


	PREVENTION & RISK MITIGATION	10 January 2017	
	<b>Supply Chain Management for Disaster Prevention and Mitigation</b>	Abstract	
	<b>Authored by:</b> Yanquiling, R; Santos, M.C; Pineda, J.D; Panaguiton, R; Fallorin, T. M; Agustin, A; Bravo, J.G; Manabat, M.	Page 1 of 27	

## 1. Abstract

The Philippines is one of the most disaster-prone countries in the world. Based on the Yolanda experience, it is important for government to develop ways/approaches/technologies for disaster prevention and mitigation, which will eventually lead to saving lives and property, as well. This paper will identify prevention measures that can be applied to the entire country.

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	<b>Supply Chain Management for Disaster Prevention and Mitigation</b>	Introduction, Big Data Analytics	
	<b>Authored by:</b> Yanquiling, R; Santos, M.C; Pineda, J.D; Panaguiton, R; Fallorin, T. M; Agustin, A; Bravo, J.G; Manabat, M.	Page 2 of 27	

## 2. Introduction



A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. (International Federation of Red Cross (IFRC), 2016) There are about 4.4 billion people have been affected by disasters since 1994, which claimed 1.3 million lives and cost US\$2 trillion in economic losses. (Child Fund International , 2013) Most countries that are disproportionately affected by these natural disasters are the low- and lower-middle-income countries and the Philippines is one of these countries. The Philippines is also known as one of the most hazard prone countries in the world. The most catastrophic disasters include tropical cyclones, floods, droughts, earthquakes and volcanic eruptions. These disasters destroyed human, social, and physical resources and with this situation, it derailed social and economic development.

Based on the report issued on November 16, 2016, provinces in Northern Luzon, Southeastern Luzon and Eastern Visayas are at high risk in terms of the occurrence of tropical depressions, tropical storms, typhoons and super typhoons. (DENR, 2005)

Regions	Provinces
I	Ilocos Sur, Ilocos Norte, Pangasinan, La Union, Tarlac
II	Cagayan
III	Pampanga, Nueva Ecija,
V	Albay, Sorsogon, Camarines Norte, Camarines Sur
VI	Masbate, Western Samar, Northern Samar, Catanduanes
CAR	Kalinga, Mountain Province, Apayao, Ifugao,

### 2.1. Big Data Analytics in Disaster Management

Big data analytics is the process of examining large data sets to uncover hidden patterns, unknown correlations, market trends, customer preferences and other useful business information. There are five (5) types of big data analytics that can be used in the analysis of data, namely: (1) Descriptive Analytics; (2) Prescriptive Analytics; (3) Diagnostic Analytics; (4) Predictive Analytics; and (5) Outcome Analytics. The analytical findings can lead to more effective marketing, new revenue opportunities, better customer service, improved operational efficiency, competitive advantages over rival organizations and other business benefits. The primary goal of big data analytics is to help organizations to come up with an information to support in business decisions by enabling data scientists, predictive modelers and other analytics professionals to analyze large volumes of transaction data, as well

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	<b>Supply Chain Management for Disaster Prevention and Mitigation</b>	Summary of Historical Data of Typhoon	
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as other forms of data that may be untapped by conventional business intelligence (BI) programs. (Tech Target)



Using big data analytics in disaster management is quite new. The data collected can be analyzed using descriptive analytics that will lead the government and other agencies concerned to come up with a decision. This decision can be policies and strategies that will reduce risk and mitigate impact of the disaster. The historical data as shown in table below shows the number of typhoons, casualties and the amount of damage for the last two decades. Analysis shows that despite the increased in number of typhoons visited the Philippines in the last two (2) decades, total death toll and amount of damage decreased. With these data, appropriate regions needing government support can be identified and thus, resources can be appropriately allocated to these regions.

## 2.2. Summary of Historical Data of Typhoon in the Philippines

Decade	Total No. of Typhoons	Trop. Depression	Trop. Storm	Typhoon	Total Death Toll	Total Amount of Damage (in Billion pesos)
1990-2000	185	32	60	93	9,537	84.82
2001-2010	202	44	62	96	5,021	33.23
<b>Total</b>	<b>387</b>	<b>76</b>	<b>112</b>	<b>189</b>	<b>14,558</b>	<b>118.05</b>

Another application of descriptive analytics is on the case of super typhoons *Yolanda* and *Lawin*. With this, government and other concerned agencies can identify improvements including lessons learned from these two (2) super typhoons.

	<b>Yolanda</b> (NDRRMC, 2014)	<b>Lawin</b> (NDRRMC, 2016)
1 <sup>st</sup> Landfall	08 November 2013 4:40AM at Guiuan, Eastern Samar	19 October 2016 11:00PM at Peñablanca, Cagayan
Public Storm Warning Signal	4	5
Strength	235kph	225kph
Gustiness	275kph	315kph
Diameter	400km	800km
Eye	14km	30km
Affected Regions	9 (IV-A, IV-B, V, VI, VII, VIII, X, XI, Caraga)	6 (I, II, III, IV-A, V, CAR)
Affected Provinces	44	26
Affected Cities/	253	315

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Municipalities		
Affected Barangays	12,139	2,782
Affected Families	3,424,593	10,397
Evacuated Families	161,973 families	31,751
Death toll	6,300	14
Injured	28,688	4
Missing	1,062	0
Total houses damaged	1,140,332	90,035
Cost of damages	P95,483,133,070.67	P3,737,721,352.16

The lessons learned from typhoon *Yolanda* can be uncovered by asking three (3) guiding questions: What did we do right? What did we do wrong? What do we need to improve?

- For 'what we did right' question, the government managed to forecast the tract and strength of Typhoon *Yolanda*, through PAGASA-DOST. With this forecast by PAGASA-DOST, NDRRMC conducted several meetings to various concerned agencies, national and local, to discuss precautionary measures and necessary preparations
- For 'what did we do wrong' question, after typhoon *Yolanda* devastated Samar Province, observations was made that there is lack of clarity on who was in charge to manage disaster from the national government. There is also confusion in some areas on which government official was in charge of managing relief. And the worst thing that happened in this tragedy is the struggle in coordinating all concerned sectors to effectively manage the disaster.
- For things that we need to improve, a simple illustration of tsunami be included in future storm signal advisories and weather terminologies. It needs to strengthen the national government's quick response in crisis situations through Damage Assessment and Needs Analysis System. There is a need to integrate settlement planning in the DRRM, particularly the evacuation center. And lastly, it needs to enforce the no-build zones policy for areas prone to disaster such as landslide, storm surge, etc.

