it too late and is it enough? It would seem as though the national administration of the Philippines is implementing policies of varying successes in order to address the poverty of a significant portion of the population, and to develop in a way that the country is ready and capable of adapting to climate change. However, current measures may prove to make the agriculture sector, and society at large, more vulnerable to climate change. Furthermore, by restricting imports of food to create a facade of self-sufficiency, the Philippine

administration is effectively attempting to fudge the numbers, and by doing so, increasing malnutrition and food insecurity for a significant number of their most vulnerable citizens.

Retroactively acknowledging and addressing the long-term damage done to the environment from industries such as mining and tourism, may not be enough to combat the violence suffered by the local communities. Furthermore, however gallant and admirable the new goals may be, it is questionable as to whether they will withstand global pressure, and whether the intricately linked needs of the poor and the environment can be prioritized over the ability to make easy money. If this proves unsuccessful, and the previous rate of mining and subsequent degradation resumes, the combined impacts on the rural poor may be too much. Not only this, but the impacts suffered through a hard-line approach to violations of environmental regulations will have a greater impact on lower socioeconomic households who rely on income from work in mining or tourism.

Perhaps there can be another approach to restorative relationships between government, local communities, and many of the transnational corporations who provide significant sources of income. The Commission on Human Rights for the Republic of the Philippines (CHR) has begun an inquiry into climate change within the human rights framework, with a particular emphasis on "carbon majors" and their potential responsibility in contributing to climate change and its impacts on the rights of people in the Philippines.[100] These "carbon majors" are non-state entities which are transnational producers of oil, natural gas, coal, and cement. The first hearing began in late March 2018, and the inquiry will continue throughout the year and draw on community dialogues and experts from both scientific and human rights disciplines.[101] The aim of this inquiry is to improve measures to protect and promote human rights in the Philippines in an era or climatic changes, it also seeks to determine the liability of companies which have had a notable contribution to climate change.[102,103] While the interwoven nature of climate change and industry may prove a challenge for this inquiry, its goals are admirable and should provide intensely beneficial recommendations for community, government policy, and corporations. As the CHR is an independent body, any recommendations should consider the implications for the environment as well as local employment and income reliance.

Conclusion

Due to its geography of being an exposed archipelago, the Philippines is incredibly vulnerable to projected climate change impacts. Mining and agriculture play an important role in the health of the environment and when combined with the expected impacts of climate change, provide the Philippines with significant risks, including food insecurity, increased prevalence of disease, and income and settlement vulnerability. The ability for local communities to be resilient to these changes and impacts are both equipped and hindered by different industry-specific government policies. The detrimental effect of climate change and industry impacts on the environment culminate and combine to exacerbate marginalized groups vulnerability. This vulnerability is reconceptualized within the scope of this paper in Galtung's forms of violence. This violence poses further threats for the attainment of positive peace and sustainable development.

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BIBLIOGRAPHY

Anda, Redempto. "Gov't study confirms widespread mercury poisoning in 2 villages in Puerto Princesa City." *Inquirer.net,* June 7, 2017.

Appleton, James, Jason Weeks, J. Calvez, and C. Beinhoffd. "Impacts of mercury contaminated mining waste on soil quality, crops, bivalves, and fish in the Naboc River area, Mindanao, Philippines." *Sciences of the Total Environment* 354, no 2-3 (2006): 198-211.

Aragao, Leoc. "Environmental science: the rainforest's water pump." *Nature* 489 (2012): 217-218.

ASEAN. "Best Practice on sustainable mineral development in ASEAN." http://asean.org/storage/2017/12/Best-Practices-on-Sustainable-Mineral-Development-in-ASEAN_Final.pdf

Asia Development Bank. "Eradicating poverty and promoting prosperity among a changing Asia-Pacific." https://www.adb.org/sites/default/files/publication/235276/eradicating-poverty-asia-pacific.pdf

Badayos, R.B., and F. C. Calalo. "Farm sustainability and organic farming." In *Securing Rice, Reducing Poverty: Challenges and Policy Directions.* SEARCA, College, Laguna, 2007.

