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Developing Agricultural Damage Simulation in the Impact of Typhoon and Flashflood in Laguna

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Abstract: Philippines suffer a great loss from typhoon damages and tons of natural disasters that has negative impacts on the environment. Typhoon and flash flood will reduce farm productivity by damaging farm inputs and destroying establishment and infrastructure and prevent an increasing in farm planting, these results in the worse condition in output and productivity which will possibly harm by the country's food security, economic losses, and income. One of the major reasons for this is allocation of fund, the lack of knowledge and preparation of a citizens and officials in agricultural damages and disaster prevention. This concept paper focuses on giving knowledge and awareness by simulating the damage of the typhoon in the Agricultural sector to help the community and officials to visualize and know the risks and damages of typhoon on the Agricultural when calamity occurs as well as to view the damages on agriculture with interactive 3D simulation environment. The proposed system can be develop using Simulation Methodology which composes of several phases to achieved the agricultural disaster simulation with the integration of Monte Carlo Algorithm, it can be used to apply the parameters from PAGASA's storm warning signals for simulation and typhoon parameters. The need for the development of this system must be develop and implement for the benefits of the farmers, agricultural sector, the people, and to the environment to prevent possible damages and mitigate larger amount of losses in economic and agriculture.

Keywords: Agriculture Damages, Natural Disaster, Agriculture Sectors, Crops. Simulation

1. Introduction

The Philippines is experiencing tons of natural disasters, the typhoon and floods damages the country the most. Way back then earthquakes, typhoons and floods killed many lives and periodically left parts of the archipelago's structure and economy in pieces. It really affect too much the farms and food systems, leaving people without food in their immediate outcome and deflation food production capacity for years afterwards (FAO, 2016). It is obviously that agriculture sector in a country's overall economic development as stylized in economic and social development literature is well known as mention in literature (Habito & Briones, 2005). Important information needed for must be take into account for the improvement of all areas of agriculture (Mao, 2012).

Natural disasters are harmful and it has negative impacts on the environment, Furthermore, Agricultural sector are easily harmed or damaged because the country is prone to natural disaster and the unwelcoming aftereffects (Israel & Briones, 2013). In article written by Uy and Pilar (2018) across the 10-year reference period, 2009 was the worst for economic losses due to natural disasters at P45.084 billion largely due to tropical cyclones (P43.423 billion). The CPES' P374.199 billion estimate for damage from "major natural extreme events and disasters" includes damage to agriculture worth P225.626 billion, infrastructure P81.974 billion and private property P66.598 billion.

The different typhoon damages in agriculture sector of Laguna in which huge amount crops were affected and significant cause to economic and agricultural losses especially in Typhoon Chedeng which destroyed Php18 billion. According to Department of Agriculture officials based on the interview, the tropical storm Maring destroyed a total of Php126 million worth of rice, fruits and

crops in Laguna. Typhoon causes flash floods, mudslides, widespread flooding causing significant destruction and damages to the Agricultural sector, these results in the worse condition in output and productivity which will possibly harm by the country's food security based Technology for Agriculture.

The law likewise orders all local government units (LGUs) in the country to apportion no less than 5% of their yearly spending plans for disaster chance lessening and administration. Be that as it may, given the impacts of these tempests, reserves accessible to LGUs, and also those put aside by the national government for the Calamity Fund, are scarcely ever enough. It is extremely obvious due to the said number of cost harms that the yearly cost of harm surpassed assessed debacle subsidizes and add up to expenses of harm were higher than the calamity finance (Dela Cruz, 2016).

Moreover, the exposure of the agriculture sector to different disaster is evident across the world. Approximately a quarter of all damages caused by disaster such as drought, floods storms or tsunamis in the developing world are captivated by the agriculture sector (FAO, 2015). Preparing for such events and taking steps to reduce risks to farmers and farming systems can significantly reduce such damages and avoid the need to build agriculture back (FAO, 2016). It is indeed that it must be lessen by creating an application to help the farmer in terms of disaster.

Based on the stated of Secretary Alcala of The Department of Agriculture (DA) have program that is preemptive and quick disaster response mechanisms have enabled the agriculture sector become resilient from the adverse effects of calamities. A more resilient and productive agriculture industry also requires sustainable management and utilization of natural resources through practices such as multi-cropping, ecological agriculture and integrated pest management, among others (Reliefweb, 2015). To make the agricultural sector sustainable and climate-adaptive practices to complement disaster response, farmer and government official must have a tool to make ready in disaster using ICT and create innovation. According to (Rosegrant & Cline, 2003), farmers on rural areas are for the most part uneducated with regards to developing nourishment proficiently and monetarily Improving their insight into new methods and innovations, notwithstanding giving them any physical assets fundamental for execution, can drastically expand the agriculturists' level of efficiency.