### 3. Scope and Purpose of Study

The experience of the Philippines with *Yolanda* and *Lawin* proved to be devastating. As a result, this paper will focus on ways or methods or approaches that will help save lives and property in times of disaster. It aims to minimize, if not totally avoid, the hazards

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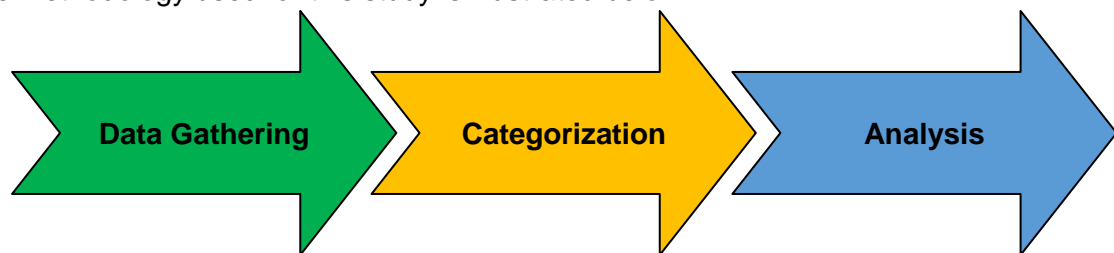
and mitigate its potential impacts by reducing risk and enhancing the capabilities of communities.

#### 4. Expected Output

The expected output of this study is to identify programs and policies for possible adoption by NDRRMC and other concerned agencies based on historical information.

#### 5. Methodology

The methodology used for this study is illustrated below:





Historical information must be gathered from 1990 up to 2010 to determine the processes of handling disaster management by the government and concerned agencies. From there, all information gathered must be categorized according to time (by decade, year and month), place (by regions, provinces and municipalities/cities) and population (by classes). This information should be reviewed and analyzed in order to see if there are improvements in managing disaster. To validate the result of the analysis, it is good to compare how the current implementation performs compared to the other countries or organizations. Finally, the over-all goal is to be able to find the gaps where the government both national and local can address to improve the disaster management in the country.

#### 6. Discussion

Supply chain management in managing disaster is one of the critical issues that the national government is facing every time there is a disaster. It starts from prevention, preparedness, response and recovery and rehabilitation. This paper will use the three (3) famous principles and methodologies that the manufacturing companies are using for discussion that will lead in recommending policies and programs for possible adoption by NDRRMC.



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## 6.1. Application of 7 Principles of Supply Chain Management in Disaster Management (David L. Anderson, Frank F. Britt, Donavon J. Favre, 1997)

If supply chain management has become top management's new "religion" in doing business, the same also at NDRRMC. The NDRRMC should solemnly adopt the supply chain management in managing disaster. It is important that managing disaster should be given serious attention especially on prevention and mitigation stage. Related information on disaster should be recorded and analyzed properly for use in planning and decision-making. This supply chain must be sustained to ensure alignment and consistent forecasts for optimal resource allocation.

The 7 Principles of Supply Chain Management laid-out a clear and compelling case for excellence in supply chain management. In disaster prevention and mitigation, this paper considers four (4) out of seven (7) principles which are relevant to this study.

**6.1.1. Segment customers based on service needs.** In manufacturing companies, they traditionally grouped their customers by industry, product, or trade channel and then provided the same level of service to everyone within a segment. The NDRRMC, for this matter, needs to cluster its customers based on their functions in providing services to avoid hazards and mitigate their potential impacts by reducing vulnerabilities and exposure and enhancing capacities of communities. These customers include Department of Social Welfare and Development (DSWD), Department of Agriculture (DA), Department of Agrarian Reform (DAR), Department of Public Works and Highways (DPWH), Department of environment and Natural Resources (DENR), Climate Change Commission (CCC) and Department of Science and Technology (DOST), as lead agency.

**6.1.2. Listen to signals of market demand and plan accordingly.** In business, sales and operations planning should span the entire chain to detect early warning signals of changing demand in ordering patterns, customer promotions, and so forth. This demand-intensive approach leads to more consistent forecasts and optimal resource allocation. Applying the signals of market demand in disaster prevention and mitigation, the disaster forecasting and planning plays a crucial role in reducing the impact of disaster; thus, it will result to saving lives and properties. The historical information available from different concerned agencies with regards to disaster can be analyzed using different models that will lead to good forecasting and planning. Other source of Information that can be used in forecasting and planning is through the testimonies of the survivors of calamity. This information is very useful because these are real experiences from actual disasters or calamities.



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**6.1.3. Develop a supply-chain-wide technology strategy.** As one of the basis of successful supply chain management, information technology must support multiple levels of decision making. It should also provide a clear view of the flow of products, services, and information. In disaster prevention and mitigation, information technology should be used as one of the major factors to avoid hazards and mitigate the impact of the disaster. Information systems, mobile apps, databases, etc, are among the technologies that NDRRMC should utilize.

