Environmental & Economic Impacts of Sea Level Rise

Do you believe our oceans are rising? Has the phrase "sea level rise" become a cliché, concept, or idea which has become overused to a point it has lost much value? What proof do the scientists have to convince the world that global warming is changing climates and creating sea level rise? To understand and accept the concept of sea level rise, the time-tested quote by Sir Frances Bacon in 1597, "Knowledge is Power", becomes extremely important as one must self-educate by creating a concoction comprised of such ingredients as history, technology, and the disturbing evidence scattered predominantly throughout our planet. For best results, the evidence should be both visually observed and supported by data collected over an extended period of time.

First, the impacts of sea level rise are as equally diverse as the factors causing the immense destruction. Environmental concerns include, but are not limited to, coastal shoreline changes, erosion, wetland and marsh disruption, and ecosystem and habitat alterations. Economic impacts include, but are not limited to, real estate values, investment risk, zoning changes, construction standards, permitting and approvals, damaged utilities and infrastructure, lost revenue from tourism, and a decrease in government taxation revenues.

The quickest method to grasp the impact of sea level rise is to first accept the concept and supporting causes of global warming. As of January 2014, current concentration levels of carbon dioxide in the Earth's atmosphere were measured at 397.80 parts per million (co2now.org, 2014). In an article produced by the *New York Times* the previous year, the average carbon dioxide reading level surpassed 400 parts per million at a research facility atop the Mauna Loa volcano on the island of Hawaii (Gillis, 2013). Though it appears concentration levels of carbon dioxide

fluctuate, scientists are observing carbon dioxide levels not measured on Earth in three million years. Of equal or perhaps larger concern, concentration levels have remained higher than the upper safety limit of 350 parts per million since 1988 (co2now.org, 2014).

Global needs for the Earth's resources are mainly due to society's wasteful and disposable behaviors, which now encumbers a world population exceeding seven billion people (USCB, 2014). With the need for the business world to exceed last year's sales or profits combined with the extraordinary speed in technological change, society's ability to modify the many wasteful habits embedded in our lifestyles will be a daunting task. Regardless of location, children and young adults of the world are living in a much different world than the baby boomers or previous generations. With the lack of environmentally friendly habits merged with population projections expected to exceed nine billion people by 2050 (Biello, 2009), the need for deforestation will continue to rise which will further compromise our forests' ability to aid in the process of absorbing harmful gases from the atmosphere. An estimated 18 million acres of forest are lost annually to the deforestation process, a process which will increase as the world attempts to feed its growing population (Herzog, 2009), but the main man-made causes of increased levels of carbon dioxide into the atmosphere include the burning of fossil fuels for transportation and heating needs, agricultural processes, cement production, and electricity.

To better understand greenhouse gas causes, clarification is needed pertaining to global warming misconceptions. Based on a Swiss Environment Survey in 2007, two-thirds of the respondents interpreted the greenhouse effect as a result of the ozone hole, and 72% did not make the connection that carbon dioxide is linked to global warming (Reinfried, et al, 2012). Combine these misconceptions with an International Energy Agency report stating that global temperatures could increase by 3.6 degrees by the year 2035, even despite a moderate rise in

renewable or efficient energy use. It would appear the quote "education is the most powerful weapon which you can use to change the world" (Mandela, date unknown) needs immediate worldwide implementation. How is civilization even able to welcome data, evidence, or solutions to a problem which is not understood? Education needs to be forever placed in the forefront of the global warming and sea level rise problem.

Though the rate of sea level rise includes data which is under much scrutiny, one consistent fact of all projections does exist: sea level rise will continue to accelerate as global warming increases. Based on a University of Hawaii study performed in December 2013, sea level rise will accelerate and rise between 18-48 cm by 2050 and 50-140 cm by the year 2100. Is it practical to accept the prediction by University of Washington geologist, Peter D. Ward, in a book titled *The Flood Earth: Our Future in a World Without Icecaps* (Marian, 2012), if the Earth's global temperature increases by 4° by the year 2100, sea level could rise 30 feet? As with an extended weather forecast, projections into the future will always be challenged for many reasons, but the process of thermal expansion of melting water has been scientifically proven in laboratories throughout the world. Acceptance of Ward's prediction even with 50% error will result in dire consequences for our planet.

