



BUILDING THE INFORMATION SYSTEM FOR EVALUATING, ADAPTING, AND MINIMIZING THE IMPACT OF CLIMATE CHANGE TO PHU YEN PROVINCE, VIETNAM.

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KEY WORD: Information System, Climate change, Database, WebGIS.

SUMMARY: Phu Yen is a coastal province in the south - central Vietnam, which has an important role in the region, to develop the integrated and diversified economy, especially marine economy. However, Phu Yen currently needs to pay attention to three major issues in responding to climate change, including sea level rise in estuary areas; erosion in coastal areas; the temperature rise and abnormal weather impacts such as storms, tsunamis, hail (UN, 2017a). To improve management activities, share information and timely provide regional data on climate change to other government agencies, the development of professional software on climate change in Phu Yen is essential. In this study, we have developed a database system specifically used for climate change at the provincial level and Phu Yen is used as a case study. The research outcome, namely PhuYenClim, is based on the application of WEBGIS technology which integrates several mathematical models to calculate and control greenhouse gas emissions. This is also a new research highlight in this study.

1. INTRODUCTION

Climate change has altered water supply factors, water demand and caused severe weather conditions in time and space (IPCC, 2006). Vietnam ranks 7th globally for climate change damage, with an average of 392 deaths per year, and the loss of more than 1% of GDP as a result of natural disasters related to climate change (MONRE, 2017). According to research by the Institute of Meteorology and Hydrology and Climate change, the average temperature increased by 0.7⁰C in the 50 years (1950 - 2000), among which Phu Yen is the typical case of being influenced by climate change (Monre, 2017).

Phu Yen is also facing many challenges in the development stage, especially in finding solutions to promote rational use of resources and at the same time, adapting to climate change. Like many other provinces in the country, the main impacts that Phu Yen incurs, as a result of climate change, are the rise of sea level, the high frequency of storm, tropical depression, increasing frequency of floods, landslides, saline intrusion, and other severe weather conditions ... which affects natural environment and economic activities in some sectors as: agriculture and food security, forestry, industry and construction, tourism, transportation. According to the socio-economic statistics in Phu Yen province in February 2017, in the winter - spring rice crop, 26,338 ha had been planted a decrease of 317 ha compared to the year of 2016 (PhuYen, 2017). It is due to the complicated weather conditions and long-lasting rains on a large scale that flooding over 3,218 ha of rice, of which 1,893 hectares were heavily submerged (PhuYen, 2017). In addition, in early February, the weather was not favorable, Dong Tac estuary of Da Dien was be filled, hence, 223 fishing boats docked at the port couldnot depart, which caused the total volume of sea food harvested in the month was only around 4,053 tons, and the accumulated volume from the beginning of the year reached 8,127 tons decreased 2.4% over the same period last year (PhuYen, 2017).

It is because of the serious impacts of climate change, many studies and projects have been investigated this issues. Many solutions are proposed to adapt and mitigate the effects of climate change: Bui Ta Long et. al., 2017; A. Duran-Encalada et. al., 2017; Endre Tvinnereim et. al., 2017; Roger S. Pulwarty et. al., 2014; Kevin Werner, Lina Svedin, 2017; Alvaro Enriquez-de-Salamanca et. al., 2017; Laura N. Rickard et. al., 2014; Martin C. Maguire, 2013; Kelli M. Archie et. al., 2014; John Tribbia, Susanne C. Moser, 2008; Stephen C. Newbold et. al., 2016; Alex L. Marten, 2013.

Inspiring from the challenges that Phu Yen province is currently facing, Phu Yen needs to, step by step, formulate a database on climate change, based on the results of the study "Building the national database on climate change and the impact of climate change, to respond to climate change", which applied specifically to the local

conditions. But it also needs to improve the database layer to make it simple and user-friendly for users, in order to improve the management of climate change in the province.

