

System Analysis: Climate Change and Coastal Areas

Arizona State University - SOS 230

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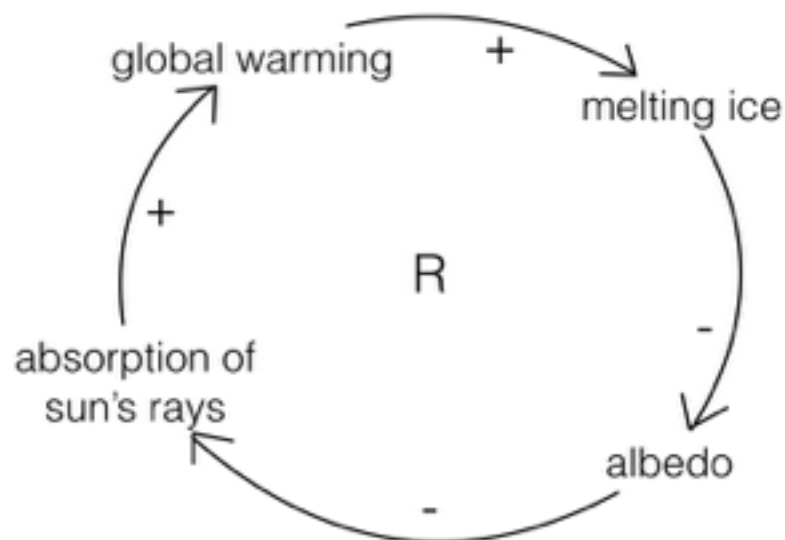
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Abstract

Climate change has impacts on the entire world. This paper will seek to analyze the system shock of climate change in regards to coastal communities, their own subsystems and factors (such as poverty and food security) and connect these specific consequences to the rest of the world. It is evident that even a specific system connects and intertwines with larger systems at play. We cannot understand this issue without a holistic approach which is attempted here.

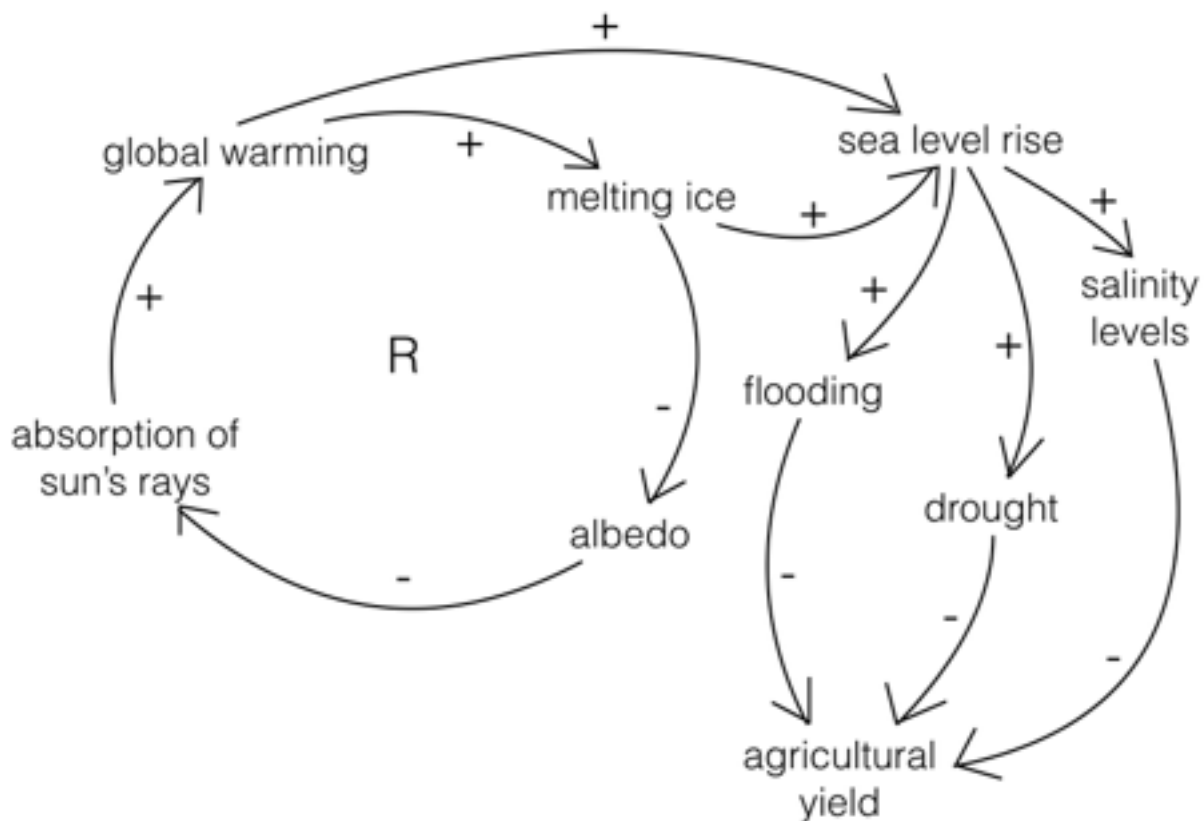
Earth has historically gone through cycles of cooling and heating. This has been largely attributed to small variations in the planet's orbit which in turn change the amount of solar energy our planet receives. Yet, recent trends differentiate themselves due to the fact that most is likely human induced and increasing at a rate not previously documented in the last 1,300 years. In fact, evidence reveals that current warming is ten times faster than the current rate of recovery (NASA, 2017).

