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Building a resilient community with an ICT-Powered Local Government Unit (LGU): Community-based disaster solution

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Abstract

The Philippines is the 3rd most disaster-prone country globally. While the Aurora, one of its provinces facing the Pacific, is included in 27 identified high-risk provinces in the Philippines. Due to its high disaster risk, the community and the local government craft different policies and innovations to ensure the local population's safety. This development research study harnesses the potential of ICT in providing solutions for the community. The researcher develops an ICT solution that empowers the LGU and the community, thus helping them in formulating decisions and responses. The chaos and panic caused by disasters demand quick solutions as time plays a critical role in these situations. Substantially, Information and Communication Technology appear. Through this research innovation, data sets were hyper-localized with the community in Barangay levels as the main information providers. Disaster maps and the DRR (Disaster Risk Reduction) tools were personalized based on the data supplied by the community. The study primarily targeted extending this technology to the LGU. LGUs, being the first responders, are the ones responsible for community development, play a key role in achieving society's resilience to disasters, and ensure the resilience of the municipalities under their jurisdiction. The findings of this study can be a reference for the other studies of Geography concerning increasing community resilience.

Keywords: disaster mapping; local government unit; resilience; ICT; analytics

1. Introduction

Aurora province is known for its tourism and majestic coastal resources. Being a coastal province has been a blessing to the Aurorans (citizens of Aurora). Besides, agriculture has been the backbone of its local industry, followed by tourism. However, the province's geographical location, which is a coastal area, exposes it to numerous disaster risks (Orencio & Fujii, 2013). Meteorological events such as hurricanes and tropical cyclones that cause flooding and shoreline erosion are examples of potential disasters (Sharples, 2006).

The global annual number of climatological, hydrological, and meteorological events has been increasing since 1980 (Munich, 2015). There is now widespread agreement that climate change has increased the frequency and severity of the disaster, with this trend expected to continue in the future (Pfefferbaum, Pfefferbaum, & Van Horn, 2015). Over the last four decades, the concept of community resilience has gained increasing prominence in science and policy circles in response to concerns about the consequences of increasing frequency and severity of the disaster.

The flip side of living in front of the Pacific Ocean is dealing with numerous typhoons all year round. These disasters have hampered economic development, while also destroying

human, social, and physical capital. Funds for ongoing programs were forced to be reallocated to finance relief and reconstruction assistance. While the documented losses caused by disasters are formidable, the full impacts were simply immeasurable and beyond numbers.

As of this moment, there is no ICT application that is deployed explicitly in the Local Government Units that adheres to their DRRM (Disaster Risk Reduction Management) needs. Most of the transactions are done manually, and all tools available were cascaded from the national level. This study proponent study aims to improve the way LGU treats disasters pre, during, and post events. By empowering the LGUs with accurate data from the community, the local authorities will better understand the risks experienced by the community through systematic analysis of historical data, current community information, and existing crucial resources during the crisis.

The community involved in this study is the general public directly under the care of Barangay officials. Barangay is the smallest political unit under the hierarchy of the Philippine Government Structure, with direct supervision from the LGUs. Bringing disaster risk reduction at Barangay and LGU levels would be most effective. National maps and different DDR technologies were available, but nothing can be more accurate and effective than the community's design.

One major deliverable was the development of a local disaster interactive mapping and resident information system named BARRIERS (Barangay Disaster Map and Resident Information Systems for the Local Government Units of Aurora) and an analysis of its impact on LGUs in delivering their services to the community.

The three main principles of this study were to prepare, respond, and digitize. The 'prepare' includes disaster trend mapping, along with the inventory of food and alternative fuel and water sources, electricity and network redundancy, and planning of strategic infrastructure placement. The mapping is detailed so that it can be zoomed in to the perspective view of a town, barangays, and buildings (internal and external 360 panoramic views of buildings, tourist spots, and so forth).

DelubView-(local Tagalog word), a disaster timeline 'Respond', includes Bakwit/Relief and Evacuation Module, with a constant improvement on DRR protocols Bakwit-(local Tagalog word) Evacuation Module. Meanwhile, the 'digitize' feature will solve the manual and error-prone recording, report escalation gaps, and archiving issues. Moreover, Badeyu (local Tagalog word) Dashboard/Analytics in the BARRIERS' deployment, the researcher investigated its impact on the LGUs' treatment in the pre, during, and post-disaster activities and the efficiency of Community-Based Disaster Solutions in building a resilient community.