Briones, Roehlano. "The Philippines Country Environmental Analysis: Land Degradation and Rehabilitation in the Philippines." 2009: The World Bank. https://pdfs.semanticscholar.org/0287/a4685653ea136d9673ae17ff2e8dcda8c508.pdf

Contreras, Antonio. "Blood and money in the sand: The tragic story of the Atis of Boracay." *The Manila Times.* February 27, 2018. http://www.manilatimes.net/blood-money-sand-tragic-story-atis-boracay/382990/

Contreras, Antonio. "Blood and money in the sand: the class dimension of Boracay environmental disaster." The Manila Times. March 1, 2018. http://www.manilatimes.net/blood-money-sand-class-dimension-boracay-environmental-disaster/383394/

Chandra, Alvin, Karen E McNamara, Paul Dargusch, Ana Maria Caspe, and Dante Dalabajan. 2017. "Gendered Vulnerabilities of Smallholder Farmers to Climate Change in Conflict-Prone Areas: A Case Study from Mindanao, Philippines." *Journal of Rural Studies* 50: 45–59. doi:10.1016/j.jrurstud.2016.12.011.

CHR, "PHL at the Forefront of seeking climate justice with CHR's landmark inquiry on the effects of climate change to human rights." 2018. http://chr.gov.ph/phl-at-the-forefront-of-seeking-climate-justice/

CHR, "CHR to conduct first hearing investigating possible contribution of carbon to climate change and its impacts on human rights." 2018. http://chr.gov.ph/chr-to-conduct-first-hearing-investigating-possible-contribution-of-carbon-to-climate-change-and-its-impact-on-human-rights/

Church, John, Peter Clark, David Bahr, Jason Box, David Bromwich, Mark Carson, William Collins, et al. "Sea Level Change." In *Climate Change 2013: The Physical Science Basis.* Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 1137–1217. Cambridge, United Kingdom: Cambridge University Press, 2013. https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter13_FINAL.pdf.

Collins, Matthew, Reto Knutti, Julie Arblaster, Jean-Louis Dufresne, Thierry Fichefet, Pierre Friedlingstein, Xuejie Gao, et al. "Long-Term Climate Change: Projections, Commitments and Irreversibility." In *Climate Change 2013: The Physical Science Basis.* Contributions of the Working Group I to the Fifth Assessment of Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom: Cambridge University Press, 2013. https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter12_FINAL.pdf

Cororaton, Caesar B., and Erwin L. Corong. "Philippine Agriculture and Food Policy: Implications for poverty and income distribution." *International Food Policy Research Institute, Research Report 161.* Washington, D.C.: International Food Policy Research Institute, 2009. https://ageconsearch.umn.edu/record/55512/files/rr161.pdf

Daniau, A.L., P. J. Bartlein, S. P. Harrison, I. C. Prentice, S. Brewer, P. Friedlingstein, T. I. Harrison-Prentice, et al. "Predictability of Biomass Burning in Response to Climate Changes." *Global Biogeochemical Cycles* 26 (4). Wiley-Blackwell: 2012. doi:10.1029/2011GB004249.

Delpla, I., A.-V Jung, E Baures, M Clement, and O Thomas. "Impacts of Climate Change on Surface Water Quality in Relation to Drinking Water Production." *Environment International* 35 (2009): 1225-33. doi:10.1016/j.envint.2009.07.001.