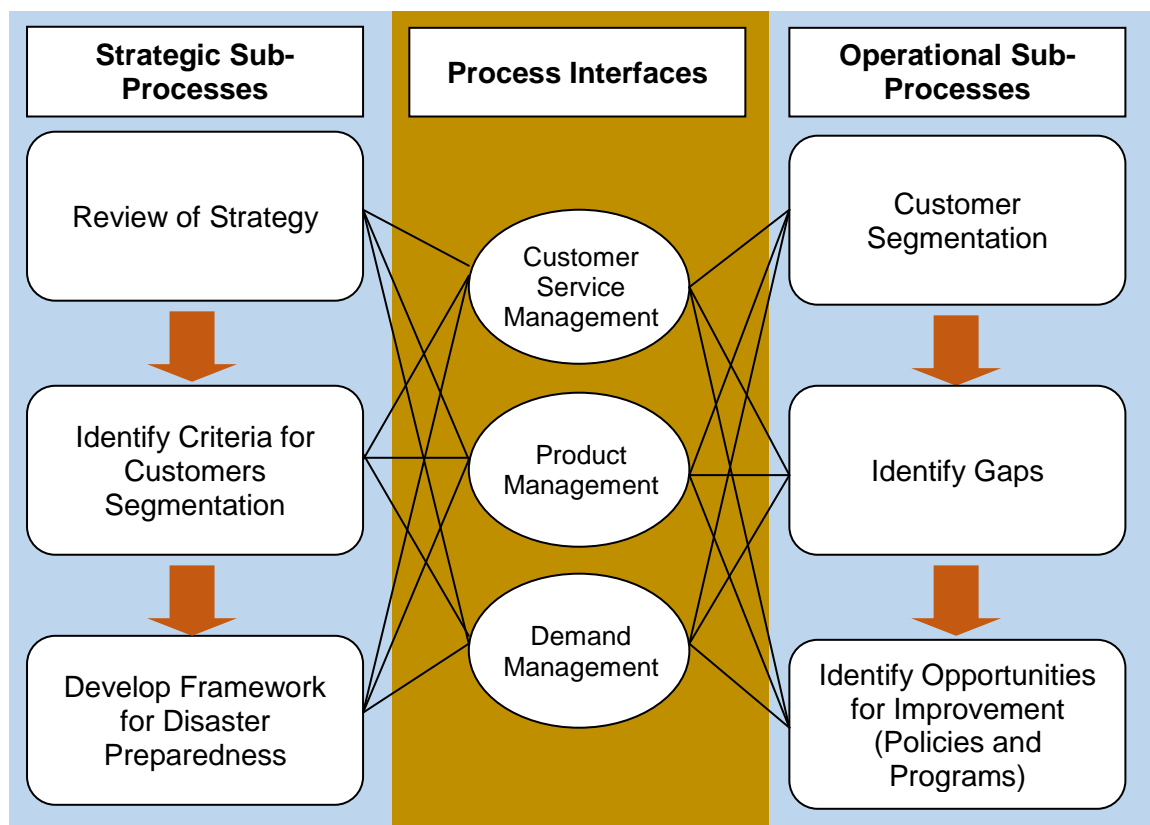
**6.1.4. Adopt channel-spanning performance measures.** Excellent supply chain measurement systems do more than just monitor internal functions. It needs to adopt measures that apply to every link in the supply chain. Importantly in disaster management, these measurement systems can improve the service that the community needs. The community deserves a quality and excellent service. In doing this, a good performance measure should be established.

As a review, the principles are not easy to implement. It needs critical and/or analytical thinking about how companies organize, operate, and serve customers. These challenges may also apply to NDRRMC and to the cluster agencies, which are responsible for disaster prevention and mitigation.

In conclusion, it is important for cluster agencies to persevere in building a successful supply chain. This will result to customer satisfaction, which will eventually result to providing efficient and quality service to the community.



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## 6.2. Customer Relation Management in Managing Disaster (The Supply Chain Management Institute)





The customer relationship management process provides the structure for how the relationship with the customer is developed and maintained. NDRRMC, for this matter, needs to identify key customers and customer groups as part of its mandate. Since this paper is focusing on disaster prevention and mitigation, these customers are the cluster agencies such as Department of Social Welfare and Development (DSWD), Department of Agriculture (DA), Department of Agrarian Reform (DAR), Department of Public Works and Highways (DPWH), Department of environment and Natural Resources (DENR), Climate Change Commission (CCC) and Department of Science and Technology (DOST), as lead agency.



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Cluster Agencies	Strategic Function	Operational / Implementation
1. DSWD	Distribution of relief	<ul style="list-style-type: none"> <li>• Barcoding of goods</li> <li>• Integrated Inventory Management System (to include location maps for easy access of storage areas resulting to efficient and timely distribution of relief goods)</li> <li>• Standardization of relief transportation</li> <li>• Mobilization of relief packaging</li> </ul>
2. DA	Identification of root crops and vegetation (fruit and vegetables) and its corresponding location where these will be planted	<ul style="list-style-type: none"> <li>• Development of a database of all fruits and vegetables, which will be of use in the municipal and barangay levels and to be taught to their constituents</li> <li>• Agricultural biodiversity and genetic diversity in crops</li> <li>• Adaptable crop resources</li> </ul>
3. DAR	<ul style="list-style-type: none"> <li>• Record, register and secure Land</li> <li>• Provide land tenure security to landless farmers</li> <li>• Provide legal intervention to Agrarian Reform Beneficiaries</li> </ul>	<ul style="list-style-type: none"> <li>• Development of Mapping and Recording Devices for Registered Lands</li> <li>• Mobilize communities</li> <li>• sustainable rural development</li> <li>• land tenure improvement</li> <li>• integrated development services to landless farmers</li> </ul>
4. DPWH	Maintenance and repair of Infrastructure (Roads and bridges)	<ul style="list-style-type: none"> <li>• Engineering solutions such as dams and levees</li> <li>• Standardization of infrastructure</li> <li>• Advance heavy contraction equipment</li> </ul>
5. DENR	Provide geographical maps in planting trees	<ul style="list-style-type: none"> <li>• Geographical maps (NAMRIA, MGB, FMB)</li> <li>• Mobilize natural resource</li> <li>• Adaptive capacities of environmental quality</li> <li>• Forest Land Use Planning</li> <li>• Adopting soil and water</li> </ul>

