The Dynamics of Disaster Economics: The Philippines' Recovery and Response to Typhoon Haiyan (Yolanda)

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Abstract

Typhoon Yolanda (international name Haiyan) is the strongest storm ever recorded to date. It made landfall in the Philippines on November 8, 2013, with damages amounting to over PhP360 billion and leaving 6,155 dead while 1,785 are still reported missing. This study uses a system dynamics model to explore the aspect of recovery and response, especially due to the immense gap between the cost of damage and cost of assistance. The primary objective is to be able to meet the needs of the affected population, through effective information flow- from the recording of damages and casualties to the allocation and distribution of relief goods, supplies, personnel and medical teams. A causal loop diagram is formulated to show the relationship between variables and which ones dictate the efficiency of response efforts. A stock flow diagram translates these into a model ready to replicate the behavior of the actual system. This would then be used for scenario analysis, to test proposed programs like an Emergency Resiliency Fund, to see the influence of media in soliciting and monitoring relief supplies, and on social entropy- how communities sustain recovery and use it to prevent disasters from happening again.

Keywords: disaster management, resilience, social entropy, Philippines, Haiyan (Yolanda), recovery and response

DRAFT FOR PRESENTATION

Background

Typhoon Yolanda (international name Haiyan) is the strongest storm ever recorded to date. On November 8, 2013, it made landfall over Guiuan, a small town from Eastern Samar, located in the Visayas region of the Philippines. Carrying maximum sustained winds of 235kph and a gustiness of up to 275kph, around 750,000 people were evacuated pre-emptively from 31 provinces, including 32 cities and 181 municipalities.

The strength and magnitude of the Super Typhoon blew off roofs and tore down buildings, leading to local officials estimating around 10,000 casualties. This was vehemently denied by the national government, whose efforts were even questioned by international media. Being the most exposed country to tropical storms in the world, the Philippines experiences an average of 20 typhoons a year. The country's national disaster budget for 2013 was set at $171 million, but was all used up before the Super Typhoon hit the country.

Thus, victims and evacuees were left to scavenge for food- looting abandoned malls, even- all while looking for lost family members and relatives. The National Economic and Development Authority has stated that the government needs PhP360.8 billion to fund the massive rehabilitation efforts for Eastern Visayas, amounting to 12 percent of the country's gross domestic product.

As of January 1, 2013, the National Disaster Risk Reduction and Management Council (NDRRMC) reports that there have been 6,155 deaths while 1,785 are still missing. NDRRMC formulates Situation Reports from each day since the typhoon was declared, all of which have been collated for this research.

Disaster Management Modeling

It has been seen that the focus of risk management and decision-making has shifted from prevention and protection to recovery and response. This has gained more attention as preparedness and resilience plans have become a common practice among countries across the world (Barker & Santos, 2010). Changes are often enacted in public policies and procedures to protect the damaged community from future threats. Reports are made out of operational performance and are used to enumerate lessons learned. New equipment is invested on, along with training to increase capacity of response organizations. Programs on disaster preparedness are initiated to inform the public how they can contribute to reduce disaster risk (Comfort, Oh, & Ertan, 2009).

The challenge (or opportunity) still remains to be the integration of different types of non-economic knowledge and information, such as geophysical land use data, with economic data and equations related to changing risk perceptions and behavioral adjustments. The continuous exposure to natural disaster risks such as floods and their corresponding economic damage costs are a function of both an individual's private choices and government decisions over land use zoning and infrastructure investments. Empirical studies have emphasized the role of socio-economic factors such as personal characteristics, risk perception, and behavior in relation to flood damage as means of reducing flood damage, in addition to structural measures (Safarzyńska, Brouwer, & Hofkes, 2013).

Problem Definition

In relation to disaster management, an approach that provides insight and understanding in various levels is that of dynamical modeling. It is able to consider the four stages of Mitigation, Preparedness, Response and Recovery. As with the aforementioned statement regarding the national budget, the Philippines finds itself more focused on recovery and response. This study aims to investigate how this could be addressed in terms of being physically and financially prepared to face incoming disasters, as well as being able to cope with its consequences and recovering the quality of life and means of livelihood of the affected population.

Problems are encountered from the collection of data to the activation of relief operations, the distribution of relief goods and the progress of meeting required needs and physical recovery. The disruption to electricity, networks, food and water supplies, health services and communication systems further compounds the costs of recovery as the limited access to these essential services inhibits the ability of communities to be able to express their demand and accept the supply.

