WVCST: Balancing Development with Environmental Management

Jasper Pastrano's Challenge

In June 2013, Jasper Pastrano returned to his alma mater, the Iloilo City, Philippines-based Western Visayas College of Science and Technology (WVCST) as a science professor. He had been away from the school for more than three years as he took part in a scholarship program that would allow him to earn his doctoral degree. He taught physics prior to entering the program, but now was instructing education and engineering students in a subject that was new to their curricula — environmental education.

As he walked across campus to his assigned classroom, what he observed disturbed him: countless trees being cut down, new construction, and an increase in population. As a science professor, he understood that the increase in development and population would also mean a spike in electrical energy consumption and make for a hot, gray, polluted environment.

The WVCST Board of Trustees would be meeting in three weeks to address issues raised by the students and other concerned groups over the imbalance between environmental management and development. They threatened to file criminal charges against the college for violation of Republic Act No. 3571 (an act to prohibit the cutting, destroying or injuring of planted or growing trees, flowering plants and shrubs or plants of scenic value along public roads, in plazas, parks, school premises or in any other public ground).[1]

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The board tasked Pastrano with preparing a report describing the impacts the development had on the environment in and around the college as well as offer recommendations to address the complaints. He wondered: What are the big issues in this case? Are there ways to balance carbon dioxide (CO_2) and oxygen (O_2) exchange? What mitigation plan should I recommend to the college to balance its carbon emissions with sequestration? In terms of infrastructure development, what should I recommend? What are the roles stakeholders could play?

After class, Pastrano found himself in the midst of friends who shared his qualities as an excited, idealistic, progressive, and environmentally active professor. As a senior faculty member, Pastrano shared information with his colleagues about how the college had evolved from a small school to a state college known as WVCST.

History of WVCST

WVSCT was established in 1905 as an elementary trade school known as the Iloilo Trade School.[2] By virtue of Commonwealth Act No. 313 of 1939, it was converted into the Iloilo School of Arts and Trades became its official name.[3] In 1940, the school offered a two-year teacher education curriculum and a three-year curriculum for those who graduated high school.[4]

In 1951, the school was authorized to provide a degree program for a bachelor of science in industrial education. The school was later made into a training center for the development of an industrial arts program when a team of industrial educators from Stanford University arrived in 1957.[5] In 1968, it also became a training center for the National Manpower and Youth Council.[6] In 1974, the Educational Development Project Implementation Task Force chose the school to be the regional staff development center for practical arts in Western Visayas.[7] It also implemented a graduate program for technical vocational education in 1976, offering the degree of Master of Arts in Teaching Vocational Education.[8] And in May 1983, by virtue of Republic Act 395, the school was converted into a state-chartered college known as the Western Visayas College of Science and Technology.[9] The college grew to become one of the Philippine's leading technological and professional manpower development institutions.

WVCST administration building. Source: WVCST.

Most of the campus' buildings were constructed during the Third Republic from 1946-1972, and mainly consisted of wooden material with an American design. In the late 1990s new construction replaced many of these buildings. During this construction many trees were cut down and a mini forest was planted to replace some of the loss. Another construction boom began in 2010, leading to the elimination of still more trees.

Under Construction

The 2010 construction was funded through the Philippine Senators and Congressional Representatives Priority Development Assistance Fund. The funding allowed the college to rehabilitate old buildings and build new ones, transforming a campus of buildings with an old American design to one arrayed with 21st century concepts. After the construction, the college offered exciting new courses to fill the new classrooms. Enrollment grew from 4,500 students to 6,650 students and faculty and employee headcount increased by 100 individuals, causing overcrowding.

The construction of new buildings. Source: WVCST.

Development and Environmental Impacts

The development excited stakeholders, but adversely impacted the environment. Trees that were planted in the 1930s, which created shade while producing O_2, had been cut down to accommodate the new construction. Temperatures not only increased outside buildings, but also inside. To cool offices and classrooms, the college invested in air-conditioning units and electric fans, causing its monthly electric bill to spike to PHP 1 million (USD 22,727) from PHP 750,000 (USD 17,045). The college tried to cut costs by running its air-conditioning units and electric fans from 9 a.m. to 4 p.m. only, but this approach had a minimal effect.