2. RESEARCH OVERVIEW

Over the years, the United Nations Climate Change Committee (UN, 2017a) has recognized the important role of the database in climate change research as "There is no database for quantitative assessment as well as studies on climate change are inaccurate and trustworthy. Programs, software, and electronic databases are the legal foundation for climate change research ". Therefore, UN's data model is a template for IT deployment in many countries in the world. This database focuses on a number of key issues. In regards to scientific factors, it focuses on the cause of climate change and the impact of climate change; In regards to solutions for minimizing the impacts of climate change, it focuses on emission reduction in economic and political aspects. In regards to adaptation approach, it emphasizes risk management, necessary actions and specific application. In terms of technology, it emphasizes multidisciplinary technological improvements. In addition, UN's organizational model share several similarities with the National Committee for Climate Change of Vietnam. It collaborates with a number of technical organizations to carry out scientific researches, such as the World Climate Program (WCP), the World Weather Program (WRCP), the APFM - Flood Management Program, DRR - Disaster Risk Reduction, carry out training workshops for model application and water resources management toolkit.

In 2014, according to the Science and Technology Program for the National Target Program to respond to climate change, code KHCN-BĐKH/11-15, the Information Technology Department, Ministry of Natural Resources and Environment in collaboration with Bach Khoa University, implemented "Building the national database on climate change and the impact of climate change, to respond to climate change ". The outcome of this study is the Vinaclim software, (Envim, 2016), with standardized database system by national standards and an integrated database to help the National Committee on Climate Change assess the impacts, propose the solutions for mitigation and adaptation to climate change. The software has incorporated GIS technology to support map display, including information management on the implementation status of the Prime Minister's Programs through the module Promulgating the plan responding to climate change, data management related to climate change, including Water Quality Assessment Models (WQI model based on the format of the General Department of the Environment), calculating and forecasting CO₂ emissions under the IPCC guidelines and statistical reports, which is necessary for the Commission's report, to ensure the connection and consistency of information which helps improve the management of climate change of the National Committee on Climate Change..

Database systems for United Nations operations are classified by region and country. The regions are divided into different regions, such as North America, Latin America and the Caribbean, Africa, Europe, Asia, Oceania and the Pacific Islands. There are also other classifications, such as Antarctica, Arctic, small islands, developing countries, underdeveloped countries. This allows the VinaClim outlines to be divided into seven different regions of Vietnam, as well as to address the fast-growing, slow-moving, coastal areas, or areas in the continent (UN, 2017b).

Intergovernmental Panel on Climate Change- IPCC is a scientific body responsible for assessing the risks of climate change caused by human activities. The Commission was established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) in 1988, both of which are part of the United Nations. One of the main activities of the IPCC is the publication of special reports on topics related to the implementation of the UNFCCC, the implementation of the UNFCCC (The United Nations Framework Convention on Climate Change) eventually led to the Kyoto Protocol. The IPCC bases its assessment primarily on published scientific papers and equivalent comparison. The IPCC is only open to WMO member states and UNEP. IPCC reports are widely cited in climate change conferences and workshops. The international community recognizes that this committee is well-grounded, accurate and competent to deal with technical aspects related to climate change. The IPCC database consists of the following groups: a/ The home page contains the most important, the latest reports on IPCC activities and updated information on the organization's activities such as scholarship programs, about the plenary sessions, the statistical report of the organization, the results of the meeting. b/Organization includes organizational structure, history and secretariat. c / Human resources include those working in the IPCC. d / Meeting schedule. e / Documents for meetings. f / Documents and data published. g / News and press information. h / Links to other boards. i / contact information source (IPCC, 2017). The IPCC database structure needs to be considered when researching the database proposal for PhuYen Clim.