Ice melting is actually a positive feedback loop within the larger system. Usually, the ice's albedo reflects the sun's rays which in turn lowers the amount of global warming. Yet, as warming increases and melts the ice, more of the sun's rays and energy are absorbed which leads to more warming which leads to more ice melting and so on (The Guardian, 2011). We can see this in the Causal Loop Diagram below.



This system becomes increasingly more complex the more factors we take into account. For instance, a warming global temperature causes water to expand, therefore, oceans take up more space and sea level rises. As previously analyzed in the diagram above, global warming increases melting of ice which also contributes to sea level rise (US Department of Commerce, National Oceanic and Atmospheric Administration, 2009).

Costal communities are widely affected by rising sea levels. According to Science Daily, sea level rise leads to increased salinity levels in agricultural lands, increased flooding, and prolonged periods of drought. These effects in turn discommode agricultural practices in turn lowering agricultural yield. Although these effects will hurt us all, coastal communities will be hit harder and quicker.

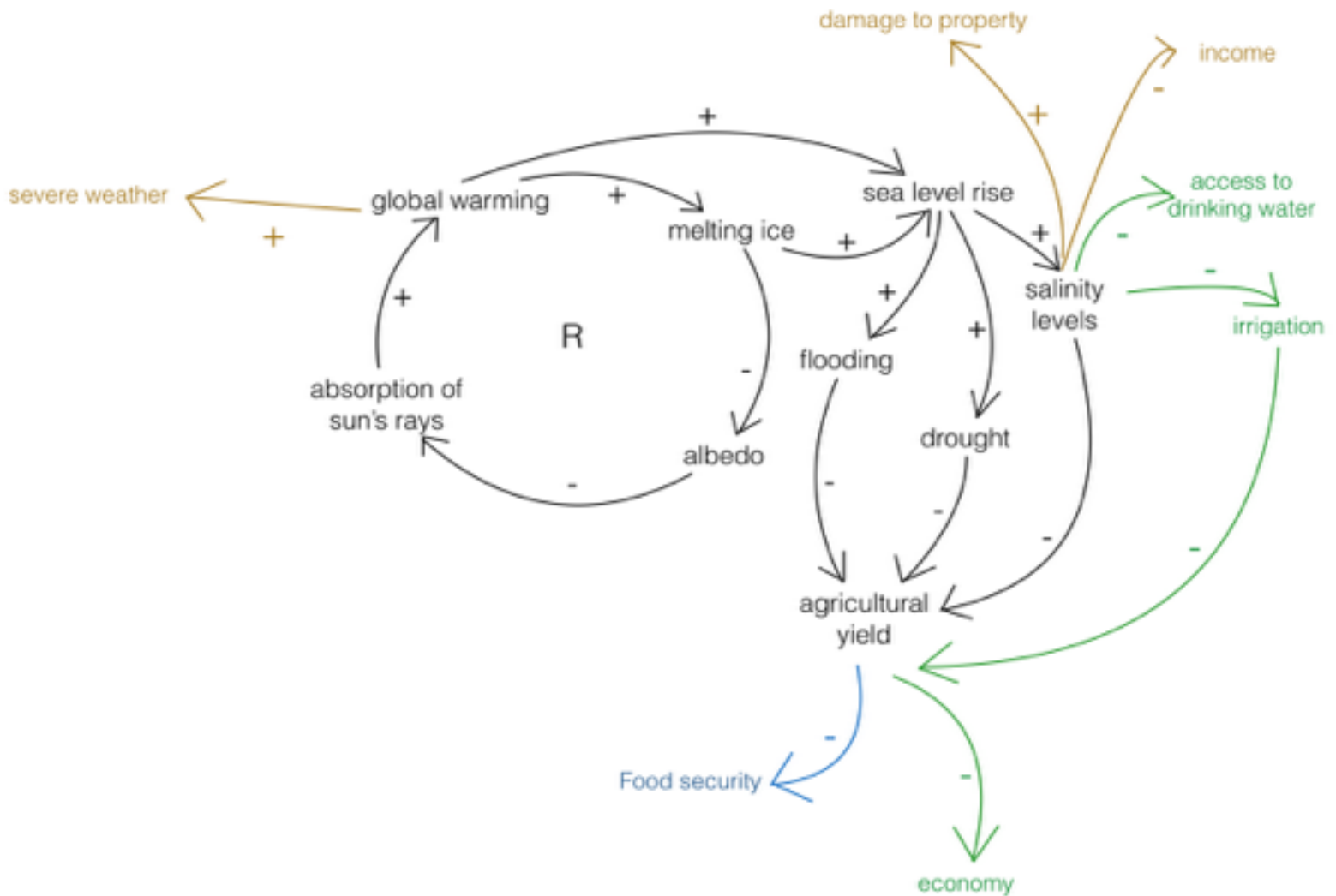


These consequences of climate change and global warming are already hurting coastal communities such as Bangladesh and Vietnam. In Bangladesh, increasing salinity levels will lower access to drinking water and irrigation by 2050 (World Bank, 2015). In turn, this is estimated to reduce rice yield by 15.6 percent which in turn lowers food security and increases economic downturn as farmers' income becomes reduced, hurting entire communities dependent on this economy (NIBIO, 2017). This is represented below with the effects on Bangladesh shown in green.