Information and Communication Technologies (ICTs), data and information is useful to support farmers and farming communities to increase agricultural output and sustainability. E-agriculture is a new trend of research and application that can uplift farmers through information services (Gakuru, Winter, & Stepman, 2009). This informatization discusses to the renovation of an economy and society through the effective distribution of Information and Communication Technologies in business, social, and public functions (Guo, 2011 and Obidike, 2011). According to National Bureau of Statistics of China (2014) it is claimed that information and knowledge are vital in agricultural development to community and where they are poorly disseminated as a result of certain constraints, the community's agricultural development becomes highly impeded. So it must be in place different technologies and tools to uplift the farmers in preventing damages to their crops and farms.

One of good ICT application is forecasting system, is regarded as part of disaster management where it is characterized by the necessities to make decisions when time is pressing and knowledge of consequent effect is still insufficient. Hence, it is recommended to develop specific disaster scenarios beforehand and to practice them in advance (Nuñez, 2005). This can be done by simulation, which is a technique for learning that can be applied to many different field especially in disaster damages in agriculture sector.

There are simulation tools about natural disaster that can help save lives such Geo Simulation by (Naqvi, 2017), Data assimilation in improving the Rainfall Simulation (Ha and Lee, 2012; Liu et al., 2012; Routray et al., 2012), Earthquake disaster simulations by (Homma, Fujita, Ichimura, et al, 2014). A physics-based earthquake disaster simulation that is look forward to contribute to high-accuracy earthquake disaster prediction also soil sampling and crop simulation method for making decision about spatial management of their farm. Moreover, web-based educational simulation tool like AgentSheets, AnyLogic, ExploreLearning Gizmos, and Medical education, used for learning and practicing clinical healthcare procedures. Proponents have found out from the literatures that simulation of damages in agricultural sector especially in terms of disaster in crops is lacking.

The provision of agricultural information plays a decisive role for the overall development of agriculture as well improving the livelihoods of farmers (Li, 2009 and Milovanovic, 2014). This concept paper aims to focus on the development of web base simulation of a typhoon and its damage in agriculture sector that are capable in: (1) creating an agricultural area with the use of different topographical area (2) simulate the impact of typhoon to agricultural environment by inputting wind speed and rainfall count (3) Visualize the damages of typhoon and flash flood to Agricultural environment (4) Receive different report of agriculture damages from different municipalities agriculture officials (5) Provide forecasting of possible damages from historical and new data. This proposed application provides features and functionality it can provides good insight in decision making, policy recommendation for prevention and mitigation, and awareness into new methods and innovation using ICT that can educate citizen toward disaster damages.

2. Proposed Software Development Method

In developing the proposed system it can employ Simulation Methodology by Ulgen, Black, Johnson Baugh & Klungle (2006). The simulation method is composed of the different phases:

1. **DEFINE THE PROBLEM.** This phase is identification of the problem in the target subject of the system. Data collections, interview form related government agencies and farmer, observation of the farm is necessary for the extent of the documentation and to analyze the cause of the problem of the farmers in times of disaster..
2. **DESIGN THE STUDY.** The outline of the investigation is the second real period of the recreation procedure. In this stage, a examining the collected data and information are examined in more detail and the specialized parts of the issue are given more weight. Maybe a couple gatherings for data assembling and watching the real or comparative process is by and large led amid this stage.
3. **DESIGN THE CONCEPTUAL MODEL.** The displaying system to be utilized as a part of the examination is the third period of the reenactment procedure. Demonstrating methodology includes settling on choices with respect to how a framework ought to be spoken to as far as the abilities and components gave by the picked recreation apparatus. The general procedure should center on finding a model idea that limits the recreation exertion while guaranteeing that all goals of the undertaking are met and every single particular issue are researched.
4. **FORMULATE INPUTS, ASSUMPTIONS, AND PROCESS DEFINITION.** The detailing of the model data sources, suppositions, and the procedure definition is the fourth period of the procedure. At this stage, the modeler portrays in detail the working rationale of the framework and performs information gathering and investigation errands. The data assembled in this period of the examination finishes all the foundation data required to fabricate the reenactment show.
5. **BUILD, VERIFY, AND VALIDATE THE SIMULATION MODEL.** The working of the model, its confirmation, and operational approval constitute the fifth period of the reenactment procedure. At this stage, the modeler utilizes surely understood programming systems for demonstrate building, confirmation and approval. The model got toward the finish of this period of the examination is prepared for experimentation in the following period of the investigation.
6. **EXPERIMENT WITH THE MODEL AND LOOK FOR OPPORTUNITIES FOR DESIGN OF EXPERIMENTS.** Experimentation with the model and applying the design of experiments techniques. At this phase, you may decide to investigate other Alternative Models and go back to the previous phases of the process for each major model change. During this phase, rather than building a design of experiments for the whole study, the modeler generally identifies the major variables and eliminates the insignificant variables one step at a time
7. **DOCUMENTATION AND PRESENTATION.** It is important to properly document the whole process of the conduct of the study and present to the target client and users. Good

documentation and presentation play a key role in the success of a simulation study. The tasks of this phase are performed in parallel to the tasks of other phases of the process.