The International Energy Agency (IEA, 2017) is one of the key coordinating organizations of the United Nations Climate Change Program. The database developed in this organization includes a database of policies and measures based on the following criteria: a / Countries applying policies and measures; b / at which government agencies policy is built or applied. Options available include municipal, local, national, state / regional and

supranational cities; c / Implementation year; d / current status of policy. The database has the following options: finished, executed, planned, and replaced (where the policy was directly replaced by another policy); e / type of policy with specific types of policies being planned or implemented; f / objectives and technology policy. Especially in the database of this organization there is a separate section on national policy in the field of energy towards climate change mitigation in member countries. Database structure of the IEA should be considered when researching the database proposal for PhuYen Clim.

3. METHODOLOGY

3.1. Approach

PhuYen Clim is based on the VinaClim National Committee on Climate Change (Envim, 2016) with the database system is standardized according to national standards, with additional changes which are appropriate to local conditions. PhuYen Clim proposed in this study includes those following modules: database management module, WebGIS module, module containing environment model bank, module display the result of model, report module and statistics module.

3.2. Integration method

Similar to VinaClim, PhuYen Clim integrated concept is understood as the combination and connection of systems (also called blocks) and modules (subsets) in the system. Four blocks were proposed in the early version: Environmental Database, GIS and Mathematical Model. Each block consists of subunits, between bound and subunits are binded. The PhuYen Clim system handles information from a variety of sources, including government agencies, scientific research institutions and authorized users. Exchanging information in PhuYen Clim means that the system must provide tools to ensure the updates and extract data. Searching means that the system must ensure the route search accordingly to the query and render the results in a convenient form for the users. Unified access means that the system must provide the most consistent mechanism for accessing reports, statistics from stored data sources.

3.3. Database Development

The database component for PhuYen Clim is based on professionally proficient of Environmental experts, which is based on the management software of VinaClim National Committee on Climate Change (Envim, 2016) . Based on this work, the team has developed a block diagram of group of objects that are noticeable in the environment field, GIS and mathematical models. Proposed database is based on **Figure 1**, the information layer is shown in **Figure 2**.

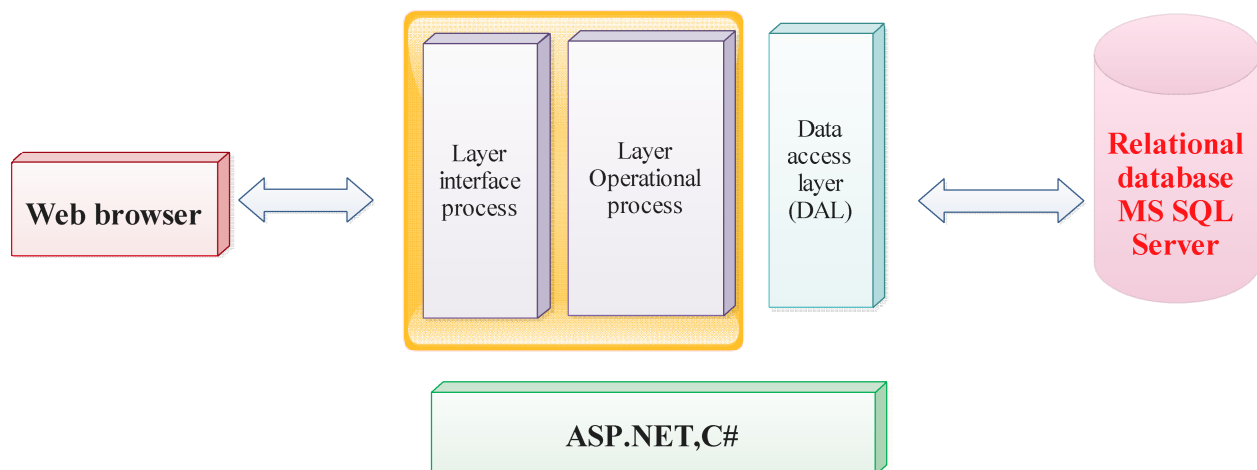


Figure 1. Database structure

Application Layer: Including layer, objects, functions ... that represent the process of professional. The application layer receives requests from users through the View-User layer, using appropriate methods to analyze, use means of communication to connect to the Connection layer to retrieve the required data as required by users from the Database layer. After receiving data and processing, the Application layer will return results to the user.