Environmental Impacts of Sea Level Rise

The immediate impact of a coastal event is erosion, sand dune damage, and loss of vegetation. A recent example of this type of event occurred during Hurricane Sandy on Fire Island, New York, a disheartening story of coastal erosion devastation in which the United States Geological Survey was able to conduct an extensive post-storm beach and dune survey, and compare it with a pre-storm study. In comparing both sets of data, they determined Fire Island

had severely eroded. Landward shift of the upper portion of the beach averaged 19.7 meters, and the shore prograded (shifted toward the water) an average of 11.4 meters in a process similar to the Bruun Model, a concept first introduced in 1954 to evaluate sea level rise impacts on shorelines. In the model, wave action erodes the upper beach and drags or pulls sediment closer to the shoreline or into shallow waters. With this change in shoreline topography, or in some instances underwater bathymetry, the stillwater elevation increases. Aided by wind, wave set-up, and storm surge, water volume is drastically increased allowing for the delivery of ocean waters to inland areas which have been dry for thousands of years (Davidson, 2005). Though several assumptions in this model have been challenged, it remains a common management tool.

Further evaluation identified a loss of 54.4% of pre-storm volume, and the dunes experienced 46.6% over wash. Since 14% of the volume lost was identified inland, over 40% of the erosion event was moved offshore (Gillis, 2013), resulting in much less landward protection and a higher stillwater elevation, a dangerous combination moving forward. This is especially important since Fire Island was left extremely vulnerable to future storms. Recovery is occurring slowly, but the dunes will take many years to recover (Hapke, et al, 2013).

The concept of becoming vulnerable to future storms is a huge component of storm impact, but often overlooked. Hurricane Sandy had much more impact to this geographic region due to a weakened shoreline caused by Hurricane Irene just 14 months prior. Should this region encounter another large tropical storm in the immediate future, damage will be much greater due to losses encountered from previous storms. This concept is applicable throughout our planet, and storms with much less intensity also aid in this process. All storms cause damage to a shoreline, even if not visibly apparent.

In Louisiana alone, coastal wetlands contain approximately 37% of all estuarine

herbaceous marshes in the contiguous United States. Long-term stability of wetlands hinges on its ability to maintain elevation equilibrium with mean sea level through plant production and sediment accretion. More specifically, wetland vegetation exists as factors of tidal duration and depth, and plant species adapt to tidal influence and salinity. Studies support the existence of salt water marshes persisting between mean high tide and mean higher high water, but with some site-specific differences (Glick, et al, 2013).

Throughout the United States and the world, coastal wetlands support the robust commercial fishing industry as they provide a home for millions of fish, wildlife, and fowl. These same wetlands also provide countless coastal communities throughout the world with a natural defense to tropical storms and hurricanes. In Louisiana, geologists have computed the state will lose a wetland the size of a football field every hour if the trend of lost wetlands over the last 25 years continues to exist (Glick, et al, 2013). As sea level rise continues to accelerate, the loss of these extremely important water bodies will certainly occur at a quicker rate.

As the climate changes and sea level rise occurs, land and marine ecosystems will also be impacted. As water temperature rises, oceans expand by several methods, and species will have to adapt to these changes. Plankton, an organism which is unable to swim against the current, is a crucial source of food for many larger species such as fish and whales. Without available plankton, food chain disruption will occur. With a continued increase in carbon dioxide into the atmosphere, sea level rise will aid in causing endangerment or extinction of marine organisms (Saleh & Haddoud, (2013).

To further emphasize the importance of marine ecosystems, they are arguably the most important and irreplaceable system in the world, providing coastal defense, a habitat for many living organisms, nutrient recycling, climate regulation, oxygen production, and carbon dioxide

absorption. Sea level rise will continue to have large negative impacts to the many important components of ecosystems.

Economic Impacts of Sea Level Rise

The National Flood Insurance Program defines a flood as "*a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is the policyholder's property)*". Most homeowners do not know that a homeowner's policy does not cover damage caused by a natural flood event. This oversight was realized by many State of Vermont residents as the damage caused by Hurricane Irene was not covered by homeowner policies, and unfortunately, many did not have flood insurance. If you do not have a second policy, you probably do not have flood coverage.