Finighan, Adrian. "Philippines Mining shutdown." *Al Jazeera.* February 11, 2017. https://www.aljazeera.com/programmes/countingthecost/2017/02/philippines-mining-shutdown-170211080450892.html

Food and Agriculture Organization. "Philippines." http://www.fao.org/faostat/en/#country/171

___ . FAOSTAT. http://www.fao.org/faostat/en/#data/QC

___ . "Soil resources depletion and deforestation: Philippines case study in resource accounting." 2007. http://www.fao.org/docrep/006/AB604E/AB604E02.htm#TopOfPage

___ . Organization (1999). FAO Country Profiles: Philippines. Retrieved from: http://www.fao.org/countryprofiles/maps/map/en/?iso3=PHL&mapID=604

Galtung, Johan. "Conflict as a way of life." *Progress in Mental Health.* London: Churchill Press, 1969.

Gedan, Keryn., Matthew Kirwan, Eric Wolanski, Edward Barbier, Brian Silliman. "The present and future role of coastal wetland vegetation in protecting shorelines: answering recent challenges to the paradigm." *Climatic Change* 106, no. 1 (2011): 7-29.

Gibson, Robert. "Beyond the pillars: sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making." *Journal of Environmental Assessments and Political Management* 8, no. 3 (2006): 259-280.

Gilman, Eric., Joanna Ellison, Norman Duke, Colin Field. "Threats to mangroves from climate change and adaptation options: a review." *Aquatic Botany* 89, no. 2 (2008): 237-250.

Gray, John, Ian Greaves, Dorina Bustos, David Krabbenhoft. "Mercury and methylmercury contents in mine-waste, calcine, water, and sediment collected from the Palawan Quicksilver Mine, Philippines." *Environmental Geology* 43, no. 3 (2003): 298-307.

Harris, Ian. *Peace Education in a Postmodern World: A Special Issue of the Peabody Journal of Education.* London: Taylor and Francis, 2004.

Hijioka, Yasuaki., Erda Lin, Joy Jacqueline Pereira, Richard T. Corlett, Xuefeng Cui, Gregory Insarov, Rodel Lasco, Elisabet Lindgren, Akhilesh Surjan. "Asia." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2013.

Homer-Dixon, Thomas. *Environment, Scarcity and Violence.* New York: Princeton University Press, 1999.

IMF. Data Mapper: Real GDP Percentage Change. http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD/PHL

International Panel on Climate Change (IPCC). History. http://www.ipcc.ch/organization/organization_history.shtml

Jasparro, Christopher, and Jonathan Taylor. "Climate Change and Regional Vulnerability to Transnational Security Threats in Southeast Asia." *Geopolitics* 13, no. 2. (2008): 232-256.

Kintisch, Eli. "Can coastal marshes rise above it all?" *Science* 341, no. 6145 (2013): 480-481.

Knutson, Thomas R., John L. McBride, Johnny Chan, Kerry Emanuel, Greg Holland, Chris Landsea, Isaac Held, John P. Kossin, A.K. Srivastava, Masato Sugi. "Tropical Cyclones and Climate Change." *Nature Geoscience* 3, no. 3 (2010): 157-163.

Mining Association of Canada. *TSM101: A Primer.* http://mining.ca/sites/default/files/documents/TSM-101-A-Primer-Eng.pdf

National Aeronautical Space Administration (NASA). *What is Climate Change?* https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-climate-change-k4.html

OECD. *Agricultural Policies in the Philippines.* Paris: OECD Publishing, 2017.

Philippine Statistics Authority. 2017a. "Poverty: Fishermen, farmers, and children constantly post the highest rates of poverty among basic sectors." http://psa.gov.ph/poverty-press-releases

___. 2017b "Tourism." http://openstat.psa.gov.ph/dataset/tourism

___. 2017c "Total number of OFWs estimated at 2.2million (results from the 2016 survey on overseas Filipino Workers." https://psa.gov.ph/content/total-number-ofws-estimated-22-million-results-2016-survey-overseas-filipinos

___. 2017d "Gross National Income and Gross Domestic Product: Gross Value added in mining and quarrying." http://psa.gov.ph/nap-press-release/sector/Mining%20and%20Quarrying

___. 2017e. "Population and housing." https://psa.gov.ph/population-and-housing

Rumney, Emma. "Philippines Agriculture counterproductive, warns OECD." *Public Finance.* April 10, 2017.