The immense gap between reported cost of damages and the assistance that is being given just shows that even with support from non-government organizations (NGOs) and international charity foundations, recovery from the aftermath is far from being met. The graph of casualties also shows the same behavior of increasing gradually over time. While this may also be a function of late reporting of data (and some possible corrections), it also exhibits the dynamic nature of the situation.

The following are critical questions this study aims to address:

1. How can the amount of donations and relief help be monitored despite concerned entities and agencies conducting independent operations?
2. How can damages affect the amount of incoming goods and services and their distribution towards involved areas?
3. How can data be collected in an efficient and accurate manner for planning and estimation?

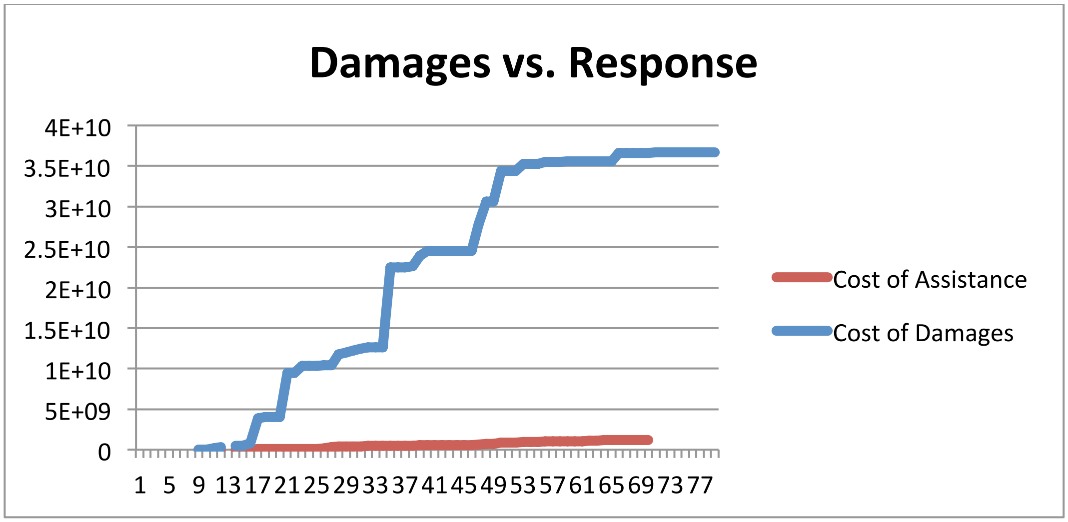

Figure 1 Damages vs. Response for Typhoon Yolanda

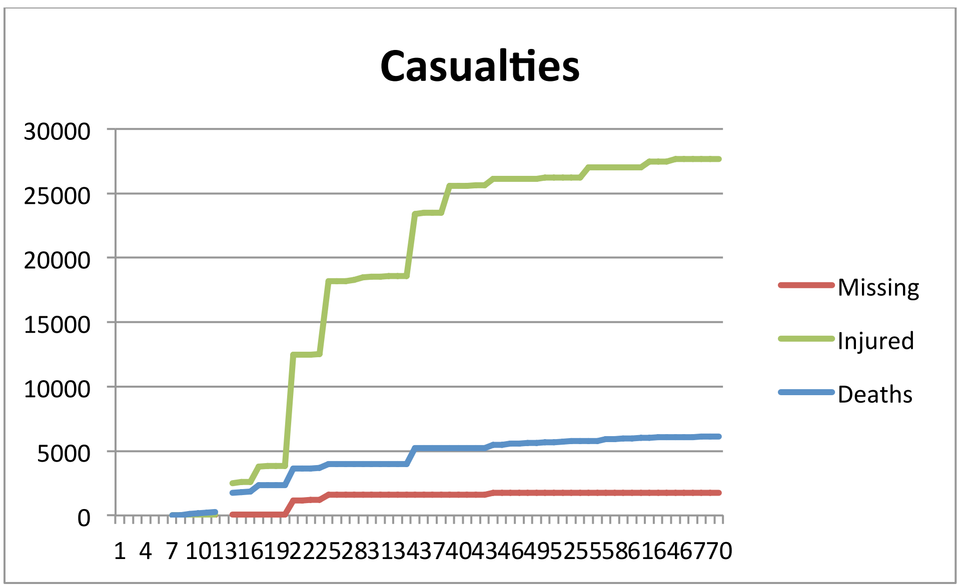

Figure 2 Casualties for Typhoon Yolanda

Research Approach

If the disaster management process is viewed as a system, it is apparent that modeling it would have the same characteristics as that of a supply chain. Thus, knowledge of each part influenced by the disaster becomes of significant importance. Variables are grouped into categories, of which relationships would be identified. All factors would be considered, thus making it possible to come up with strategy assessments and formulating policies that would bring change into the system. System Dynamics enables this, along with being able to simulate the behavior of the system before and after the disaster. Parameter sensitivity is shown to identify the key ones, which would then be used to create a strategy that would meet a desired goal.