Two Towns were choose as prototypes of this study. They are Baler and Dingalan in Aurora Province. The National Disaster Risk Reduction and Management Council (NDRRMC) is assigned to formulate a framework for disaster risk reduction and management (DRRM), as well as supervise preparations for and responses to natural calamities and human-induced disasters under the Philippine Republic Act 10121, also known as the Philippine Disaster Reduction and Management Act. However, local government units (LGUs) are expected to be at the frontline of emergency measures in the aftermath of disasters to ensure the general welfare of their constituents, according to the Local Government Code of 1991. Every LGU should also create a Local Disaster Risk Reduction and Management Plan (LDRRMP) covering

four aspects of DRRM as specified in NDRRMC's framework, consisting of disaster preparedness, response, prevention, and mitigation, as well as rehabilitation and recovery.

Some of the local government units' duties include submitting the report when unexpected events and situations arise at any time during the year, mainly when artificial or natural disasters affect the general welfare of the city, province, and so forth. In that situation, they should carry out such necessary emergency measures and in the aftermath while also providing relief services and assistance for victims during and in the aftermath of said disasters or calamities and their return to productive livelihood following said events.

Being at the forefront of disasters, the LGUs of Aurora Province has become more resilient and innovative in disaster management. Several studies and innovations showed positive impacts of ICTs (including mobile ICTs) in understanding and responding to extreme events. A study by Scholl, Patin, & Chatfield (2012) recommends radically re-thinking event response scenarios through data integration, training, and effective use of ICTs, planning, and preparedness. Since technology has never stopped evolving, a lot of innovations have been developed to add to the body of knowledge and practices relating to extreme events management. This development research is anchored on designing and developing an innovative solution that will provide stability and sustainability in local government units of Aurora, especially in the context of Disaster and Risk Reduction Management using Information Technology.

The advancement of disaster management technology in the Aurora area can be used as a lesson for students and academics. This study can be used as a reference for the implementation and development of Geography learning, particularly in disaster preparedness and mitigation. Besides, learning also necessitates multiple data sources as it provides students with opportunities for contextual and meaningful learning (Siriwardena, Malalgoda, Thayaparan, Amaratunga, & Keraminiyage, 2013).

2. Method

This development study followed AGILE Adaptive Software Development (ASD) to control the software project for changeable requirements over the defined period of development. Each phase (sprints) was evaluated and reviewed. Using ASD, the researchers should be quicker and more effectively adapt to changing requirements. The researcher's approach was exemplified by ASD's three-phase process of speculating, collaborating, and learning.

The Adaptive Software Development Lifecycle focused on results, not tasks, and the results were identified as application features. The adaptive software development lifecycle focuses on results not tasks. These results are identified as application features. The features could be divided into several parts as follows: 1) project initiation; 2) development of plan; 3) solution development; 4) testing; 5) implementation; 6) training and simulation; 7) stabilization project acceptance/sign off.

Upon a year of BARRIERS' deployment, the researcher assessed its impact on the treatment of LGUs in their pre, during, and post-disaster activities, as well as the efficiency of Community-Based Disaster Solutions in building a resilient community. The researcher conducted interviews and analyzed the logs to compare changes in the processes, protocols, tools, procedures, time variability, data gathering, and report generation of the LGU relating to

DDR. Table 1 shows the major phases and deliverables necessities for the completion of this study.

Table 1. Major Phases and Deliverables

Phase	Activity/Deliverables
Project Initiation	Business Case
	Project Proposal
	Project Charter
	Project Plan - Project Goals
	Project Plan - Budget
Develop Project Plan	Project Deliverables
	Define Change Management Process
	Project Team
	Personnel Policies
Execution of WBS	Security - Define Security Controls
	Business Process Design
	System Architecture design
	Development Standards
	Module Design - MOD001-Administration
	Module Design - MOD002-User Interface
	Module Design - MOD003-Mapping
	Module Design - MOD004-Interfaces
	Module Design - MOD005-Users
	Module Design - MOD006-Dashboard
	Module Design - MOD007-Reports
	Module Design - MOD08- Evacuation
Testing	Quality Assurance - Document
	Test Cases
	Operational Readiness Test
	Test Result and Findings
Implementation	Risk assessment
	Identify approval and sign off person (BCP)
	Define Go-Live Activities
	Production Environment
	Operational Readiness Test
Training	Attendees
	Systems
	Schedule
	Train the Trainers
	Training Materials
	Conduct Training
	Post Training
Stabilization and Closeout	Project Closeout

3. Results and Discussion

Community resilience during disasters occurs before, during, and after the disaster (Aldrich & Meyer, 2015). Community resilience covers the preparedness for a disaster and overcoming vulnerability to ensure the community's survivability in a disaster-stricken environment in the short term (Sharifi, 2016). By using traditional systems and technology, the community activities in building resilience to respond to disasters in the Aurora province could be compared. The use of technology aids the community in identifying disasters, inventory disasters, and their effects, as well as providing the required solutions. Table 2 presents the data of comparison between traditional and BARRIERS (ICT) activities.