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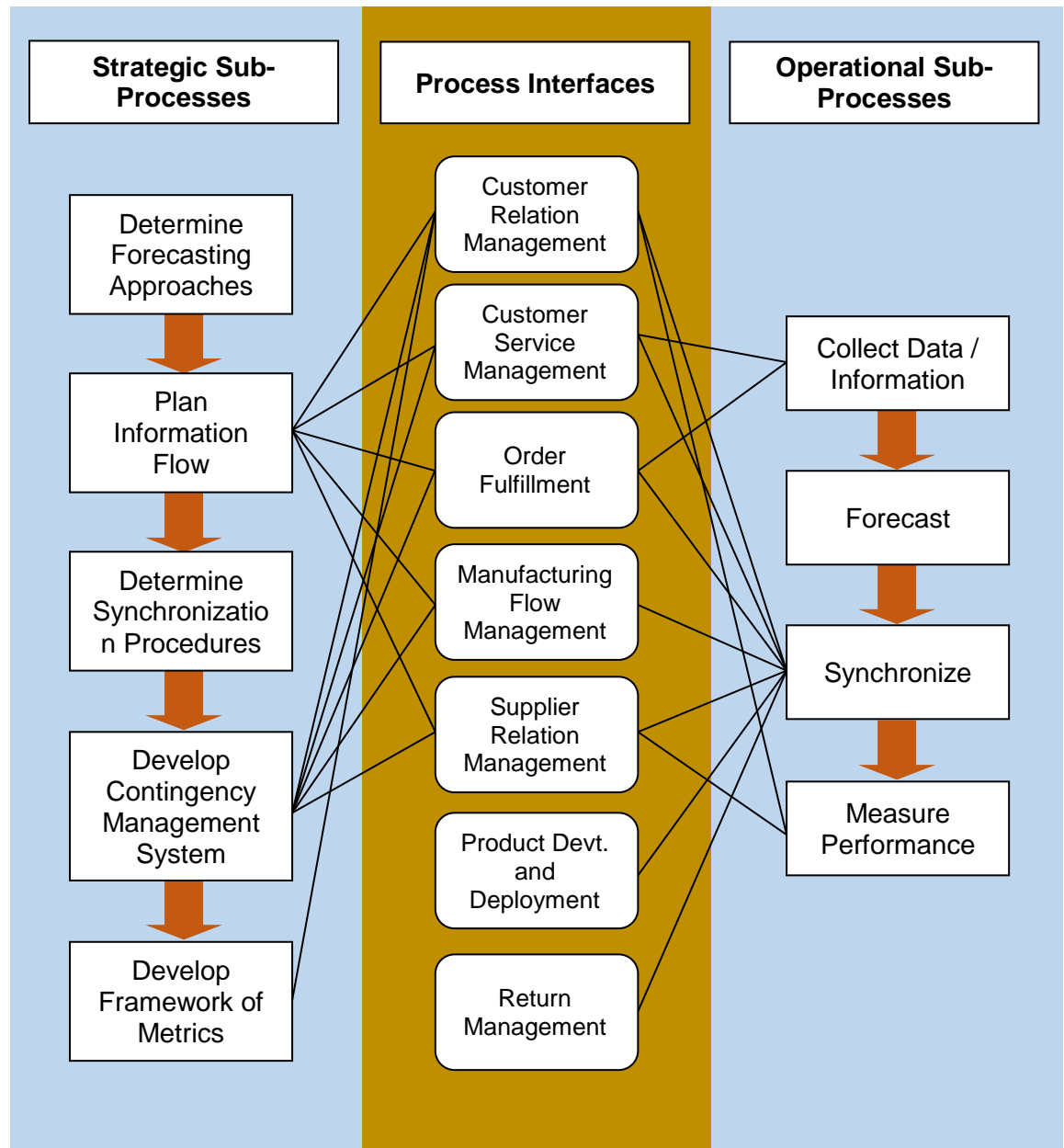
		conservation measures
6. CCC	<p>Communicate / Coordinate with local government units and private entities to address vulnerability to climate change impacts of regions, provinces, cities and municipalities</p> <p>Monitor and evaluate government programs and ensure mainstreaming of climate change in national, local, and sectoral development plans</p>	<ul style="list-style-type: none"> <li>• Agroforestry systems</li> <li>• Implement Climate change adoption for each Cluster/Agencies</li> <li>• Knowledge sharing</li> <li>• Conduct information dissemination activities</li> <li>• Land resource allocation</li> <li>• Track progress of proper evaluation to measure performance of several practices</li> </ul>
7. DOST	Provide forecasting and early warning signals	<ul style="list-style-type: none"> <li>• Updated hazard maps to be incorporated in the single system</li> <li>• Use of satellite images from DIWATA-1</li> <li>• Continuous upgrading of facilities for PAGASA and PHIVOLCS</li> </ul>

Proposed additional cluster agencies:



8. PSA	<ul style="list-style-type: none"> <li>• Handling of the statistical data of disasters</li> <li>• Primary data collection</li> <li>• Prepare and conduct periodic censuses</li> <li>• Collect, compile, analyze, abstract and publish statistical information</li> </ul>	<ul style="list-style-type: none"> <li>• Integrate social and economic statistics</li> <li>• Maintain appropriate frameworks and standards</li> <li>• Methodological, analytical and development activities</li> <li>• Implement policies on statistical</li> </ul>
9. DOE	Repair electric infrastructure and provide alternative source of energy or electricity	<ul style="list-style-type: none"> <li>• Development of portable solar kit</li> </ul>
10. DICT	<ul style="list-style-type: none"> <li>• Repair telecommunications infrastructure and provide other means of telecommunications</li> <li>• Develop information system for NDRRMC</li> </ul>	<ul style="list-style-type: none"> <li>• Develop a single system for the NDRRMC (Discussed in Annex 1)</li> <li>• Explore other advance communications to be used in managing disaster</li> </ul>

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### 6.3. Demand Management in Managing Disaster





The demand management process needs to balance the impact or effect of disaster with that of cluster agencies' capabilities. This includes forecasting of demand of supplies needed after the disaster, if in case there is destruction. The process is also

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concerned with developing and executing contingency plans by the cluster agencies when operations are interrupted.