Vietnam is also suffering similar effects. Coastal areas are being affected by increasing saline levels and sea level rise. In addition to these problems, they also have increasing levels of storm surges due to rising temperatures and changes in rain patterns (NIBIO, 2017). There have also been reports of increased salivation levels along the Mekong and Red River deltas which cause damage to property as well as loss of income. This is shown below with effects on Bangladesh shown in yellow.



source: <http://www.vietnam-briefing.com/news/regional-spotlight-vietnams-mekong-river-delta.html/>



We have arrived at an interesting part of the system. The combination of factors can lead to loss of income and as a result, poverty. Not only can climate change lead to poverty as was the case with Bangladesh, but it will hurt those already in poverty. This is due to the fact that the

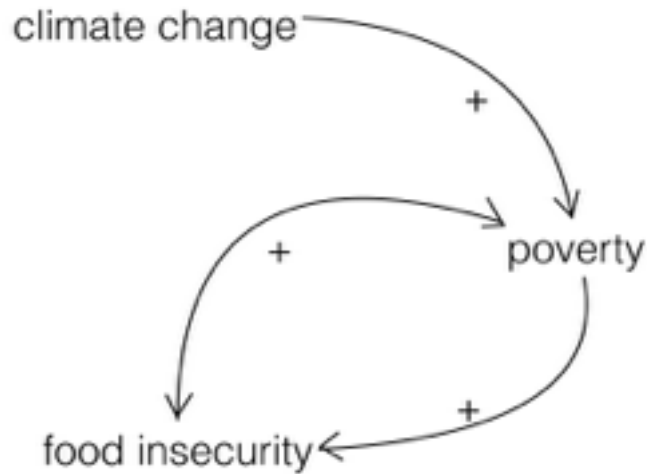
poor are less resilient. They have the least resources to bounce back from the system shock; climate change. The following video from World Bank analyzes the effects further.

<https://www.youtube.com/watch?v=zELiQv4YMM>



An important feedback loop to note is that climate change increases poverty and being in poverty increases climate change. Of course, not literally, but the effects on the people, such as many located in coastal regions, are more severe. The video describes an example of this, “After Hurricane Katrina in Honduras, poor people lost 30% of their assets, 3 times as much as non-poor people,” (World Bank, 2015).