Table 2. Comparison between Traditional and BARRIERS (ICT) Activities

	Traditional	BARRIERS (ICT)
Pre-disaster activities	Disaster Drills	Active mapping of new and existing establishments
	Identification of Evacuation Centers	Active use of Resident information System
		Updated data of active responders, constituents, and so forth
		Mapping of Evacuation Centers, lifelines (Gas, Water, Food), and survival routes
During-disaster activities	Manual inventory of supplies and relief	Real-time update from responders and Brgy officials - logged into analytics
	Manual recording of affected families and individuals	Real-time data of evacuees containing basic demographics, special needs, and evacuation center carrying capacity vs. evacuees.
	Sirene (warning system)	Data were constantly fed (real-time)
		Text blast
		Generation of reports
Post-disaster activities	Gathering of data (weeks)	Generation of report
		Evaluation
	Escalation of reports	Evaluation of damages
		Analytics
	Rehabilitation	Forecasting
		Update of protocols
		Review logs, upload images in the data map archive

Significant development contributing to the Resiliency of the LGU include: digitization of reports, multimedia archive of disaster history, interactive web-based Disaster Map of Baler with trend and analytics, a resident information system that supports the LGU and Brgy Offices, evacuation module recording the name of evacuees, the number of evacuees, beneficiaries, and so forth, Baler/Dingalan disaster map that covers: an interactive top view of the Baler map that indicates the critical level and risks of a certain barangay, for government infrastructure strategic planning and shall guide investors and residents in positioning their assets, can be scaled down to the street panoramic view to provide details.

3.1. Significant Modules of the System

The preparation stage includes the mapping of disaster trend mapping and inventory of food, alternative fuel and water sources, electricity and network redundancy, as well as planning of strategic infrastructure placement. The mapping is detailed that it can be zoomed in to view a town, barangays, and buildings (internal and external 360 panoramic views of buildings, tourist spots, and so forth). These software development was divided into several part, namely; 1) DelubView-(Local Tagalog word for Disaster Timeline; 2) Bakwit-(Local Tagalog word for Evacuation Module); 3) Badeyu (Local Tagalog word for Dashboard or Analytics).

These part of the software could be explained as follows. 1) Respond includes Bakwit (relief) and evacuation module, along with a constant improvement of DRR protocols. 2)

Digitize feature will solve the manual and error-prone recording, report escalation gaps, and archiving issues.

The dashboard consists of important information on the account, including critical areas, real-time analysis, forecast, a news feed, and the most efficient response based on records. Figure 1 illustrates the dashboard display.

Figure 1. Dashboard

By using Bakwit Module, disasters can be measured with real-time information and met with a rapid, accurate, and precise response. In addition, big data can enhance disaster recovery by utilizing community information and connecting victims with emergency responders and families. Figure 2 shows the Bakwit module display.

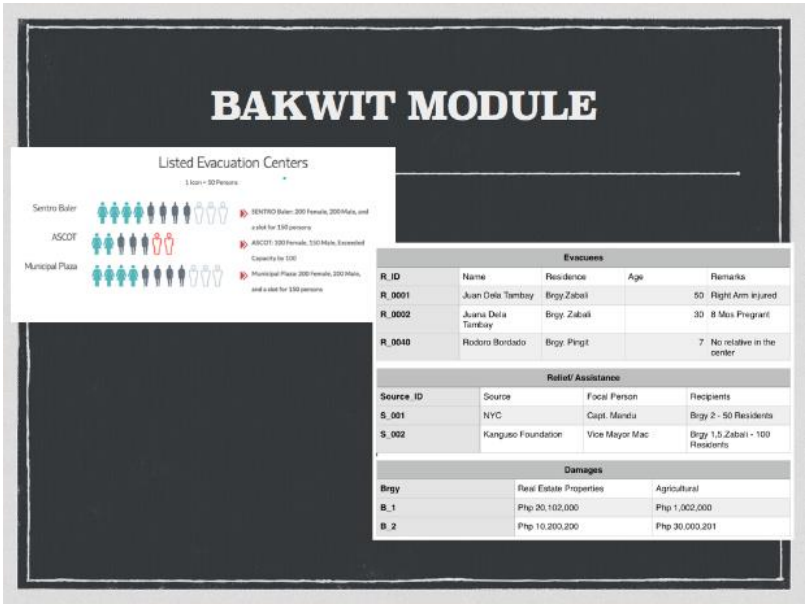

Figure 2. Bakwit Module

Likas Module requires a review occasionally and made publicly available since this is a mini-app inside the system that points to where you are and where are your nearest lifelines. Figure 3 shows the Likas Module display.

Figure 3. Likas Module

The mapping module offers trend mapping and heat mapping functions. This is beneficial to residents and investors planning to build or put up assets in the municipalities. Figure 4 shows the mapping module display.