Cluster Agencies	Strategic Function	Operational / Implementation
1. DSWD	Distribution of relief	Sustainable relief of goods in the evacuation area
2. DA	Identification of root crops and vegetation (fruit and vegetables) and its corresponding location where these will be planted	Equipment/Facilities that can save farmlands from flooding
3. DAR	Record Register and Secure Land  Provide land tenure security to landless farmers  Provide legal intervention to Agrarian Reform Beneficiaries	Evacuation Site/Land including Ethnic Tribes can be used in terms/during natural disaster
4. DPWH	Maintenance of Infrastructure (Roads and bridges)	Rescue/Armagedon Vehicles (vehicles can operate in extreme weather condition)
5. DENR	To geographical provide maps in planting trees	Endangered Plants and Trees Identification and Protection
6. CCC	Communicate / Coordinate with local government units and private entities to address vulnerability to climate change impacts of regions, provinces, cities and municipalities  Monitor and evaluate government programs and ensure mainstreaming of climate change in national, local, and sectoral development plans	Facilities that can allow different agencies to view and manage climate change
7. DOST	To provide forecasting and early warning signals	Accurate forecasting of early warning signals

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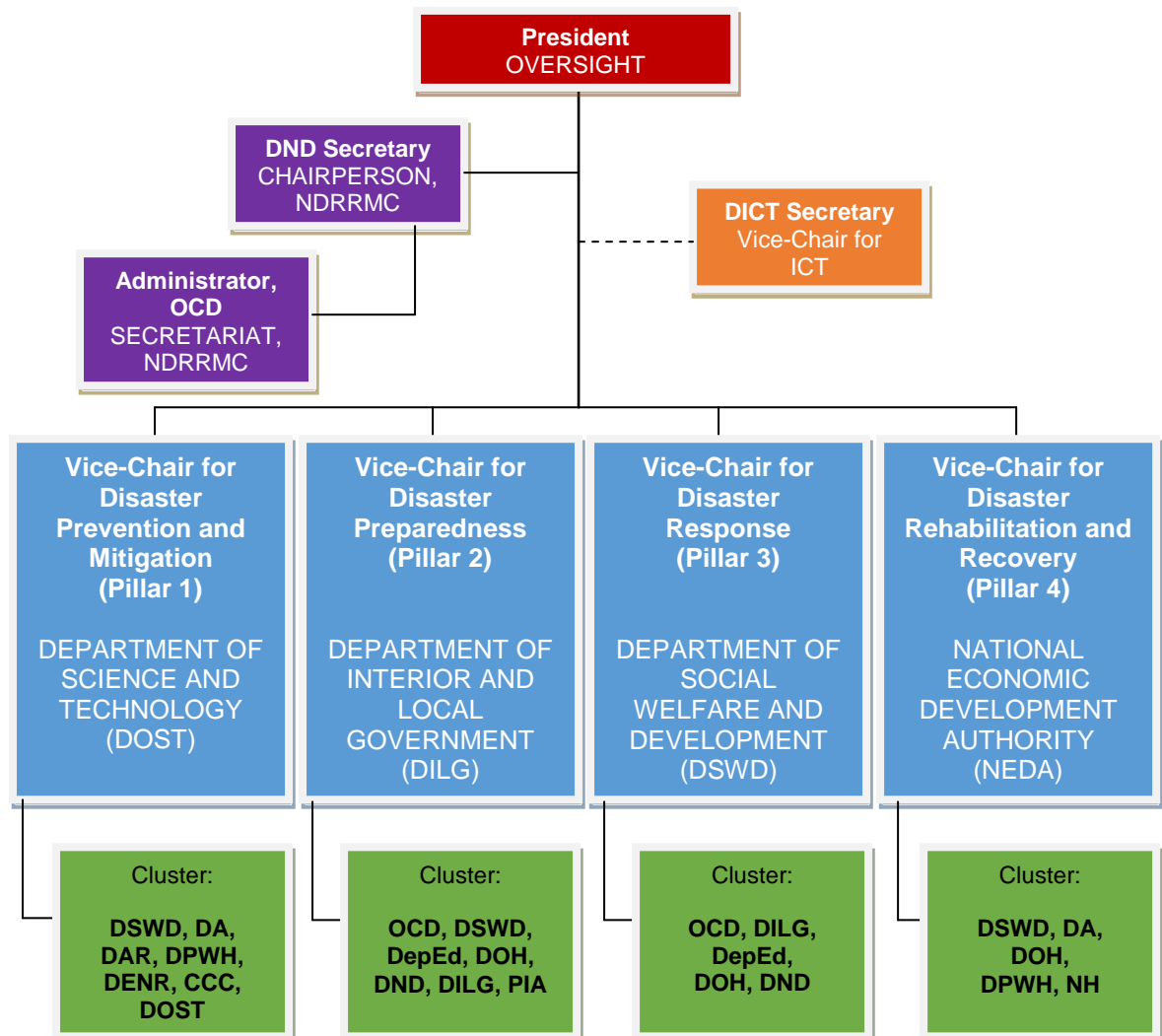
Proposed additional cluster agencies:

8. PSA	<ul style="list-style-type: none"> <li>To collect and handle primary statistical data of disasters</li> <li>to prepare and conduct periodic censuses</li> <li>To collect, compile, analyze, abstract and publish statistical information</li> </ul>	Updated accurate statistical data
9. DOE	To repair electric infrastructure and provide alternative source of energy or electricity	Portable technology for immediate source of energy
10. DICT	<ul style="list-style-type: none"> <li>To repair telecommunications infrastructure and provide other means of telecommunications</li> <li>To develop information system for NDRRMC</li> </ul>	Advanced and integrated disaster management system





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#### 6.4. NDRRMC Functional Structure

