

## **Building environmental information system using open source program in VinhPhuc province**

Hoang Trung Son<sup>1</sup>, Nguyen Le Nghia<sup>1</sup>, Pham Thanh Van<sup>2</sup>, Vu Van Manh<sup>1</sup>

### **Abstract**

Nowadays, monitoring, backing up and managing environmental data in developed countries have become simpler than ever before. However, due to financial pressure, licensed server software and professional training are two main difficulties in Vietnam. Unlike the commercial softwares, the open-source operating systems and softwares are free but require users to understand programming languages. OpenSUSE is an open source operating system that can run the command and support the familiar windows interface and can be considered confidential and features equivalent to the Windows operating system, and compatible with most server programs such as MySQL, postgres, as well as web GIS application. The previous research on web-GIS, the open source program, shows that its application has low efficiency. Therefore, this article presents the result of building environmental information system of Vinh Phuc Province by using kvwmap on openSUSE operating system. The openSUSE operating system proves to be efficient at supporting managers to manage their local environmental data.

Keywords: kvwmap, Environmental Information System (EIS), WEB GIS, Internet GIS, openSUSE

### **1. Introduction**

Environmental Information System (EIS) is developed from geographic information systems (GIS) to serve collecting, storage, processing and sharing spatial data, time and relate content to describe the current state of the environment, especially the emphasis on environmental pressures and impacts. The tight relationship between EIS and community activities, create global and regional environment databases. EIS covers most areas such as water quality monitoring, hazardous waste, etc. to connect, process, and present the different data sources. Supporting decision making as well as analyzing causes and effect is also mentioned in EIS. Nowadays, there are many technical solutions, which have the ability to provide spatial data about natural resources and environmental issues through internet to build an environmental information system with the above requirements, but a general problem in developing countries such as Vietnam is data sharing. In Vietnam, the environmental data is still mainly in package form, there is no unified database and online support method to share information.

In addition, the cost to purchase licensed software to manage GIS server is very high with developing countries. Therefore, the study focuses on solutions by using open source operating system openSUSE and open source web GIS technology: FGS - kvwmap, with trials is to build an information systems environment of Vinh Phuc Province, to assist managers get timely decisions, create a friendly environmental portal for community.

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<sup>1</sup> VNU University of Science, 334 Nguyen Trai Street, Thanh Xuan District, Hanoi, Vietnam. Email: [fesvym@yahoo.com](mailto:fesvym@yahoo.com)

<sup>2</sup> Technische Universität München, Arcisstrasse 21, 80333 München, GERMANY. Email: [thanhvsn3007@gmail.com](mailto:thanhvsn3007@gmail.com)

## 2. Materials and methods

### 2.1 Research subjects

Object of study in this project is the OS openSUSE and open source web-GIS program kvwmap, application-based FGS (FGS-Free OpenSource GIS Suite is a software package from maptools.org for the LINUX operating system with all the necessary components for WebGIS applications. FGS available installation packages and related modules are required for the use kvwmap).

### 2.2 Methods

Today, there are many solutions to build different web GIS all over the world but mainly divided into two development teams:

- The commercial programs: provided in the form of proprietary packages (such as ArcGIS Server, MapInfo MapXtreme Java Edition, etc.) and distributed by the software company. These programs are highly cost and the scope of application is limited because it does not be able to edit the source code.
- The open source programs: are free programs, available as source code (as kvwmap, ka map, etc.), users can access the source code to calibrate and develop program according to the intended use. These programs are the great support of the open source community and be able to integrate well with the new technology such as cloud computing. However, these programs are not been used in the state-level projects because no research has recognized the superiority of them.

Therefore the authors recommend to use technology based on UMN-MapServer.

Kvwmap program, which is developed by Faculty of Agriculture and Environmental Science, Rostock University, Germany (with many years in developing solutions to provide spatial data environment via internet) and Faculty of Environmental Science, University of Science, VNU Hanoi, Vietnam, has been widely used successfully in Germany and some other European countries.

The model was built in developed version Client/Server and run on the network, through webGIS technologies with the support of open-source programs such as UMN-MapServer, MySQL, PostgreSQL, Kvwmap, LibreOffice, Kwriter, etc.

The technology used to make the GIS Internet connection which is: CGI, API, ASP, JSP and Java Servlet (Ralf Bill, Zölitiz-Möller et al, 2007).

Cover some of the main programs used in the construction of programs:

#### MapServer based FGS:

FGS is a free open source software (FOSS) GIS Suite (FGS) compile available from <http://maptools.org> for the openSUSE operating system with all the components necessary for WebGIS applications

The FGS Linux Installer is a self-extracting file that will install MapServer with PHP/MapScript and all of their dependencies on your Linux system. It provides a independent environment with all the required software (incl. Apache and PHP) to run PHP/MapScript webmapping applications. The bundled version of Apache can be configured to run on any port so it will not interfere with previous installations of Apache or other web servers on your system.