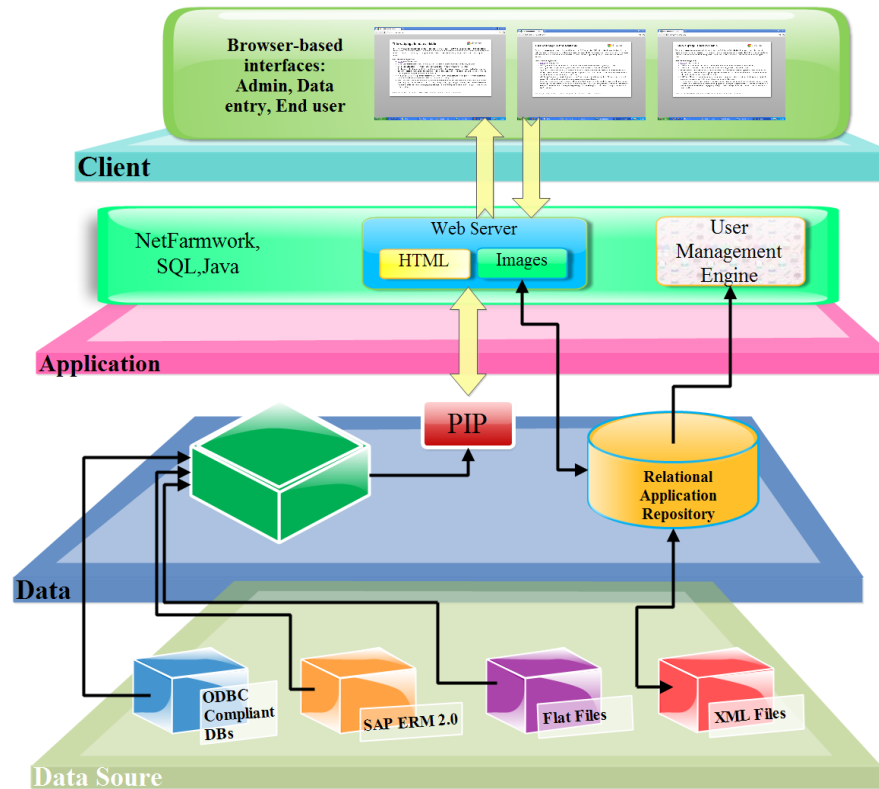


Figure 2. Four layer-model

View-User Layer: Communicate with users, connecting the users to functions of the system. The View layer communicates with the Application layer by entering input via textboxes, button. Request and receiving information is also conducted via this layer.

Function, working and communication method of layers:

Database layer: The database layer has the function of storing and expressing relationships between objects in the system. This layer stores system data, major and map data. The Database layer communicate with the application layer through the Connection layer.

Connection layer: The Connection layer represents the methods used to extract data from the Database layer as required by the Application layer the Connection layer. The Connection layer communicates with the Database layer and the Connection layer.

4. RESULTS AND DISCUSSION

4.1. Suggestion on PhuYen Clim major database

Research and propose major database based on the results of document synthesis and expert consultation, to analyze relationships with related departments and agencies based on documents legislation regulates the functions of each department, and at the same time clarifies climate change response processes at local areas.

Inherited the management software of the VinaClim National Committee for Climate Change, reviewing the current situation in the local area, based on the status on the legal documents of climate change, getting opinion of experts and local authorities to build PhuYen Clim to address the needs of the province.

For Department of Natural Resources and Environment, Department of Agriculture and Rural Development, Department of Industry and Trade, Department of Transportation, Department of Health, Department of Construction, Border Guard Command, Provincial Military Command Department of Labor, Invalids and Social Affairs, Department of Culture and Sports and Tourism, Central Committee, the research program have clarified the relationship as well as the right to participate and exploit or update the data Based on recommendation and reference.