Poverty has another effect. Climate change keeps people in poverty while poverty keeps people food insecure and being food insecure keeps people in poverty. We can justify this with Maslow’s hierarchy of needs which in itself is a system.



source: <http://myventurepad.com/entrepreneurial-motivation/>



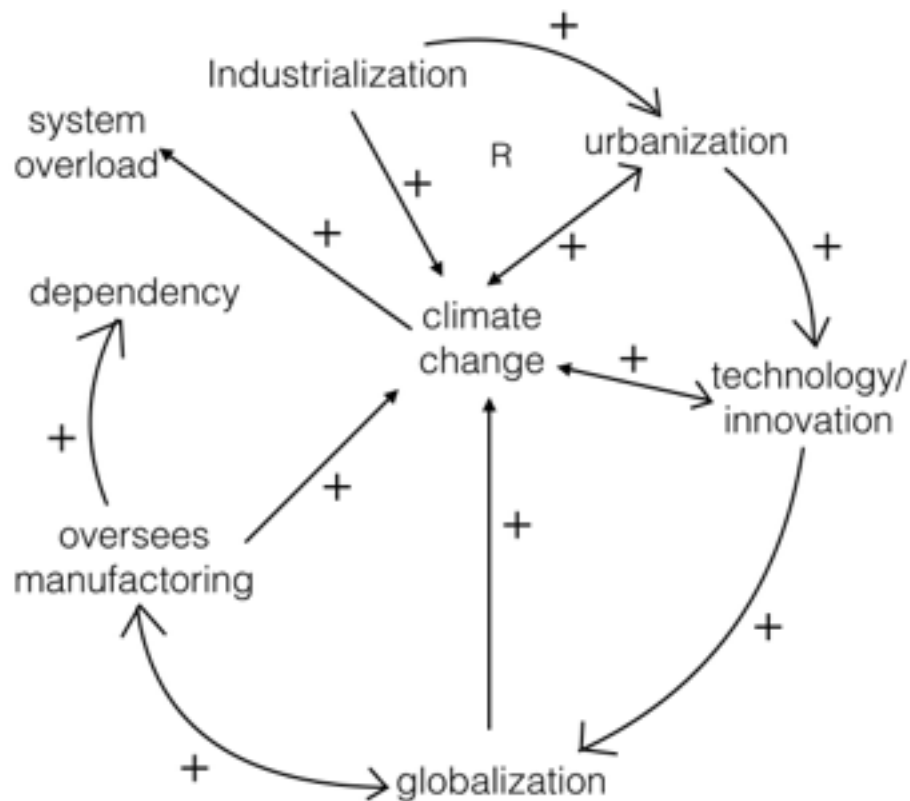
By applying systems thinking to Maslow's theory we can see how each section of the pyramid is a part of the system, Individuals have to climb up, similar to the diagram below.

People are the ball. The ball spins around the trough until it's able to climb up only to fall to the bottom again when trying to reach a new level towards self actualization.



Individuals in poverty are stuck in the beginning of the system, the first trough. They can't meet their own physical needs so therefore they won't be able to meet their safety, social, esteem and self actualization goals.

Even though many of these coastal cities in the developing world can't even meet their own needs, the rest of the world is highly dependent on them due to historical and current practices such as industrialization and globalization. In fact, according to Wunder Blog, India, Vietnam, Australia, and Bangladesh, Indonesia, Thailand, Philippines being hit by a the system shock of climate change and sea level rise could cause a global food security issue. This is because those countries provide up to 50% of the crops the rest of the world eats and are all coastal nations.



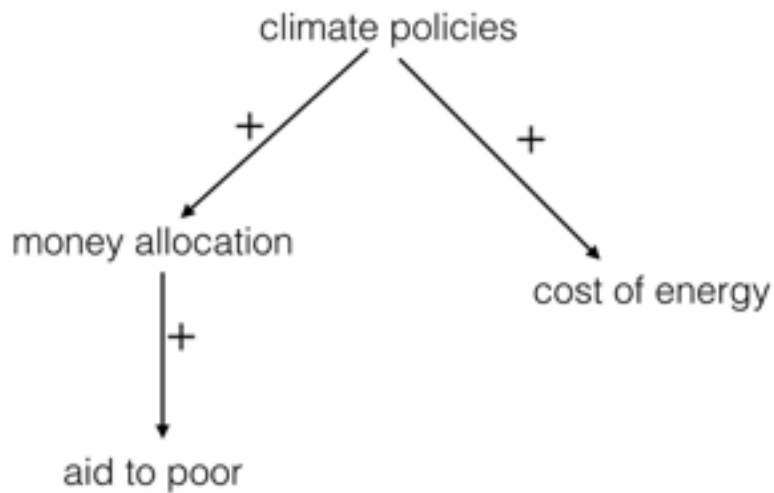
These questions can be analyzed in a sub system. Historical factors of industrialization lead to urbanization which lead to technology creation / innovation which lead to further globalization and oversees manufacturing or production. This ends with dependent until climate change cause too many system shocks, ending the entire system. There are loops within this model as well. For example, industrialization increases urbanization which in turn increases climate change which in turn creates more urbanization.