The president of the college's Environmental Club convinced students to join him in his campaign against tree clearing on campus. The club filed a position paper with the board to no avail. Still, there was growing support among the student body, environmental groups, and the local media.

Meanwhile, confronted with the threat of legal action, Pastrano was determined to find a solution to the college's environmental management problem. It was Roly Gambol, president of the Faculty and Employees' Association and a member of the board, who approached Pastrano and asked him to launch an investigation.

The newly constructed HRT Business Center. Source: WVCST.

Climate Change: A Global Concern

Once a student leader himself, Pastrano understood the plight of both the administration and the activists — the administration wanted to continue down the path of development, while the activists sought environmental protections. He hoped he would be able to present data to the board that would help it to come to a decision that would be acceptable to both the Environmental Club and the college administration.

To fast track the research, Pastrano asked his friends for help. Their focus was climate change; the students claimed it caused the warming inside and outside campus buildings. The group researched the issue for a week and met to discuss what they had uncovered.

They found that climate is the average weather pattern that takes place over many years.[10] Weather is constantly changing, while climate also does not stay the same. Factors such as rainfall, humidity, and temperature contribute to climate change. Changing the climate on a global scale requires that the amount of heat that is let into the system changes, or the amount of heat that is let out of the system changes. For example, warming climates are either due to increased heat let into the earth or a decrease in the amount of heat that is let out of the atmosphere.

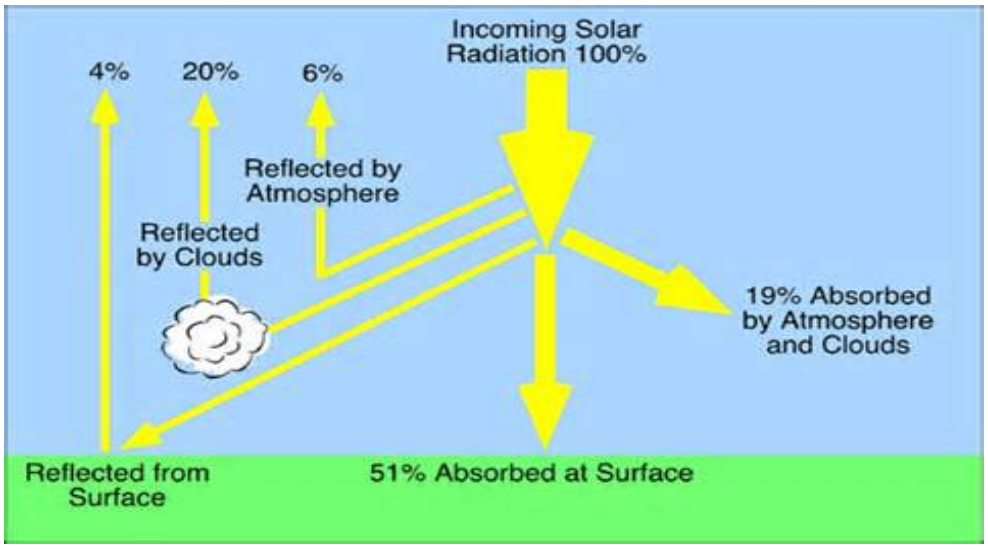
The amount of heat energy given off or absorbed in the atmosphere is due to the greenhouse effect. This phenomenon is a naturally occurring process that heats the earth's surface and atmosphere.[11] It is catalyzed by some atmospheric gasses, such as CO_2, water vapor (H_2O), and methane (CH_4); and changes the energy balance of the planet by absorbing long wave radiation from the earth's surface. The term "greenhouse" is used to describe this phenomenon since these gases act like the glass of a greenhouse to trap heat and maintain higher interior temperatures than would normally occur.[12] Without the greenhouse effect, it is not possible to sustain life on the planet — the average temperature of the earth would be -18° C, rather than the present 15° C.[13]