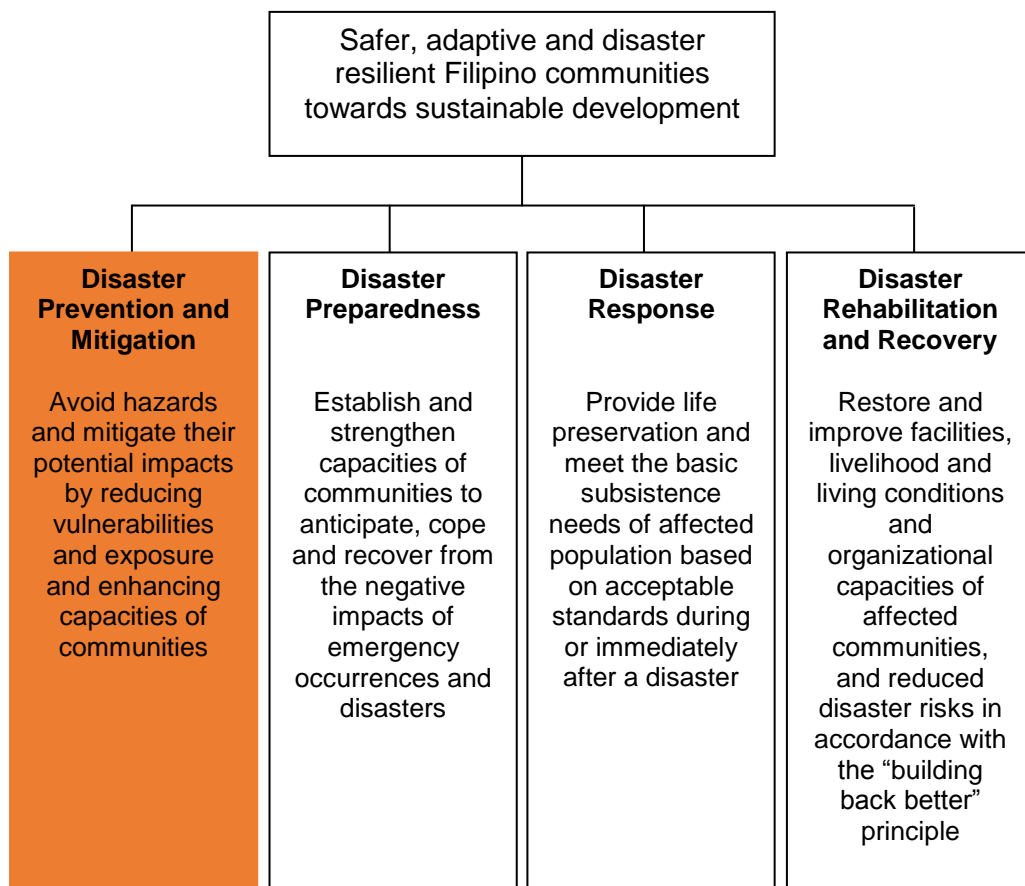


#### Proposed Additional Agency

The Department of Information and Communication Technology (DICT) will serve as Vice-chairperson for ICT to identify and manage ICT resources for disaster management. Its outcome will be a well-established systems infrastructure for disaster management.

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## 6.5. Thematic Areas in Disaster Management



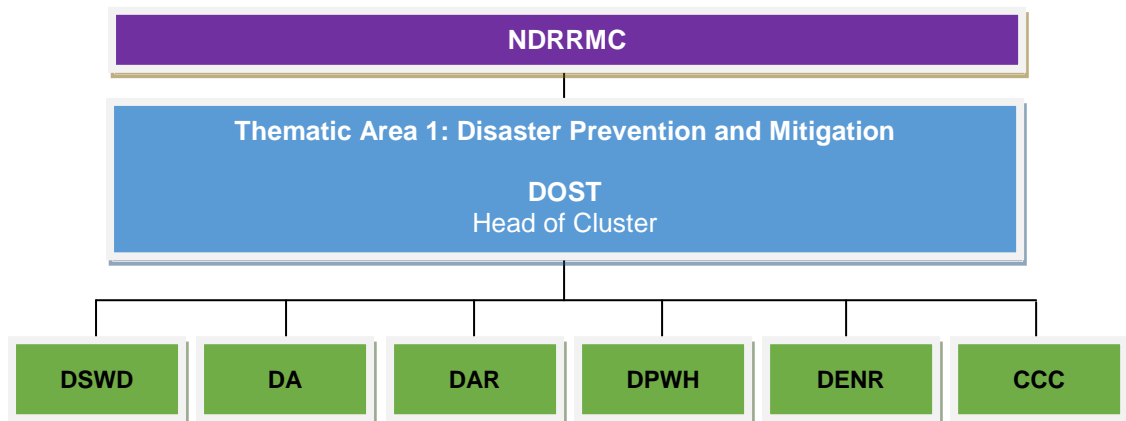
To reduce vulnerabilities and to enhance capacities and capabilities of communities, the following are the proposed initiatives:

- Build capacity and capability of local community to respond to any calamity. Community includes regional, provincial, municipal and barangay levels.
- Strengthen partnerships and alliances to respond to disaster. Partnerships include private and public organizations.
- Establish hazard category and equivalent color for the level of governance
- Develop single system for disaster preparedness, response, rehabilitation and recovery

Details of these initiatives are further elaborated in the recommendations.

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## 6.6. Thematic Area 1. Disaster Prevention and Mitigation





**Thematic Area 1. Disaster Prevention and Mitigation.** Lead Agency: Department of Science and Technology (DOST)

Executive Order No. 128 mandates the Department to “provide central direction, leadership and coordination of scientific and technological efforts and ensure that the results therefrom are geared and utilized in areas of maximum economic and **social benefits for the people**”

- Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA)  
*To provide protection against natural calamities and utilize scientific knowledge as an effective instrument to insure the safety, well-being and economic security of all the people, and for the promotion of national progress.*
- Philippine Institute of Volcanology and Seismology (PHIVOLCS)  
*To mitigate disasters that may arise from volcanic eruptions, earthquakes, tsunami and other related geotectonic phenomena.*

The NDRRMC identified six (6) outcomes based on the National Disaster Risk Reduction and Management Plan (NDRRMP) 2011-2028. The Prevention and Mitigation Thematic Area is focusing on **Outcome 6. End-to-end monitoring (monitoring and response), forecasting and early warning systems are established and/or improved.** In order to achieve this outcome, the cluster

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agencies, lead by DOST, will provide early warning signals and forecasting to any calamities that Philippines is facing.

## 7. Recommendations

In this section, details of recommendations identified above will be elaborated further.

### 7.1. Build capability of local community to respond to any calamity.

It is important to support and build local capabilities of people to mitigate and reduce impact of disasters. These capabilities include drills, trainings, orientation and actual simulation on pre-emptive evacuation, rescue and relief operations and taking care of people in the evacuation center. Such capabilities will enable communities to cope better with those few disasters which are unavoidable. For this matter, the Department of Interior and Local Government (DILG) will take the lead in building capabilities of local communities in coordination with other concerned private and public agencies.