Serapio, Manolo. "Philippine's Duterte keeps open pit mining ban in policy clash." *Reuters.* November 20, 2017.

Simbulan, Roland G. "Indigenous Communities' Resistance to Corporate Mining in the Philippines." *A Journal of Social Justice* 28 (2016): 29-37.

Singh, A. "A Canadian era for Mining in the Philippines." *Asia Pacific Post.* January 23, 2018.

Su, Glenn Io Sia. "Correlation of climatic factors and dengue incidence in Metro Manila, Philippines." *AMBIO: A Journal of the Human Environment* 37, no. 4 (2008): 292-294.

UN DESA Statistics Division. "The Millennium Development Goals Report 2009." New York: United Nations Department of Economic and Social Affairs, 2009.

UN Economic and Social Council. "Human rights and indigenous issues: Mission to the Philippines." 2003. https://documents-dds-ny.un.org/doc/UNDOC/GEN/G03/115/21/PDF/G0311521.pdf?OpenElement

UN HABITAT. "The State of Asian Citites 2010/2011." Fukuoka: UN Habitat, 2011.

Villanoy, Cesar, Laura David, Ollivia Cabrera, Michael Atrigenio, Fernando Siringan, Porfirio Alino, Maya Villaluz. "Coral reef ecosystems protect shore from high-energy waves under climate change scenarios." *Climatic Change* 112, no. 2 (2012): 493-505.

Wassman, R., Krishna SV Jagadish, K. Sumfleth, Surendra Pathak, G. Howell, A. Ismail, Rachid Serraj, E. Redona Rakash Kumar Singh, Sigrid Heuer. "Regional vulnerability of climate change impacts on Asian rice production and scope for adaptation." In *Advances in Agronomy,* Vol. 102, Burlington (VT): Academic Press, 2009.

Wong, Poh Poh, Inigo J. Losada, Jean-Pierre Gattuso, Jochen Hinkel, Abdellatif Khattabi, Kathleen L. McInnes, Yoshiki Saito, Asbury Sallenger. "Coastal systems and low-lying areas." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press, 2014.

World Bank. 2017a. "Philippines Economic Update April 2017." http://www.worldbank.org/en/news/feature/2017/05/04/philippines-economic-update-april-2017

World Bank. 2017b. "Agriculture, value added (% of GDP)." https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS

World Bank. 2017c. "Employment in Agriculture % in total employment. https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS

World Commission on Environment and Development. *Our Common Future.* New York: Oxford University Press, 1987.

Yamano, Hiroya, Kaoru Sugihara, Keiichi Nomura. "Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures." *Geophysical Research Letters* 38, no. 4 (2011): 1-6.