Twenty-six percent of solar energy is reflected back to space by clouds and particles.[14] About 19% of the energy available is absorbed by clouds, gasses, and particles in the atmosphere. The remaining 55%

of the solar energy passes through the earth's atmosphere, while about 4% is reflected from the earth's surface back to space. On average, about 51% of the sun's radiation reaches the surface.[15] (See **Exhibit 1**). This energy is used in a number of processes including the heating of ground surfaces, melting of ice and snow, evaporation of water, and plant photosynthesis.[16]

Exhibit1

Solar Radiation

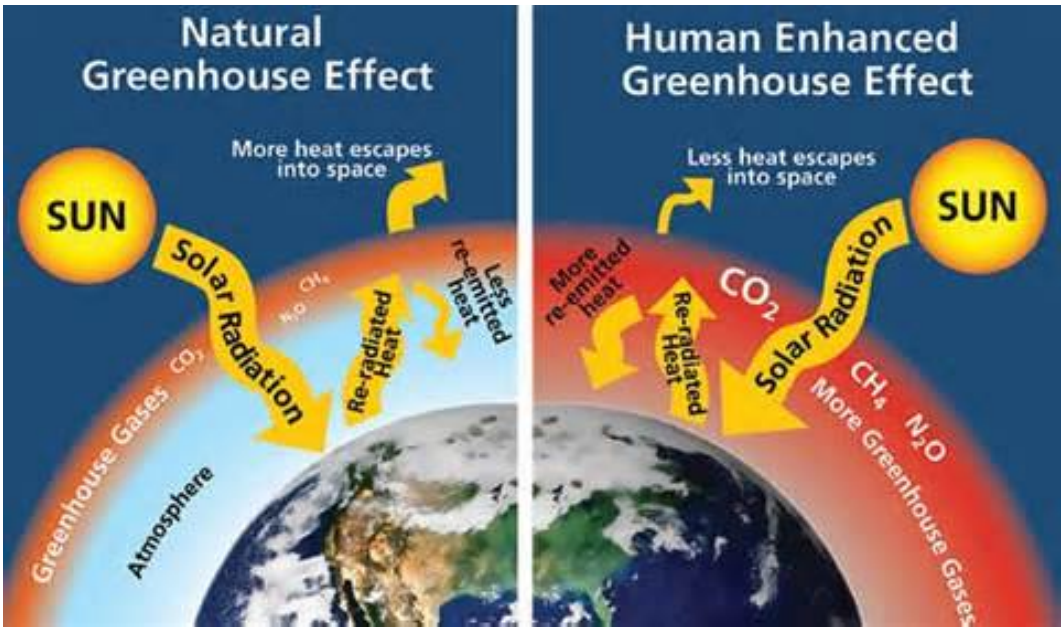


Source: Michael J. Pidwimy, Ph.D., department of geography, Okanagan University College. <http: //geolab.gzhu.edu.cn/resources/courseware/PhysGeogBook/contents/7f.html.>.

The heating of the ground by sunlight causes the earth's surface to become a radiator of energy in a long-wave band (infrared radiation). The emission of energy is generally directed to space, however, only a small portion of this energy actually reaches space. The majority of the outgoing infrared radiation is absorbed by a few naturally occurring atmospheric gases known as greenhouse gases. Absorption of this energy causes additional heat energy to be released to the Earth's atmosphere. The warmer the atmosphere's greenhouse gas molecules, the more it will radiate long-wave energy. This emission contains over 90% of the long-wave energy that is directed back to the Earth's surface where it is once again absorbed.[17] The heating of the earth surface's by long-wave radiation causes the ground surface to once again radiate, repeating the cycle discussed above, again and again, until long wave bands are no longer available for absorption.[18] (See **Exhibit 2**).

Exhibit 2

The Greenhouse Effect



Source: ifink.com. <http://www.i-fink.com/the-greenhouse-effect/>.