Why is this dependency a problem? In this system analysis we have focused on the ways climate change is hurting coastal areas. Yet there is a chain of events in this system. If these coastal areas are damaged, it will hurt the rest of the world, especially in regard to food security.

We saw these effects in 2010, “the Earth’s most extreme weather year since the famed ‘Year Without a Summer’ in 1816,” (Masters, 2016). This proved the conclusions in this analysis: system shocks in major grain producing areas can cause dangerous shocks to the entire global food system (Masters, 2016).

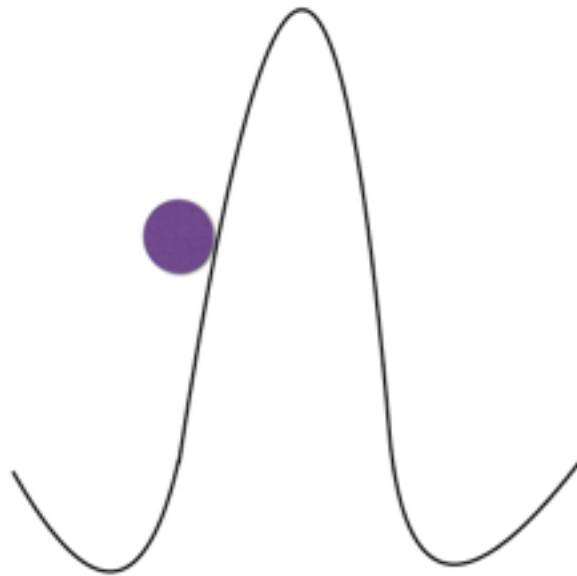
To contradict this line of thinking, the United States and Canada are the greatest wheat producers in the world (Masters, 2016). Although both countries have coastal areas, they aren’t particularly known for being coastal countries. Sea level rise won’t affect all the production. Other factors and systems come into play and affect production there yet the cause won’t necessarily be what this analysis has proposed thus far. Perhaps an alternative ending would simply be the global supply chain shifting.

There are various proposed solutions to the impact climate change is and will continue to have on coastal communities which in turn have the potential to affect the rest of the world. The first is adequate climate policies. According to World Bank, climate policies can help those in poverty both in the long run and short run. While they can increase the cost of energy, they can also make it so more money is allocated to help the poor. A simple diagram of this is shown below.



Another proposed solution includes a “safety net” of sorts to catch people before they fall into deep levels of poverty. If we can’t reduce climate change which leads to poverty, we can strengthen the social protection system around those who are vulnerable. This would in turn make social programs more accessible. A counter to this proposed idea is that people will become dependent on this. As we analyzed earlier, dependency in a system can lead to a complete disruption (World Bank, 2015)

The system that incorporates climate change, poverty and even food security is quickly going towards a point of no return. At this point, it is easier to act now and reverse the damage that has been done. Once we tip over the edge, coming back will be a lot more challenging, if not impossible. If this occurs, then there are adaptive measures and technology solutions that can possibly be implemented, yet it is a more complex way to solve the issue.



It is unfair to lump all coastal cities together. San Francisco, California is a coastal city in the developed world. As a result, the damage is less prominent. Yet even coastal cities in the developed world face challenges due to sea level rise. The following video by Wired, analyzes this city further.

<https://www.youtube.com/watch?v=5cZGlli1myA>



Although San Francisco is being affected by sea level rise, there are adaptive strategies that they can take. One could say this is because it is in the United States and as a result has access to technology and innovation. One could also say that perhaps there are adaptive strategies that can be applied to the developing world as well. We could also argue that we should not allow the system to tip this way, as illustrated by the diagram above. Once tipped, there is no coming back.

In conclusion, an analysis of climate change and its impacts has many sub systems and factors. The complex nature of the world, proposed solutions and their counter evidence and possible endings to the system need to be further analyzed.

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