NOTES

1. Roehlano Briones, "The Philippines Country Environmental Analysis Land Degradation and Rehabilitation in the Philippines." The World Bank, 2009.
2. Food and Agriculture Organization. 2017a. Philippines. http://www.fao.org/faostat/en/#country/171
3. IMF. Data Mapper: Real GDP Percentage Change. http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD/PHL
4. World Bank. 2017a. "Philippines Economic Update April 2017." http://www.worldbank.org/en/news/feature/2017/05/04/philippines-economic-update-april-2017
5. Food and Agriculture Organization, 2017a.
6. Asia Development Bank. "Eradicating poverty and promoting prosperity among a changing Asia-Pacific." https://www.adb.org/sites/default/files/publication/235276/eradicating-poverty-asia-pacific.pdf
7. National Aeronautical Space Administration (NASA). "What is Climate Change." https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-climate-change-k4.html
8. International Panel on Climate Change (IPCC). "History." http://www.ipcc.ch/organization/organization_history.shtml
9. Yasuaki Hijioka, Erda Lin, Joy Jacqueline Pereira, Richard T. Corlett, Xuefeng Cui, Gregory Insarov, Rodel Lasco, Elisabet Lindgren, Akhilesh Surjan, "Asia," in *Climate change 2014: Impacts, adaptation, and vulnerability. Part B: Regional Aspects*, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press, Cambridge, United Kingdom and New York, NY, 2013), 1327-1370.
10. Matthew Collins, Reto Knutti, Julie Arblaster, Jean-Louis Dufresne, Thierry Fichefet, Pierre Friedlingstein, Xuejie Gao, et al, "Long-Term Climate Change: Projections, Commitments and Ireversibility," in *Climate Change 2013: The Physical Science Basis,* Contributions of the Working Group I to the Fifth Assessment of Report of the Intergovernmental Panel on Climate Change (Cambridge, United Kingdom: Cambridge University Press, 2013).
11. A. L. Daniau, P.J. Bartlein, S. P. Harrison, I.C. Prentice, S. Brewer, P. Friedlingstein, et al, "Predictability of biomass burning in response to climate changes," in *Global Biogeochemical Cycles* 26 no.4 (2009). https://doi.org/10.1029/2011GB004249
12. Hijioka et al, "Asia."
13. Ibid.
14. Delpla et al, "Impacts of climate change on surface water quality in relation to drinking water production." *Environment International* 35 (2009): 1225–1233. https://doi.org/10.1016/j.envint.2009.07.001
15. Ibid.
16. Collins et al, "Long-term change: Projections, commitments and irreversibility," 2013.
17. Yamano, Hiroya, Kaoru Sugihara, Keiichi Nomura, "Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures." *Geophysical Research Letters 38,* no. 4 (2011): 1-6.
18. Hijioka et al, "Asia," 2013.
19. John Church, Peter Clark, David Bahr, Jason Box, David Bromwich, Mark Carson, William Collins, et al, "Sea Level Change," in *Climate Change 2013: The Physical Science Basis.* Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge, United Kingdom: Cambridge University Press, 2013), 1137–1217.
20. Thomas R. Knutson, John L. McBride, Johnny Chan, Kerry Emanuel, Greg Holland, Chris Landsea, Isaac Held, John P. Kossin, A.K. Srivastava, Masato Sugi, "Tropical Cyclones and Climate Change," *Nature Geoscience* 3, no. 3 (2010): 157-163.
21. Eric Gilman, Joanna Ellison, Norman Duke, Colin Field, "Threats to mangroves from climate change and adaptation options: a review," *Aquatic Botany* 89, no 2 (2008): 237-250.
22. Eli Kintisch, "Can coastal marshes rise above it all?" *Science* 341, no. 6145 (2013): 480-481.

23. Keryn Gedan, Matthew Kirwan, Eric Wolanski, Edward Barbier, Brian Silliman, "The present and future role of coastal wetland vegetation in protecting shorelines: answering recent challenges to the paradigm," *Climatic Change* 106, no 1 (2011): 7-29.

24. Cesar Villanoy, Laura David, Ollivia Cabrera, Michael Atrigenio, Fernando Siringan, Porfirio Alino, Maya Villaluz, "Coral reef ecosystems protect shore from high-energy waves under climate change scenarios," *Climatic Change* 112, no. 2 (2012): 493-505.

25. World Bank, 2017c, "Employment in Agriculture % in total employment." https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS

26. Food and Agriculture Organization, 2017b. http://www.fao.org/faostat/en/#data/QC

27. Philippine Statistics Authority, 2017a. "Poverty: fishermen, Farmers, and Children constantly post the highest rates of poverty among basic sectors." http://psa.gov.ph/poverty-press-releases

28. Philippine Statistics Authority, 2017b "Tourism." http://openstat.psa.gov.ph/dataset/tourism

29. Philippine Statistics Authority, 2017c "Total number of OFWs estimated at 2.2million (results from the 2016 survey on overseas Filipino Workers." https://psa.gov.ph/content/total-number-ofws-estimated-22-million-results-2016-survey-overseas-filipinos

30. Philippine Statistics Authority, 2017d "Gross National Income and Gross Domestic Product: Gross Value added in mining and quarrying." http://psa.gov.ph/nap-press-release/sector/Mining%20and%20Quarrying

31. Poh Poh Wong, Inigo J. Losada, Jean-Pierre Gattuso, Jochen Hinkel, Abdellatif Khattabi, Kathleen L. McInnes, Yoshiki Saito, Asbury Sallenger, "Coastal systems and low-lying areas," In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects,* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge: Cambridge University Press, 2014).