MapServer is faster than other IMS and easy to install. MapServer is not a full-featured GIS system and has the following characteristics:

- Support for raster and vector data formats: TIFF/GeoTIFF, GIF, PNG, ERDAS, JPEG and EPPL7, ESRI shapefiles, PostGIS, ESRI ArcSDE, Oracle Spatial, etc.
- Support OGC compliant GIS web services

- Support the common language and development environment. NET, PHP, Perl, Python, Java, and Ruby
- Support more than 1000 different grid.

MapServer can operate in two different modes: CGI and MapScript. In CGI mode, a MapServer function in a web server environment is as a CGI script. This is set up easily and run fast, straightforward application. In MapScript mode, the MapServer API is accessible from perl, Python, or PHP. The MapScript interface allows for a flexible, feature-rich application that can still take advantage of MapServer's templating facilities.

### Kvwmap

Kvwmap, which was developed based on the UMN MapServer and is written in PHP and Java Script, is an open source web GIS application. The database of kvwmap is built and managed by MySQL and PostgreSQL. Kvwmap is able to provide users with information and thematic maps as well as connect to a database that stores user information and spatial data.

By using UMN-MapServer, kvwmap should be able to handle all the GIS data formats GDAL/OGR supported raster and vector formats.

In addition, Kvwmap can work with metadata compatible with ISO 19119:2005. So the layers of Kvwmap information are given in forms according to OGC standards such as WMS, WFS, etc.

Users can access the source code of the program to change the original interface, set the content as well as the construction of new GIS applications create data storage table attributes, data space in the database management system for applications (Kvwmap–Dokumentation, 2013).

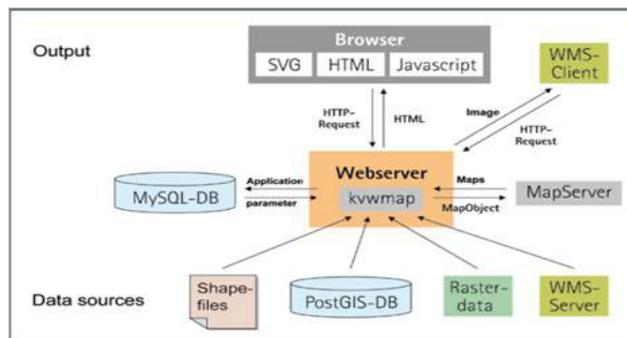


Figure 1. General interaction model of the components in the program Kvwmap (Ralf Bill, Zölitz-Möller et al, 2008)

### MySQL

MySQL is a database management system and is the most popular open source in the world, very popular with the developers. The role of the program in kvwmap stores user database, configures the map and saves the sessions.

### PostgreSQL

PostgreSQL is a powerful open source database with the ability to multi-tasking controller, system data recovery, data table space, asynchronous reproduction, nested transactions, supports object binary storage format assignment, etc. The program is used to store and process spatial database. The vector data

stored in PostgreSQL database with spatial extension PostGIS can be edited through the edited window of information in program Kvwmap (Vu Van Manh, Nguyen Le Nghia et al,2010).

### 3. Results and Discussion

The program can operate well on other operating systems e.g. Windows, Linux, Mac OS with common browsers such as Firefox, Google Chrome and Internet Explorer (Peter Korduan, Vu Van Manh and Pham Ha Anh, 2008).

The program has the ability to store, represent the GIS data as maps and online interaction with the user.



Figure 2: Login screen

The data is managed in the program include: non-spatial data (user, information flood situation, environmental quality, etc.) and spatial data (maps). All map layers are transferred to Shape file format and upload via the program interface, edit properties, edit and label directly on the web browser (Vu Van Manh, Nguyen Le Nghia et al, 2010).

Environmental information system of Vietnam and Vinh Phuc province is divided into several layers of information such as: administrative, topography, geology, hydrology, river observation system, earth observation systems, digital elevation models, land use and remote sensing images, etc., in each group includes specific class information.

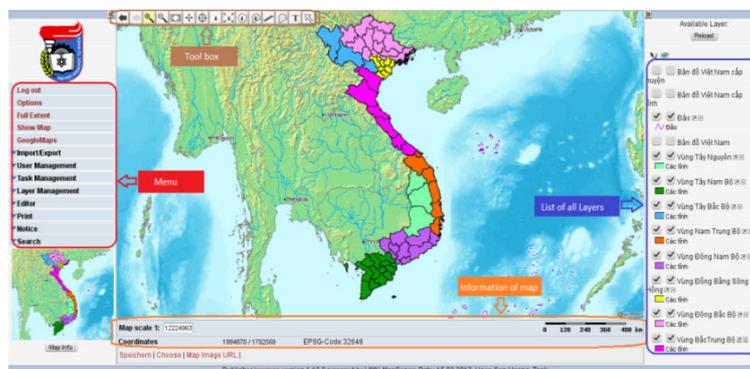


Figure 3. Main interface

There are 3 level of task:

## User

**User** have the ability to display a group of classes of information that the **Administrator** allows, in addition to functional use can be limited to the query, printing is not allowed to edit, change the database

## Manager

**Manager** in addition to the right to the same **User** have the ability to upload specialized information and information website in the form of shapefiles

## Administrator

**Administrator** role management, program operations, maintenance, system updates, manage tasks, create and assign permissions to user groups.