4.2. Suggestion on the information layers

Within the scope of this research, the research team has developed information layers for climate change mitigation and response, such as: health, environmental incidents, disaster risk management, energy management, food security management, current status of forest resource exploitation, water resources management, land resources, ecological data management, irrigation management, Meteorological stations. In addition, the research team also developed information layers on the issuance process and the results of implementation of the climate change response plan in Phu Yen province.

The information layer group developed in each report is based on the legal documents adopted by the Government for each sector and sector. The process of building information layer group is in accordance with the regulations of the Government, Ministry of Natural Resources and Environment in accordance with Decision No. 357 / QD-TCMT dated May 9, 2012 on construction and standardization of data format, data integration and development of environmental database system.

The content of each report has created a relatively completed and specific information layer for each sector, which takes into account mitigation and response to climate change.

Information layer groups are built to help government agencies and scientists see in a comprehensive way the impacts of climate change on risk management to integrate risk management issues, environmental incidents and climate change into programs and plans for socio-economic development in a timely and effective manner to ensure the sustainable development goals.

4.3. Building PhuYen Clim software

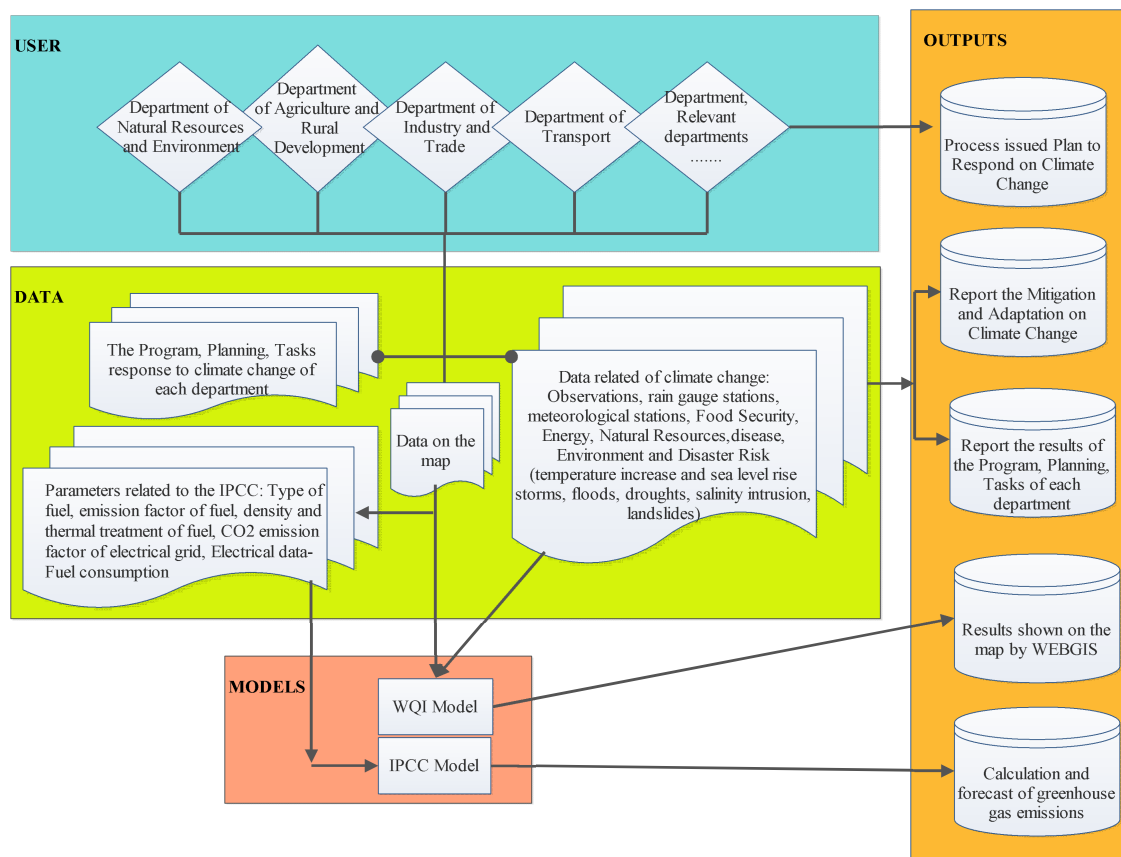


Figure 3. Process of database creation



Figure 4. Functions list in PhuYen Clim

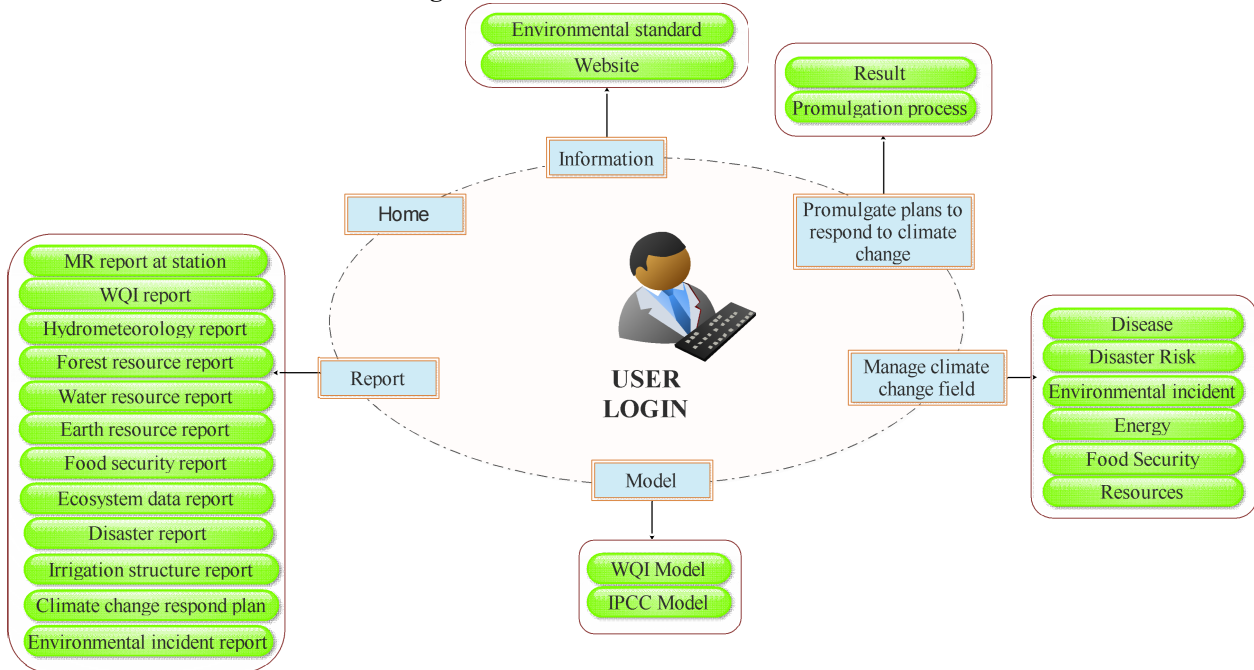


Figure 5. Management/control function of PhuYenClim information system

5. CONCLUSIONS

In this article, from all of the above, it was initially set up professional basis for Phu Yen province on climate change. Information layers are based on theory, legal documents, inherited from VinaClim software and many related domestic and foreign studies. The software enables the provision of access, monitoring, storage and export of related data in Phu Yen province for easier management. Particularly, the mathematical model allows calculations, projections of local CO₂ emissions. Model of water quality indexes are integrated and presented on a map using WebGis technology with a single use operation. The results will also be consulted for further improvement.

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