As sea level rise continues and storms are slowly reaching homes which have been safe for generations, the risk of damage increases, and so will the premiums. If a federally-backed or insured loan to purchase a home or investment is created, and the improvements to be used as loan collateral fall in a Special Flood Hazard Area, mandatory insurance will be required. The limits of coverage for a residential home are $250,000, and an additional $100,000 is available for personal contents. These limits are often deficient of the actual value of the financed improvements used as loan collateral.

The real estate industry will change drastically upon a value adjustment created appropriately due to actual risk. Several scenarios may play out, but the result will be similar. An applicant to a loan encumbered with required mandatory flood insurance will have diminished purchasing power. A seller will lose value upon the placement of mandatory flood insurance. Homes with deficient flood insurance coverage, or none at all, will be impacted

greatly with a reduction in asset value. Until a time comes that values created within a real estate transaction does not overlook actual risk, loan defaults and foreclosures will be an applicable topic. As sea level rise continues to impact our coastal communities, real estate values will remain in peril. Remember, the flood maps are a guide used by insurance agents to create a premium based on perceived risk, not actual risk. In fact, 26% of all flood claims occur outside the designated high risk area (NFIP, 2014). With the slow movement of floodplain mapping combined with the side effects of sea level rise, this percentage will increase.

As new data-based maps become effective, these risk evaluation documents will increase the areas of high risk due to the addition of factors such as storm surge, wave set-up, erosion, and wind. The placement of more homes into the mandatory requirement of flood insurance will sustain the process of mortgage defaults and foreclosures for many years. Lenders will be impacted as foreclosures increase, since debt will far exceed value in many circumstances. These financial impacts will extend to secondary market investors holding bundles of mortgages as long term investments.

As risk and lawsuits increase, governmental bodies will be forced to revise and strengthen building and land use standards by raising minimum requirements, resulting in less construction. Disputes will vary from poor representation of Realtors, poor design by architects or engineers, and faulty permitting by municipalities. As well, more stringent requirements will change the highest and best use of parcels, create smaller less attractive designs, and minimize overall value. The three most important words in real estate: “Location, Location, Location”, will be reevaluated with an increase in requirements and penalties.

As environmental impacts are felt from loss of habitat, wetlands, and diminished ecosystems, governmental bodies such as the Department of Environmental Protection or an

individual state will eventually step in to stop or slow down the development or disturbance process in areas of high risk. The cost of design, permitting, and approvals will become extremely expensive and will cause many projects to fall short.

Neatly packaged within the concepts of foreclosure and decreasing development is a much smaller tax base, a source of income which fuels the many other needs of every community. Communities rely heavily on tax dollars for capital improvements such as utilities and infrastructure. Where will these funds come from if the tax base is decreased?

On the topic of utilities and infrastructure, these life supporting needs will have their own difficulties as they also deal directly with the rising waters of our oceans. Large cities throughout the world will fall into much peril when the sea level rise increases one, two, or three feet. In the meantime, storm surge and erosion will cause substantial damage to these coastal metropolitan areas much sooner.

When an area is devastated by natural disaster, pretty water views and sunsets will be greatly diminished or eliminated, and so will millions of dollars of tourist revenue, another large component of positive economy movement. Of equal importance, tourism dollars are the primary source of many small business owners, and in many communities, often the heartbeat of a community.

Conclusion

Ignorance and irresponsibility should not be accepted or tolerated by society when the discussion of sea level rise is discussed. Skeptics still do exist in swarms pertaining to the lack of evidence of climate change and global warming, but it is unfortunate. Data supports the continued rise of our ocean waters, and at some point, even the naysayers will become less concerned with the cause or rate of sea level rise and become more in tune with the reality of this

global issue.

Mitigation through education is a step which needs to be implemented immediately and forever. The majority of society has become very lazy and non-caring of the environment being altered beyond repair. Society must grasp the importance of sea level impact on both environmental and economic levels. It is not too late to correct, minimize or postpone the largest storms the Earth has ever seen, but with each tide, we get a bit closer.

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