All set for the map and the user is stored in the database can be changed directly via the Internet. Some commonly functions such as adding users, adding layers of information, copying tasks, creating new menu, changing attributes, etc. be integrated in the graphical user interface (GUI).

In addition, the team has privileged access to the source of the program and building supported languages feature to increase efficiency when applied in Vietnam.

Program features are displayed simultaneously support three languages: German, Vietnamese and English, depending on the user's selection in the process of use.

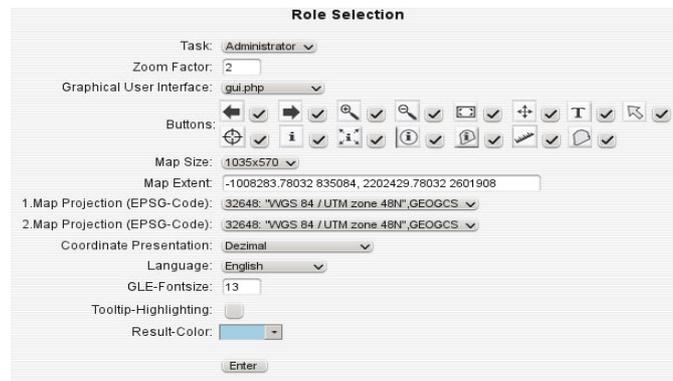


Figure 4. Options

### Some functions of the program:

- Display Function: Zoom in, zoom out, display the class map options, move, print the map...
- Functional analysis and design: not only has the ability to display data, the program also allows editing of data. It allows the user to modify, add, delete information. If the allowed, the user can save the data is used and added to their database.
- It also allows information retrieval, label editing, spatial analysis, geometric correction for spatial objects, import-export different types of data ...

The study used data from project "Mornitor and analysis samples for assessing environment in Vinh Phuc province in 2011" for building environmental monitoring system of Vinh Phuc Province (Vu Van Manh et al, 2011) that includes:

- 65 water monitoring points with parameters: pH, O<sub>2</sub>, BOD<sub>5</sub>, DO, TSS, pb (mg/l)
- 13 soil monitoring points with parameters: Total N (mg/kg), total P (mg/kg), total K<sub>2</sub>O (mg/kg), pesticides (mg/kg), heavy metals: As, Cd , pb (mg/kg)
- 18 air monitoring points with parameters: O<sub>3</sub>, CO, SO<sub>2</sub>, NO<sub>x</sub>, TSP, PM<sub>10</sub>

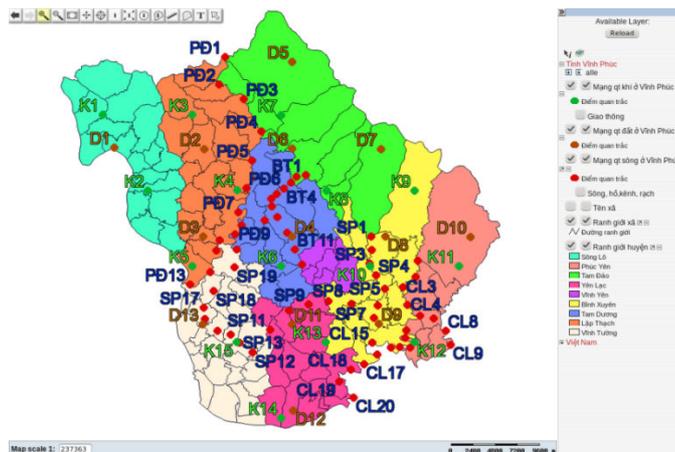


Figure 5. Image display the monitoring points

The program has been able to develop other functions, depending on the purpose of users.

#### IV. Conclusions

In this paper the authors have reviewed and discussed the theoretical and technical problems of applying the open source web GIS technology Kvwmap in management establishment of environmental information systems.

The authors use Kvwmap to generate environmental information systems of Vinh Phuc province. The program has ability to interact online and can meet the requirements of storage, security, sharing, and displaying spatial data effectively with a high speed, which can assure to provide updated information on the status and changes of the environment.

With the use of open source GIS web tool, users do not have to buy and install the GIS software but can still analyze, compute, storage and share environmental information directly. The program was built with a computer that has Internet connection and a web browser.

Besides, since it is an open source program Kvwmap which could get the great support from the open source community that is currently using the program in Germany and the Nordic countries. After each quarter, the set of program will be commented and amended by users and then updated and upgraded to newer versions in order to meet the user's requirements in advance. Therefore, if the program is widely applied in Vietnam, open source programs and Kvwmap program in particular will generally promote the best benefit thanks to the contributions of the community.

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