The amount of heat energy added to the atmosphere by the greenhouse effect is controlled by the concentration of greenhouse gases in the Earth's atmosphere. All of the major greenhouse gases have increased in concentration since the beginning of the industrial revolution. Scientists have identified a number of gasses involved in the greenhouse effect. These gasses include: CO_2, CH_4, nitrous oxide (N_2O), chlorofluorocarbons (CF_xCl_x), and tropospheric ozone (O_3).[19] Of these gases, the single most important gas is CO_2, which accounts for about 55% of the change in the intensity of the earth's greenhouse effect.[20] The contributions of the other gases are: 25% for CF_xCl_x, 15% for CH_4, and 5% for N_2O.[21] Ozone's contribution to the enhancement of the greenhouse effect has yet to be quantified. The major greenhouse gas concentrations and sources are shown in **Appendix A.**

Scientists have observed that CO_2 in the earth's atmosphere had increased by 29% since 1750. About three-quarters of the anthropogenic emissions of CO_2 to the atmosphere were due to the burning of fossil fuels during the Industrial Revolution. The rest was predominantly due to land-use change, especially deforestation.[22] During the 1990s, the year-to-year increase varied from 0.9 ppm (0.2%) to 2.8 ppm (0.8%). A large part of this variability was due to the effect of climate events like El Niño on CO_2 uptake and release by land and oceans. It was observed that the rate of increase of atmospheric CO_2 concentration had been about 1.5 ppm (0.4%) per year since 1970.[23]

Global warming trends could cause a significant impact on global climate. Climate patterns and human adaptations determine the availability of food, fresh water, and other resources necessary for sustaining life. The social and economic characteristics of a society are shaped by weather patterns, particularly temperature and rainfall. Some potential effects associated with global warming are as follows.

Rising Water Levels

Warm surface temperatures cause glaciers, polar ice shelves, and other ice bodies to completely destabilize and melt. This in turn increases the amount of water in the world's oceans thus contributing to a rise in sea levels. This rise especially threatens populations located in low lying coastal areas due to

their vulnerability to flooding. Scientists speculate that the melting ice from Greenland and Antarctica is capable of raising sea levels by more than 20 feet by 2100.[24]

Drought

Due to intense heat, there could be large scale evaporation, which would be the major cause of drought in many regions, particularly Africa. Increased global warming would make the situation worse, causing famine.

Plants and Animals

All plants and animals live in regions with specific climate and geological conditions that enable them to survive and reproduce. Any change in climate can affect plant and animal biodiversity. Some species respond to warmer climatic conditions by migrating to cooler locations. Climate change is also capable of altering the life cycles of plants and animals.[25]

Extinction

Warming water temperatures, desertification,[i] and deforestation can all have irreversible impacts on natural habitats, threatening the extinction of plant and animal life. An example of this is the spotted deer. It is considered to be an endangered species, in part, due to its inability to adapt to volatile temperatures resulting from deforestation.

Storms

Global warming has increased the severity of storms. Warmer temperatures and warmer ocean waters fuel the intensity of storms, leading to a spike in the number of typhoons. The frequency of severe storms had increased since 1980, causing damage to property and resources as well as loss of life.[26] This was especially true when Typhon Haiyan hit the Philippines and took thousands of lives, destroyed property, and left virtually nothing to survivors.

Economy

Natural disasters such as hurricanes and floods resulting from global warming are expensive affairs for governments due to clean-up, property damage, and rehabilitation costs. These crises result in price hikes for food and energy. Many countries whose national income is tied to just one or two industries that are dependent on the environment run an enormous financial risk.

The Role of Trees

Around campus were different varieties of trees, gardens, and lawns. There were four new three-story buildings with a total ground floor area of 10,287.44 m² (see **Exhibit 3**), seven new two-story buildings with a total ground floor area of 7,586.65 m², and four one-story buildings with a total ground floor area of 1,491.05 m². The buildings were situated in strategic locations. These data were provided to Pastrano by Gambol.

In addition, Gambol provided data on the species of the trees on campus and their capacity to absorb CO_2, as well as their ability to give off O_2 and remove pollution. Looking at the trees, students and teachers also said they gained a sense of serenity. Trees seem to make life more pleasant and

i Desertification is a type of land degradation in which a relatively dry land region becomes increasingly arid, losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as climate change and human activities. Desertification is a significant global ecological and environmental problem.

meaningful. Pastrano used tables to explain what he meant on a deeper level. **Table 1** provides a description of how trees and plants affect the environment.