32. Hijioka et al, "Asia."

33. John Gray, Ian Greaves, Dorina Bustos, David Krabbenhoft, "Mercury and methylmercury contents in mine-waste, calcine, water, and sediment collected from the Palawan Quicksilver Mine, Philippines," *Environmental Geology* 43, no. 3 (2003): 298-307.

34. James Appleton, Jason Weeks, J Calvez, and C Beinhoffd, "Impacts of mercury contaminated mining waste on soil quality, crops, bivalves, and fish in the Naboc River area, Mindanao, Philippines," *Sciences of the Total Environment* 354, no 2-3 (2006): 198-211.

35. Redempto Anda, "Gov't study confirms widespread mercury poisoning in 2 villages in Puerto Princesa City," *Inquirer.net.* June 7, 2017.

36. Food and Agriculture Organization, "Soil resources depletion and deforestation: Philippines case study in resource accounting," 2007. http://www.fao.org/docrep/006/AB604E/AB604E02.htm#TopOfPage

37. Leoc Aragao, "Environmental science: the rainforest's water pump." *Nature 489* (2012): 217-218.

38. Briones, "The Philippines Country Environmental Analysis Land Degradation and Rehabilitation in the Philippines."

39. R.B. Badayos, and F. C. Calalo, "Farm sustainability and organic farming," in *Securing Rice, Reducing Poverty: Challenges and Policy Directions,* SEARCA, College, Laguna, 2007.

40. R. Wassman et al, "Regional vulnerability of climate change impacts on Asian rice production and scope for adaptation." In *Advances in Agronomy,* Vol. 102, Burlington: Academic Press, 2009.

41. Hijioka et al, "Asia."

42. Appleton et al, "Impacts of mercury contaminated mining waste," 2006.

43. Philippine Statistics Authority, 2017e, "Population and housing." https://psa.gov.ph/population-and-housing

44. Hijioka et al, "Asia."

45. Ibid.

46. Ibid.

47. Glenn Io Sia Su, "Correlation of climatic factors and dengue incidence in Metro Manila, Philippines," *AMBIO: A Journal of the Human Environment* 37, no. 4 (2008): 292-294.

48. Hijioka et al, "Asia."

49. Philippine Statistics Authority, 2017a, "Poverty: Fishermen, Farmers, and Children constantly post the highest rates of poverty among basic sectors."

50. UN DESA Statistics Division, "The Millennium Development Goals Report 2009" (New York: United Nations Department of Economic and Social Affairs, 2009).

51. Hijioka et al, "Asia."

52. Ibid.

53. UN HABITAT, "The State of Asian Citites 2010/2011)." Fukuoka: UN Habitat, 2011

54. Alvin Chandra, Karen E McNamara, Paul Dargusch, Ana Maria Caspe, and Dante Dalabajan, "Gendered Vulnerabilities of Smallholder Farmers to Climate Change in Conflict-Prone Areas: A Case Study from Mindanao, Philippines," *Journal of Rural Studies* 50 (2017): 45–59. doi:10.1016/j.jrurstud.2016.12.011.