Causal Loop Diagram

In order to show the variables present in the disaster management recovery and response system, a causal loop diagram is formulated to show their respective relationships. This would then be used to identify the stocks and flows for the stock flow diagram, the final model which would be used for simulation purposes.

The causal loop diagram explains the complexity of each relation, while showing how the flow of information and physical goods would affect the overall behavior of the system. The system of the study is divided into four different categories, namely: population, damages, data estimation, and recovery and response.

Population is seen as the most important aspect as it shows how many are affected by the disaster. In response efforts, the number of people killed or injured would always be the first to be reported. The next one is the number of infrastructure (e.g. buildings and roadways) destroyed. This enables the decision-makers to plan better as they would know which ones are more accessible, and through what means the others may be. Agricultural damage is also gathered, as it is the primary source of income for most families in the province. Lastly, recovery and response is modeled so the decisions on personnel, supplies and monetary distribution would help the affected population.

Also considered is the assessment of information, as to how it is collected and identified. These should be done with caution in preventing errors and reducing biases. The type and quantity of information that would be gathered are important for the resolution of crisis situations, so access to multiple and unique data sources is required. This would be critical for the formulation of criteria to evaluate the best course of action for each situation. The ambiguity, urgency, and high stakes are referred to as the core elements of a crisis- therefore needing verification, such as the case of correcting data which are overestimated (Hadley, Pittinsky, Sommer, & Zhu, 2011).

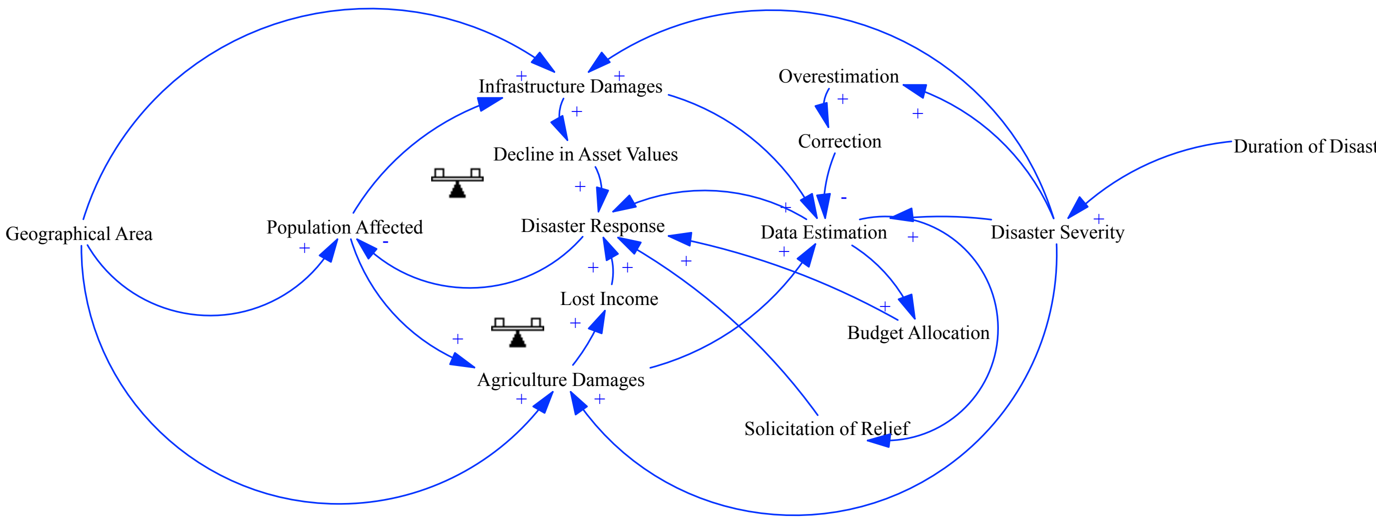

Figure 3 Causal Loop Diagram for Typhoon Management

Stock Flow Diagram

Population

The population stocks and flows begin with the actual population. This would go through the rate called Disaster Magnitude, which is a measure of severity that grows through time. Therefore, it is defined by the duration of the disaster and the geographical area covered. After this rate, the affected population would be identified. This would go through the rates of mortality and recovery, which would then quantify the number of deaths and missing individuals. Not considered for the study is the number of evacuees, as the data provided by the NDRRMC fluctuates over time and is not accurately monitored.