#### **Building Capability through Competition Program**



There is a need to strengthen the awareness campaign on managing disaster to local communities and to prepare them to any calamities. A program should be established to require all municipalities and cities all over the country to conduct awareness campaign through a competition. This will motivate the local community to participate because award has been waiting on top of their built capability through the competition.

Additional component to the program is the competition on Best Community Ready for Calamity or *Handa Kami sa Kalamidad*. This will be synchronized during barangay or town/city festival. Instead of beauty pageant, a competition related to disaster preparedness should be organized.

### 7.2. Strengthen partnerships and alliances to respond to disaster.

There are a number of organizations and groups that are involved, or need to be involved, in disaster prevention and mitigation. It is important to build participatory alliances and partnerships among these entities in order to map out responsibilities and activities in coordination with different private organizations.

1. **Department of Information and Communications Technology (DICT)** – to study the possibility of having a Mobile Internet and Communication to be used during disaster.

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- Technology: NFC – Near Field Communication.
  - Collaboration: IBM Philippines
- Information System: A cross platform mobile application—for citizens, volunteers and a website for the involved government agencies—that will crowdsource (Merriam-Webster) disaster information, send disaster alerts, suggest planned evacuation, track people and identify medical needs. (We Are Ready (WAR), 2014)
- Large Scale System: Smart City (IBM, 2012)
  - Collaboration: IBM NYSE
  - Initiatives: Davao City

In June 2012, IBM and the Davao City Government announced an agreement to help the city scale-up its existing Public Safety and Security Command Center (PSSCC) by integrating city operations into a single system, infused with advanced technologies, to further enhance public safety operations in the city.

In addition, there are already existing disaster management mobile applications available for Android and iOS. (Gonsalves, 2014)

1. American Red Cross Apps
  - number of preparedness apps including First Aid, Floods, Tornados, Earthquakes, Wildfires, Hurricanes, Volunteer, Shelter Finder.
  - include interactive videos, quizzes and simple step-by-step advice. In addition, they include customizable warning indicators if you live in areas prone to natural disasters.
2. Disaster Alert (Pacific Disaster Center's World Disaster Alerts) - Disaster Alert (by Pacific Disaster Center)
  - free download providing mobile access to multi-hazard monitoring of and early warning for “Active Hazards” around the globe.
  - Additional information and reports about hazards can be viewed and shared.
3. Global Emergency Overview (ACAPS)
  - weekly update that provides a snapshot of current humanitarian priorities and recent events.
  - a summary of major humanitarian crises, both recent and protracted.
4. Humanitarian Kiosk (United Nations)
  - provides a range of up-to-the-minute humanitarian related information from emergencies around the world.



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There is also an existing mobile app that we can improve specifically for the Philippines: (Smart, 2016)



- “First released in 2014, PINDOT, short for Provincial Information Network on Disaster Occurrences and Threats, now includes a user-friendly content management system (CMS) to enable immediate dissemination of warnings, information, and updates via the app.
- PINDOT is a disaster management tool designed to enable faster coordination during emergencies to facilitate immediate rescue and response. PINDOT app has an active listing of various concerned government and non-government offices, which are also mapped to aid in planning and decision making.”

**2. Department of Energy (DOE)** – to study the possibility of manufacturing Portable Solar Kit as an immediate solutions when electricity is shut down during disaster. This Portable Solar Kit can accommodate at least household lightings and charging battery of mobile phones.

- Technology: Solar Kit
- Collaboration: ORANGE and ENGIE (Nigeria Curator, 2016)
  - The partnership requires ENGIE to supply the solar kits through BBOX and Fenix International, and also take responsibility for the installation and maintenance of the equipment.
- Initiatives: African Countries
- Solar Kit Inclusions:
  - The kits include a solar panel connected to a battery that can be used to power domestic appliances, and a remote control solution and a mobile payment system.
  - The solar kits can be used as a lighting solution with LED lamps, to operate small electrical appliances (radio, television, etc.) or to recharge mobile phones.
  - This equipment offers a low cost, alternative solution to petroleum lamps, disposable batteries or diesel-powered devices, which are harmful to the health and environment.

**3. Department of Environment and Natural Resources (DENR)** – for tracing the spring water and water basins underground

"Access to clean and adequate water remains an acute seasonal problem in urban and coastal areas in the Philippines. The National Capital Region (Metro

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Manila), Central Luzon, Southern Tagalog, and Central Visayas are the four urban critical regions in terms of water quality and quantity. The Government's monitoring data indicates: (WEPA, 2003)

- Just over a third or 36 percent of the country's river systems are classified as sources of public water supply:
- Up to 58 percent of groundwater sampled is contaminated with coliform and needs treatment;
- Approximately 31 percent of illness monitored for a five-year period were caused by water-borne sources; and
- Many areas are experiencing a shortage of water supply during the dry season."

Table: 2 Groundwater Sectorial Demand in the Philippines for 1996 and projected for 2025 (in MCM per year)

	1996	2025	% of Total	Low	High
Municipal	2,178	7,430	8,573	7.27	
Industrial	2,233	3,310	4,997	7.46	
Agriculture	25,533	51,920	72,973	85.27	
Irrigation	18,527	38,769	53,546	61.87	
Livestock	107	224	309	0.36	
Fishery	6,899	14,437	19,939	23.04	
<b>Total Demand</b>	<b>29,994</b>	<b>62,660</b>	<b>86,543</b>	<b>100.0</b>	
Groundwater (GW) Recharge	20,200	20,200			
%Potential/Total Demand	67.46	32.24	23.34		

Source: Master Plan Study on Water Resources Management in the Republic of the Philippines, 1998 (PNRI, 2012)

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**Table 1: Total Annual Resource Potential of the Philippines (in MCM per year)**