Figure 4. Mapping Module

The panoramic view is a trend or heat map that can be zoomed to a "street view" level, providing the viewer with a panoramic 360 image of the captured scene. In this era of information, where information is valued and utilized at a very high rate, the government should take the positive advantages offered by ICT. The 2010 NDRRMC law mandated the creation of Local DRRM Offices (LDRRMOs) to support the local chief executive in pursuing DRR. In response, LGUs of Aurora created their respective Municipal Disaster and Risk Reduction Management Office (MDRRMO).

The study shows that harnessing the capability of ICT and putting the intelligent utilization of Community-Provided Data results in a data-driven government, providing efficiency and effectiveness in planning, executing NDR protocol, and responding to disasters. In the initial test and prototyping of the ICT tools (BARRIERS), there are notable improvements that may be adopted by LGUs in handling their pre, during, and post-disaster activities.

Recently, considerable attention has been given to disaster management, but such efforts have largely concentrated on post-disaster response with very few concerns on prevention and mitigation. The prevention and mitigation of disaster represent the proactive and not reactive in handling disasters. review, update, and innovation on the process and protocols relating to the man-made or natural disaster are consistent. Meanwhile, the higher technological upgrades require more integration processes into our processes.

3.2. More Accurate Generation of Reports

An automated attendance-like system to be used in the disaster or evacuation period, particularly on fast escalation and production of general reports.

3.3. Cost-cutting

Equipped with proper information, LGUs could plan their infrastructure and projects strategically. This will eventually minimize the allocated budget for building rehab and repair. The review of their processes signifies that several processes were redundant, either in the internal or external offices, such as in collecting data from victims of the disaster carried out independently by different government offices. Further, the faster data gathering and reports generation cost fewer resources.

3.4. Process Improvement

During disaster activities, local officials convene to form a command center to decide and carry out actions immediately. With the provision of proper data, such as the number of evacuees per evacuation center, and the most deprived Brgy, they can come up with better decisions. Information-driven decisions are effective decisions.

3.5. Information Value Appreciation

With this innovation, the information does not become obsolete and useless. Data gathered in every disaster or history of the information system were always useless in data analytics, trend reading, and forecasting.

4. Conclusion

ICT can provide potent solutions for building a disaster-resilient community. This process involves the development of policies, strategies, and capacities, as well as activities to assess, prepare for and reduce disaster risks before a disaster strikes. BARRIERS provides data-driven decisions for disaster management in both planning and responding. The prototype of BARRIERS has shown significant improvement in the procedures and protocols applied by the LGUs in the three phases of disaster (pre, during, and post). Accurate data provided by the communities, such as accurate maps, the value of resources, and household information, shall be vital for LGU's responses, as assessed in the BARRIERS. Community-based information remains to be the most accurate and potent tool to deal with disasters. ICT powered LGU that maximizes the power of information and technology (ICT) like the BARRIERS has the potential to reduce the possibility of death and economic disruption by improving access to the information that facilitates a better decision making. This project is recommended to be scaled up to the entire Aurora province and used as a second-level prototype for a Disaster Resilient Province. The findings of this study can be used in Geography classes to teach about the development of community resilience.

References

Aldrich, D. P., & Meyer, M. A. (2015). Social capital and community resilience. *American Behavioral Scientist*, *59*(2), 254–269.

Munich, R. E. (2015). Natcatservice loss events worldwide 1980–2014. *Munich Reinsurance: Munich, Germany*, *10*.

Orencio, P. M., & Fujii, M. (2013). An index to determine vulnerability of communities in a coastal zone: A case study of Baler, Aurora, Philippines. *Ambio*, *42*(1), 61–71.

Pfefferbaum, B., Pfefferbaum, R. L., & Van Horn, R. L. (2015). Community resilience interventions: Participatory, assessment-based, action-oriented processes. *American Behavioral Scientist*, *59*(2), 238–253.

Scholl, H. J., Patin, B. J., & Chatfield, A. T. (2012). ICT-enabled city government field operations: Resiliency during extreme events. *2012 45th Hawaii International Conference on System Sciences*, 2346–2356. IEEE.

Sharifi, A. (2016). A critical review of selected tools for assessing community resilience. *Ecological Indicators*, *69*, 629–647.

Sharples, C. (2006). Indicative mapping of Tasmanian coastal geomorphic vulnerability to sea-level rise using GIS line map of coastal geomorphic attributes. *Consultant Report to Department of Primary Industries & Water, Tasmania*, *222*.

Siriwardena, M., Malalgoda, C., Thayaparan, M., Amaratunga, D., & Keraminiyage, K. (2013). Disaster resilient built environment: role of lifelong learning and the implications for higher education. *International Journal of Strategic Property Management*, *17*(2), 174–187.