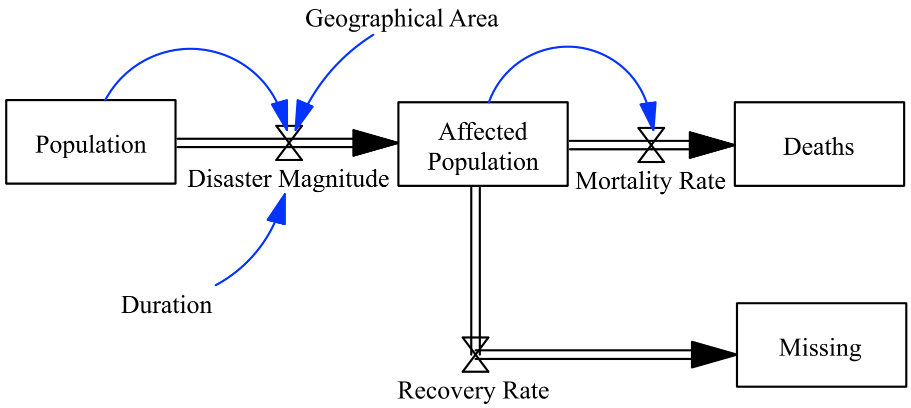

Figure 4 Population Stocks and Flows

Damages

The impact of damages leads to potential congestion, with shortages in basic needs such as shelter and food is considered with these stocks and flows. The destruction rate is dependent on the aforementioned Disaster Magnitude. These stocks are critical in data collection as these would be the basis of decision-makers in allocating resources.

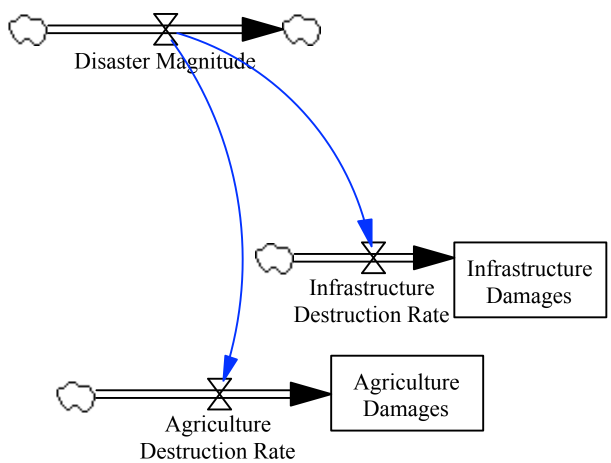

Figure 5 Damages Stocks and Flows

Data Estimation

The most critical aspect of disaster management is ensuring the accuracy and truth of estimated data. Because it is often a cause of delay due to lack of accessibility and the uncertainty brought by the damages, various variables are considered for the estimation rate.

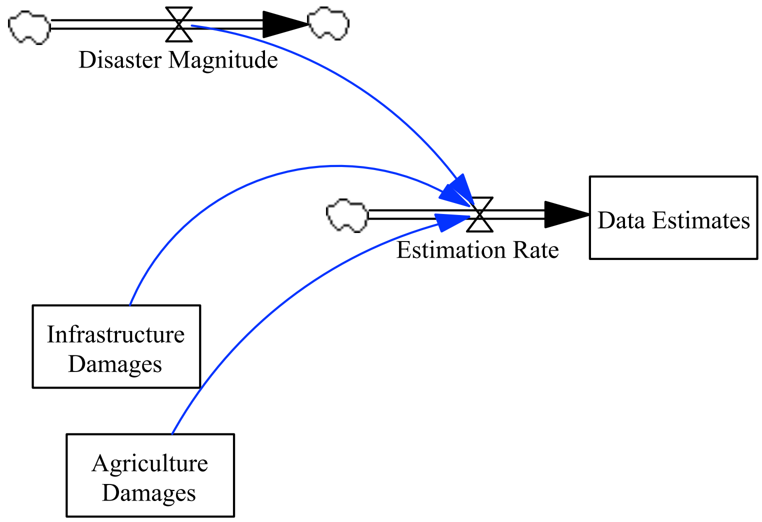

Figure 6 Data Estimation Stocks and Flows

Recovery

From the estimated rates, resources would be allocated according to personnel, supplies and other needs. This would lead to access to other areas, of which resources would be recovered-reconstructed or repaired. Said access would lead to the affected population, whose needs would be satisfied and eventually control the mortality rate.