3. Proposed System

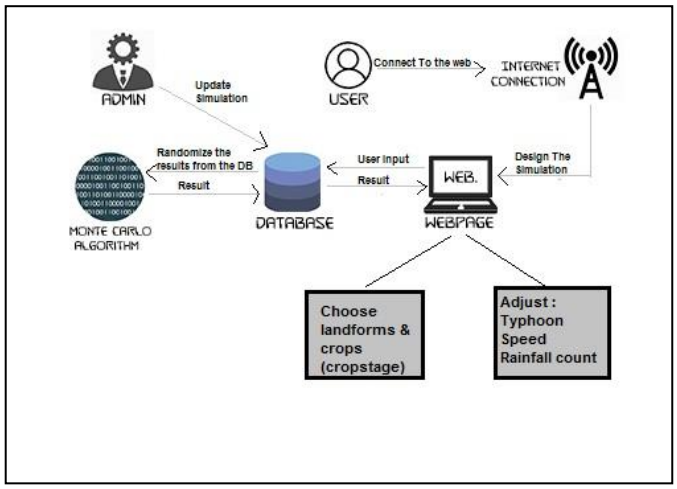

Figure 1. Proposed System Design

The System Paradigm as shown in Figure. 1 demonstrates the processes on how the website works. The proposed system allows the user to create and visualize the impact of typhoon and flash flood in agricultural environment. The system is composed of four main modules. These are 1.) Create the agricultural environment Model 2.) Creating Typhoon and Viewing the damage in live 3D simulation Model. 3.) Displaying the damage statistics of the simulation 4. Forecasting. The proposed system works as follows:

1. Creating the agricultural environment allows the user to create and design the topography of the agricultural environment. First, the user will choose the native crop of Laguna (e.g. banana, rambutan, mango and coconut) and terrain (mountain, plane, plane with body of water in side) as well as input the typhoon parameter (wind speed, and rainfall count).

2. Creating Typhoon and Viewing the damage in live 3D simulation Model, the system will send the inputted data in the system to process and see the simulation hat will visualize the possible damages. The typhoon strength is being categorized by the Wind speed and Rainfall count slider. The user can view the live simulation and adjust the rainfall count and wind speed. So that community or officials can identify the possible preventive measures and activities to mitigate the occurrences of damages.

3. Then Monte Carlo algorithm will capture the data from the user and will generate a randomized result based from the computed data on the database and send it as feedback to the system that show amount of possible damages or serve as statistics of damages.

4. Moreover, after the simulation and statistics the system also give some information to the users what to do for prevent or avoid damages when disaster occurs based on what input the user give in the system. It is like Risk Assessment Information based on MDRRO (Municipal Disaster Risk Reduction Office) and Municipal/Provincial Agriculture Office for the user (community and farmer) to lessen and mitigate the damages through which such risks can be answered, like ground contouring, building retaining walls, or planting protective vegetation/crops.

5. The forecasting module will be collecting the data from different municipal agriculture office to consolidate all the record of damages from the disaster. The collected disaster

damage report it will be retrieved in the database to be used in forecasting the future damages using Time Series Analysis.

4. Conclusions

Agriculture sector which is the most affected when it comes to typhoon. Typhoons trigger significant destruction and damages like landslides, flash flood, mudslide, widespread flooding. Most of the people don't have the knowledge on what will they do when it comes to typhoon, so this paper aims to develop the Agricultural Damage Simulation in the Impact of Typhoon and Flash flood in Laguna, it focus in simulating the damage of the typhoon in agricultural environment and forecast possible probability of disasters occurrence. This can help by giving the knowledge and awareness on what will happen to the environment when the typhoon occurs.

The need for the development of this system must be develop and implement for the benefits of the farmers, agricultural sector, the people, and to the environment to prevent possible damages and mitigate larger amount of losses in economic and agriculture. The paper can give idea and information on utilizing Information and Communication technology to protect environment, agriculture and people. It might use to save time and tools as source of information to plan and give appropriate intervention and responses to the farmers in times of disaster and calamities. The related government agencies can help in decision making for crafting new program and activities for preventing environment and minimize losses. The additional feature can be added to make more to valuable system and good tool for prevention are adding geo mapping to easily track the location of what will the user want to simulate in the Laguna but not just in Laguna area, but it can also apply in the different places.

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