Exhibit 3

New Building to be Constructed

Source: WVCST

Table 1

CO_2 and O_2 Exchange

Diameter at Breast Height (cm)	No. of Trees	O_2 Produced (kg/year)	Carbon Sequestration (kg/year)	Pollution Removal (kg/year)
0 cm – 30 cm	40	109.09	36.36	1.27
31 cm - 53 cm	86	1,915.45	742.73	31.27
54 cm - 76 cm	87	4,547.73	1,700.45	87.00
77 cm and above	131	14,707.73	5,537.73	315.59
Total	344	21,280.00	8,017.27	435.14

Source: Created by the author of the case.

Greenhouse gas mitigation strategies must be used to control global warming. There are two main approaches to slow the buildup of greenhouse gases. One is to reduce the consumption of fossil fuels; the other is to keep CO_2 out of the atmosphere by storing the gas or its carbon component somewhere else, a strategy known as "carbon sequestration" or "carbon capture."

The way to keep CO_2 emissions from reaching the atmosphere is to plant more trees. Trees soak up a great deal of CO_2 from the atmosphere and store carbon atoms in new wood. Forests were being cleared at an alarming rate, particularly in the tropics. In many areas, there was little regrowth as land lost fertility or was converted for other uses, such as farming or housing development. In addition, when trees are burned to clear land, they release stored carbon back into the atmosphere as CO_2.

The college could add to the rate of carbon sequestration by planting more trees. This had already been tested during the administration of Philippines President Ferdinand Marcos. Under presidential

decree, he required every student from elementary school to college to plant at least 10 trees before graduation.[27] If this practice was continued at WVCST, the college would go a long way toward mitigating CO_2 emissions.

Environmental Benefits

Now the friends understood the important role trees played in absorbing CO_2 and other pollutants. To improve air quality, conserve water, and cool the atmosphere, trees had to be planted. During the summer months, the shade of trees keeps individuals cool and offers protection from direct sunlight. When the rainy season comes, rainfall is deflected by trees, providing some degree of protection for people, pets, and buildings. Trees also intercept water, store some of it, and reduce storm runoff and flooding.[28]

The temperature in the vicinity of trees is cooler than that away from trees, and the larger the tree, the greater the cooling capacity. The research team found that if additional trees were planted on campus, the heat-island effect[ii] caused by pavement and buildings could be moderated. Moreover, air quality could be improved by planting trees, shrubs, and grass. Leaves filter the air, while rain washes the pollutants to the ground. Leaves absorb CO_2 from the air to form carbohydrates that are used in plants' structure and function. In this process, leaves also absorb other air pollutants, such as O_3, carbon monoxide, and sulfur dioxide, while giving off O_2.[29]

CO_2: The Major Culprit

The 2012 Report on Trends in Global CO_2 Emissions by PBL Netherlands Environmental Assessment Agency indicated there was a decrease of 1% of CO_2 in the atmosphere in 2009. In 2010, there was a 5% surge, and global CO_2 emissions increased by 3% in 2011 compared to the previous year, reaching an all-time high of 34 billion tons.[30]

CO_2 is used by green plants in the process known as photosynthesis, by which carbohydrates are manufactured. It constantly circulates in the environment through a variety of natural processes known as the carbon cycle. Volcanic eruptions and the decay of plant and animal matter both release CO_2 into the atmosphere.

Cellular respiration is the process by which nutrients are converted into useful energy. A byproduct of respiration is the formation of CO_2, which is exhaled by animals into the environment. Oceans, lakes, and rivers absorb CO_2 from the atmosphere, while plants collect CO_2 and use it to make food. In this process, plants incorporate carbon into new plant tissue and release O_2 into the environment as a byproduct.[31]

To provide energy to heat buildings, power automobiles, and fuel power plants, humans burn material that contains carbon, such as fossil fuels like oil, coal, and natural gas. When these products are burned, they release CO_2 into the air. In addition, humans cut down huge tracts of trees for lumber, to clear land for farming, and for new construction. This deforestation can both release the carbon stored in trees and significantly reduce the number of trees available to absorb CO_2.[32]

As a result of human activities, CO_2 in the atmosphere is accumulating faster than the Earth's natural processes can absorb the gas. By analyzing air bubbles trapped in glacier ice that is many centuries old, scientists have determined that CO_2 levels in the atmosphere have risen by 29% since

ii The term "heat island" describes developed areas that are hotter than rural areas.