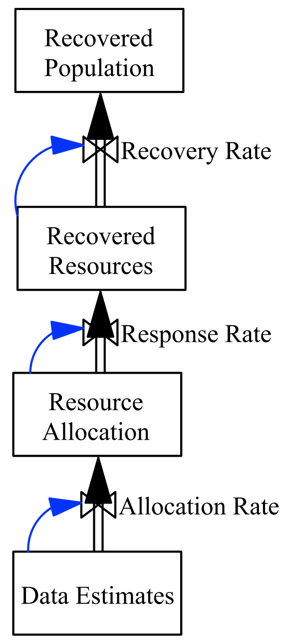

Figure 7 Recovery Stocks and Flows

The complete stock flow diagram is shown in the following page.

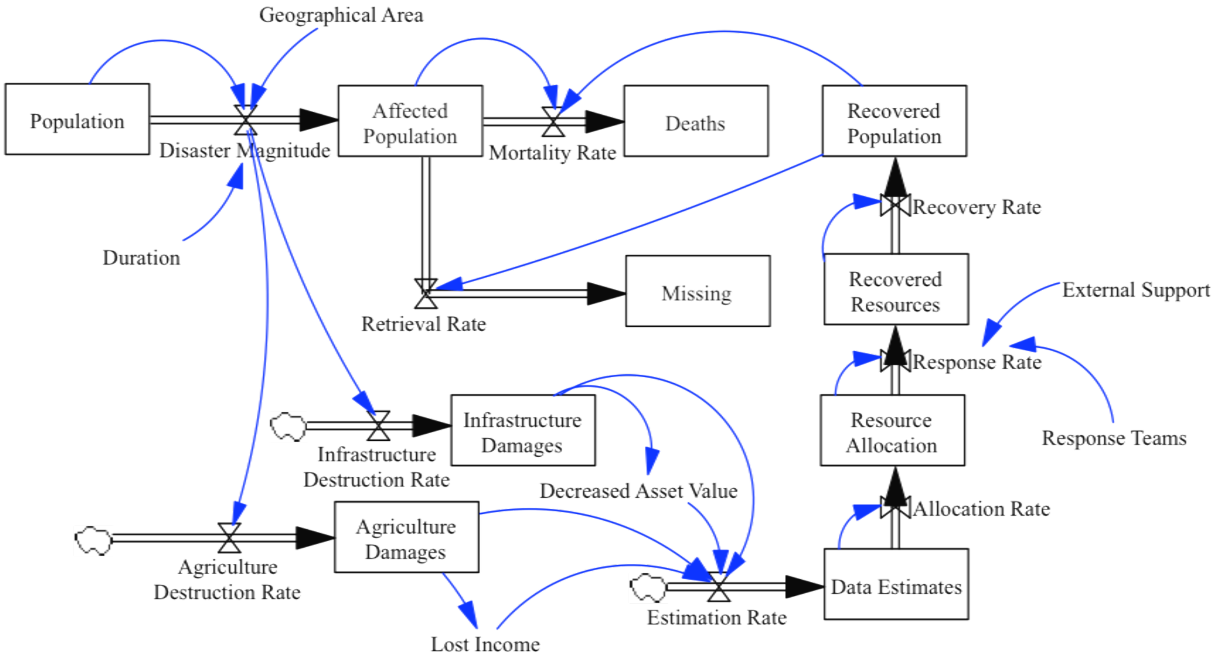

Figure 8 Complete Stock Flow Diagram

Future Direction

The preceding models would then be filled with parameters from the collated data as to exhibit the behavior of the actual system. Once it replicates the said behavior, it could be used for scenario analysis, of proposed policies that could be able to address the recovery and response properly.

A main objective is to be able to identify a way to understand the dynamics of information flow between government agencies handling monitoring and implementation of all operations (NDRRMC) and those non-government entities such as the Philippine National Red Cross (PNRC). System Dynamics should be used to understand which counterintuitive solution would be able to address this, aside from the most commonly suggested centralization of all information.

Another solution is in line with the Department of Finance's proposed program of having an Emergency Resilience Fund. This would be funded through tax revenues so resources would not be diverted from important long-term development projects. This fund is intended for the construction of public infrastructure, as well as for the relocation of families residing in risky, low-lying areas.

Media exposure would also be considered as to how it could be able to solicit more help from other countries, as well as monitoring the progress of relief operations done by all participating entities. This would be directly involved with the government's efficacy and resilience as it would be them accountable for what would be reported, broadcasted, and shared on an international level.

Lastly, the social entropy theory would be used to try and explain how waning efforts from the affected population and the relief donors could affect the gap between supply and demand. By studying the perception behind how relief programs operate, policies and procedures could be formulated in a way that would encompass even preparation and mitigation, which should be the true objective of disaster management and risk assessment.

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