Water Resources Region	Groundwater Potential	Surface Water Potential	Total Water Resources Potential	Percent Groundwater to Total Potential
X Northern Mindanao	2,116	29,000	31,116	6.8
VI Western Visayas	1,144	14,200	15,344	7.45
IX Western Mindanao	1,082	12,100	13,182	8.21
XII Southern Mindanao	1,758	18,700	20,458	8.59
XI Southeastern Mindanao	2,375	11,300	13,675	17.37
III Central Luzon	1,721	7,890	9,611	17.91
IV Southern Tagalog	1,410	6,370	7,780	18.12
VIII Eastern Visayas	2,557	9,350	11,907	21.47
II Cagayan Valley	2,825	8,510	11,335	24.92
V Bicol	1,085	3,060	4,145	26.18
I Ilocos	1,248	3,250	4,498	27.75
VII Central Visayas	879	2,060	2,939	29.91
<b>Total</b>	<b>20,200</b>	<b>125,790</b>	<b>145,990</b>	<b>13.84</b>

Source: *Master Plan Study on Water Resources Management in the Republic of the Philippines, 1998*





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Table: 2 Groundwater Sectorial Demand in the Philippines for 1996 and projected for 2025 (in MCM per year)

Water Demand	1996	2025		% of Total (1996)
		Low	High	
Municipal	2,178	7,430	8,573	7.27
Industrial	2,233	3,310	4,997	7.46
Agriculture	25,533	51,920	72,973	85.27
Irrigation	18,527	38,769	53,546	61.87
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<b>Total Demand</b>	<b>29,994</b>	<b>62,660</b>	<b>86,543</b>	<b>100.0</b>
Groundwater (GW) Recharge	20,200	20,200	20,200	
%Potential/Total Demand	67.46	32.24	23.34	

Source: Master Plan Study on Water Resources Management in the Republic of the Philippines, 1998

- Department of Health (DOH) in coordination with the Department of Agriculture (DA)** – to determine the different variety of medicinal plants as alternative medicine to be planted near the evacuation center. This will be used as alternative medicine before the medical help arrives.
- Department of Agriculture (DA)** – to provide reference on which root crop to plant
- Office of Civil Defense (OCD)** – lead in conducting drill on rescue and relief operations
- Department of Social Welfare and Development (DSWD)** – lead in taking care of people in the evacuation center
- Department of Health in coordination with the Philippine Red Cross** – lead in conducting drill on responding emergency situations
- Department of Education (DepEd)** - to conceptualized the promotion of hazard/disaster awareness based from the existing Disaster Risk Reduction

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Resource Manual to help all school communities reduce the risk of threats from the disasters.

**10. Department of Public Works and Highways (DPWH)** – to provide location map for human settlements away from high risk areas and land-use plan to prevent development in hazardous areas.



**11. National Housing Authority (NHA) in partnership with the Chamber of Real Estate and Builders' Associations Inc. (CREBA)** – strengthen the building code of the Philippines for the construction of typhoon-resistant houses and other structures

**Strategies on Strengthening Partnerships and Alliances** (Handmer J. M., Integrated Adaptation and Disaster Risk Reduction, 2014)

- Informal and formal partnerships: agency heads-to-agency heads, professional to professional, agency-to-agency, sharing information, building capacity, personal relationships
- Asia Pacific Alliance for Disaster Management
- Institutional staff exchanges between government agencies and private organizations
- Donors taking a more consultative approach in Climate Change & Disaster Risk Reduction, consistency in methods, tools and assessments
- Multi-agency projects: Joint project proposals
- Inclusion of civil society in national discussions and community resilience building

One of the most important enabling factors that participants mentioned was partnerships, both informal and formal. Informal partnerships were seen to play an important part in sharing lessons and strengthening practice. These partnerships have included for example agency-to-agency exchanges between Philippine Government agencies and Private Organizations where Disaster Risk Reduction and Business Continuity Officers have been able to spend time at the partner agencies. For example, Business Continuity Officer of Coca-Cola had undertaken placements at the DILG in order to build capacity and to understand how to adapt DRR plans and policies for local context and vice versa. Such twin-arrangements have strengthened the opportunities to learn from practice and relate these lessons back to the agency context, and modify existing plans and policies to fit the local context.



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	<b>Supply Chain Management for Disaster Prevention and Mitigation</b>	Recommendations: Protocol for the Dead, Hazard Category, Single System	
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Greater integration had brought new alliances into the area, such as the *Asia Pacific Alliance for Disaster Management*, and made new space for collaborative approaches where different people and institutions could pursue joint projects. For example, a participant from Japan noted that the strength of this new alliance relied on everyone coming together to support public safety:

The *Asia Pacific Alliance for Disaster Management* encouraged Asian Countries to forge better relationships (a pure support mechanism) so that it's going to be an interesting journey and to have all these agencies supporting this alliance. The National Disaster Risk Reduction and Management Council is actually very good and efficient. The whole issue of supporting public safety, it is about getting a focal point.

### **7.3. Establish protocol to identify and settle dead after disaster**



It is very essential to take care of the dead immediately after the disaster. A program that NDRRMC can look into is an establishment of a mortuary. In the case of Typhoon Yolanda, there are thousands of dead bodies that can be found around the streets and nowhere to be settled. In doing this, the government can partner with Philippine Mortuary Association (PMA) to take the lead in the delivery of mortuary services in the field of funeral service. The National Bureau of Investigation (NBI) - Forensic Chemistry Division (FCD), for this matter, can take the lead in identifying the dead using the Automated Fingerprint Identification System (AFIS).

### **7.4. Establish hazard category and equivalent color for the level of governance**

To address the lessons learned identified above, it is important that in times of disaster, everything will be systematic and synchronize. In every level of disaster, there is a corresponding agency to take the lead in managing disaster. The NDRRMC can design hazard category and equivalent color for the level of governance.



### **7.5. Develop single system for disaster preparedness, response, rehabilitation and recovery**

Technologies in this era are fast evolving. The government should look into a possibility in developing a single system that covers the preparedness, response and rehabilitation and recovery.

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## 8. Conclusion

In times of disaster, unity and cooperation between government, concerned agencies and the general public is important. They must help each other and work together to reduce the risk. The government plays a vital role in disaster prevention and mitigation. Its resources should efficiently and effectively utilize in order to establish policies and strategies. New technologies should also be identified out of these resources to minimize the impact of the disaster.

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