1750. And since CO_2 can remain in the atmosphere for centuries, scientists expect these concentrations to double or triple in the next century if current trends continue.[33]

Global warming is an important issue on both national and international levels. Responding to the challenge of controlling global warming will require fundamental changes in energy production, transportation, industry practices, government policies, and development strategies around the world. The challenge will be managing the impacts that cannot be avoided, while taking steps to prevent more severe impacts in the future.

Findings and Recommendations

The group had completed its research, identifying the main sources of CO_2 on campus to be the clearing of trees for new development, an increase in the school population, and a spike in electrical energy consumption. The group agreed that the volume of CO_2 emitted into the atmosphere must be canceled out by the CO_2 sequestered by plants and trees inside or outside of the campus. Pastrano directed his friends to **Appendix B** for information on the amount of CO_2 emitted into air.

Finally, Pastrano and his friends completed their study on the impact of development to the environment. They explained the effect of cutting down trees in terms of temperature changes, and demonstrated how trees could absorb the CO_2 emitted into the environment by students, teachers, employees, and electrical energy consumption. The data that Gambol gave them were useful in determining the number of trees that remained on campus as well as their ability to sequester CO_2 and other pollutants, while increasing the volume of O_2 being released into the air.

The data they gathered proved that with the current number of plants and trees on campus and the increase in development, population, and energy consumption, the college's CO_2 emissions would not be balanced with carbon sequestration.

The friends pondered several questions as they went about preparing their recommendations: Which mitigation strategies should the school adopt? Should the college purchase new ecofriendly electrical equipment, and would there be funds for it? What about the school's high rate of energy consumption — which strategies should the college employ to decrease its use? What could students, teachers, and the community do to lessen the burden? Which roles could the media, environmental activists, and other concerned groups play in addressing the issue? Would the administration and the Environmental Club agree on a solution? The friends had just one day left before they would have to present their findings and recommendations to the board. They sat down and began to craft their report.

Appendix A

Major Greenhouse Gas Concentrations and Sources

Greenhouse Gas	Concentration in the year 1750	Concentration in the year 2003	Percentage Change	Natural and Anthropogenic Sources
Carbon Dioxide	280 ppm	360 ppm	29%	Organic decay, forest fires, burning of fossil fuels, deforestation, land use change.
Methane	0.70 ppm	1.70 ppm	143%	Wetlands, organic decay, termites, natural gas and oil extraction, biomass burning, burning of fossil fuels.
Nitrous Oxide	280 ppb	0.310 ppb	11%	Forest, grasslands, oceans, soils, soil cultivation, fertilizers, biomass burning, burning of fossil fuels.
Chlorofluorocarbons	0	900 ppt		Refrigerators, aerosol spray propellants, cleaning solvents.
Ozone	Unknown	Varies with latitude and altitude in the atmosphere.	Global levels have generally decreased in the stratosphere and increased near the Earth's surface in recent years.	Created naturally by the action of sunlight on molecular O_2 and artificially through photochemical smog production.

Note: ppm=parts per million; ppb=parts per billion; ppt=parts per trillion

Source: Joseph, Benny. Environmental Studies. 2009. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Appendix B

Sources of CO_2 on Campus

Major source of CO_2	Total population in the campus	CO_2 emissions per Capita (g/day)	Total No. of work hours at school per year	Total No. of work hours in one school year	Total CO_2 emissions at 8 work hours at school (kg)	Average volume of CO_2 (ton/month)	Average volume of CO_2 (tons/year)
Students	6,500	565	23.5	1,600	244,400	21.3	256.432
Teachers and employees	320	565	23.5	1,600	12,032		
Average electric energy consumption (76, 345 kw per month)						57	684
Total						80.89	971.512

Source: Created by the author of the case.