55. Hijioka et al, "Asia."

56. Ibid.

57. A. Singh, "A Canadian era for Mining in the Philippines." *Asia Pacific Post.* January 23, 2018.

58. Manolo Serapio, "Philippine's Duterte keeps open pit mining ban in policy clash," *Reuters,* November 20, 2017.

59. Adrian Finighan, "Philippines Mining Shutdown," *Al Jazeera.* 2017, February 11. Retrieved from: https://www.aljazeera.com/programmes/countingthecost/2017/02/philippines-mining-shutdown-170211080450892.html

60. Singh, "A Canadian era for Mining in the Philippines."

61. Finighan, "Philippines Mining Shutdown."

62. Ibid.

63. Singh, "A Canadian era for Mining in the Philippines."

64. Serapio, "Philippine's Duterte keeps open pit mining ban in policy clash."

65. Mining Association of Canada, "TSM101: A primer." http://mining.ca/sites/default/files/documents/TSM-101-A-Primer-Eng.pdf

66. Ibid.

67. Singh, "A Canadian era for Mining in the Philippines."

68. Serapio, "Philippine's Duterte keeps open pit mining ban in policy clash."

69. Antonio Contreras, "Blood and money in the sand: The tragic story of the Atis of Boracay." *The Manila Times*. February 27, 2018. http://www.manilatimes.net/blood-money-sand-tragic-story-atis-boracay/382990/

70. Antonio Contreras, "Blood and money in the sand: The class dimension of Boracay environmental disaster." *The Manila Times.* March 1, 2018. http://www.manilatimes.net/blood-money-sand-class-dimension-boracay-environmental-disaster/383394/

71. OECD. "Agricultural Policies in the Philippines." Paris: OECD Publishing, 2017.

72. Ibid.

73. Ibid.

74. Ibid.

75. Caesar Cororator, Erwin Corong, 2009. "Philippine Agriculture and Food Policy: Implications for poverty and income distribution." https://ageconsearch.umn.edu/record/55512/files/rr161.pdf

76. OECD, "Agricultural Policies in the Philippines."

77. Ibid.

78. OECD, "Agricultural Policies in the Philippines."
79. Ibid.
80. Cororaton and Corong, "Philippine Agriculture and Food Policy: Implications for poverty and income distribution."
81. OECD, "Agricultural Policies in the Philippines."
82. Emma Rumney, "Philippines Agriculture counterproductive, warns OECD."
83. Chandra et al, "Gendered Vulnerabilities of Smallholder Farmers to Climate Change in Conflict-Prone Areas: A Case Study from Mindanao, Philippines."
84. Ibid.
85. Ibid.
86. Ibid.
87. Christopher Jasparro, Jonathan Taylor, "Climate Change and Regional Vulnerability to Transnational Security Threats in Southeast Asia."
88. UN Economic and Social Council, "Human rights and indigenous issues: Mission to the Philippines."
89. Ibid.
90. Roland Simbulan, Roland G. "Indigenous Communities' Resistance to Corporate Mining in the Philippines."
91. ASEAN, "Best Practice on sustainable mineral development in ASEAN." http://asean.org/?static_post=sustainable-practice-minerals-development-best-practices-asean
92. Johan Galtung, "Conflict as a way of life." In *Progress in Mental Health.* London: Churchill Press, 1969.
93. World Commission on Environment and Development. "Our Common Future." New York: Oxford University Press, 1987.
94. Robert Gibson, "Beyond the pillars: Sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making." *Journal of Environmental Assessments and Political Management* 8, no 3 (2006): 259-280.
95. Ian Harris, *Peace Education in a Postmodern World: A Special Issue of the Peabody Journal of Education.* London: Taylor and Francis, 2004.
96. Galtung, "Conflict as a way of life," 1969.
97. Thomas Homer-Dixon, *Environment, Scarcity and Violence.* New York: Princeton University Press, 1999.
98. Ibid.
99. Jonathan Jasparro, "Climate Change and Regional Vulnerability to Transnational Security Threats in Southeast Asia."
100. CHR, "CHR to conduct first hearing investigating possible contribution of carbon to climate change and its impacts on human rights," 2018.
101. Ibid.
102. Ibid.
103. Ibid.