Endnotes

1 Chan Robles Virtual Law Library. Republic Act No. 3571. Web. Accessed 11 Nov. 2014. <http://www.chanrobles.com/republicactno3571.htm>.
2 Western Visayas College of Science and Technology. "About WVCST: A Glimpse of the Past." Web. Accessed 11 Nov. 2014. <http://www.wvcst.edu.ph/?page_id=11>.
3 Ibid.
4 WVCST. "About WVCST: History." Web. Accessed 11 Nov. 2014. <http://www.wvcst.edu.ph/?page_id=9>.
5 Ibid.
6 Ibid.
7 Ibid.
8 WVCST. "About WVCST: A Glimpse of the Past."
9 WVCST. "About WVCST: History."
10 Australian Government. "Understanding Climate Variability and Change." Web. Accessed 11 Nov. 2014 <http://www.pacificclimatefutures.net/en/help/climate-projections/understanding-climate-variability-and-change/>.
11 The Encyclopedia of Earth. "Causes: Greenhouse Effect." 17 Sept. 2008. Web. Accessed 11 Nov. 2014. <http://www.eoearth.org/view/article/153146/>.
12 Earth System Research Laboratory, Global Monitoring Division. "Frequently Asked Questions: Questions about Greenhouse Gases." Web. Accessed 11 Nov. 2014. <http://www.esrl.noaa.gov/gmd/outreach/faq_cat-3.html>.
13 U.S. Department of Energy Office of Science. "Ask a Scientist: Does the greenhouse effect occur naturally?" ARM Climate Research Facility. Web. Accessed 11 Nov. 2014. <http://education.arm.gov/studyhall/ask/past_question.php?id=445>.
14 The Encyclopedia of Earth.
15 Ibid.
16 Ibid.
17 PhysicalGeography.Net. Fundamentals eBook. Chapter. 7, "Introduction to the Atmosphere." Web. Accessed 11 Nov. 2014. <http://www.physicalgeography.net/fundamentals/7h.html>.
18 Ibid.
19 Ibid.
20 Ibid.
21 Ibid.
22 The Rough Guide to Climate Change. 3rd Edition. New Delhi: Rough Guide Ltd, 2011.
23 Houghton, J.T., et al. Climate Change 2001: The Scientific Basis. 2001, Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge U.K. <http://www.ipcc.ch/ipccreports/tar/wg1/pdf/WG1_TAR-FRONT.PDF>
24 Joseph, Benny. Environmental Studies. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2009.
25 United States Environmental Protection Agency. "Climate Impacts on Ecosystems." Web. Accessed 12 Nov. 2014. <http://www.epa.gov/climatechange/impacts-adaptation/ecosystems.html>.
26 Environment America. "Global Warming and Extreme Weather: The Science, the Forecast, and the Impacts on America." 8 Sept. 2010. Web. Accessed 12 Nov. 2014. <http://www.environmentamerica.org/reports/ame/global-warming-and-extreme-weather-science-forecast-and-impacts-america>.
27 Sabandal, James. "DENR-7 to Revive Marcos Law." 9 June 2014. Metro Cebu News. Web. Accessed 12 Nov. 2014. <http://metrocebu.com.ph/2014/06/denr-7-to-revive-marcos-law/>.
28 The City of Bowling Green Kentucky. "Benefits of Planting Trees." Web. Accessed 12 Nov. 2014. <http://www2.bgky.org/tree/benefits.php>.
29 Ibid.
30 Olivier, Jos G.J. et al. "Trends in Global CO_2 Emissions 2012 Report." 2012. PBL Netherlands Environmental Assessment Agency, The Hague/Bilthoven. Web. Accessed 12 Nov. 2014. <http://edgar.jrc.ec.europa.eu/CO2REPORT2012.pdf>.
31 Bitesize. "Carbon and oxygen cycles." *BBC*. Web. Accessed 12 Nov. 2014. <http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_pre_2011/chemicals/biocompoundsrev3.shtml>.
32 FAO Corporate Document Repository. "Forests and climate change: Carbon and the greenhouse effect." Web. Accessed 12 Nov. 2014. <http://www.fao.org/docrep/005/ac836e/AC836E03.htm>.
33 Joseph, Benny.