GUIDELINES FOR CREATING WEB GIS APPLICATION FOR TREES' MAP ON ARCGIS SERVER AND OPEN SOURCE GIS SOLUTION: THE CASE OF NONGRAWEING AREA, THAILAND

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ABSTRACT: The aim of this study is to guide web-GIS development for presenting tree maps in forest area at Nongraweing sub-district where is important place for learning locally natural resources of Rajamangala University of Technology Isan. This study suggested two approaches: 1) developing GIS web on ArcGIS server and 2) developing GIS web on Geoserver. As a result, both approaches return the same number of features, attributes and metadata for the test datasets, and download time and file size of given datasets. However, the most significant differences occurred in the operation *GetCapabilities* and *Getfeatures*. In the first operation, file size is generated by Geoserver regarding the geometry type and the request described. The second operation is similar with minor variations but the Web Feature Service (WFS) files created by ArcGIS server are larger than those created by Geoserver. Moreover, those requests were done by a python script so we need to take a second look on the common consumer side with the Desktop GIS. For nongraweing area, this area is not so big so trees' data is not large too. We suggest that should use developing GIS web on ArcGIS server because it is easy for using and not complex for learning.

1. INTRODUCTION

From the past to present, there are many new geospatial tools that have been developed. However, each tool has the difference of advantages and disadvantages that are up to their studied goals. Furthermore, these tools also allow other environmental benefits as well as enabling us to get to know tree species around us (Altaweel, 2020). Recently, there are many published papers that purposed trees' mapping and studying using geospatial technology such as area-based vs tree-centric approaches to mapping forest carbon in Southeast Asian forests from airborne laser scanning data (Coomes et al., 2017), tree cover mapping tool (Cotillon and Mathis, 2016), mapping tree density at a global scale (Crowther et al., 2015), and a framework for mapping tree species combining hyperspectral and LiDAR data: Role of selected classifiers and sensor across three spatial scales (Ghosh et al., 2014). From the mentioned papers, there are using various geospatial tools for studying and mapping trees. In this study, we focus on online presenting trees' data on platform based on ArcGIS server and Geoserver. For reasons, both approaches have been used for studying and researching to display trees in Nongraweing area where is one of two educational places of Rajamangala University of Technology Isan (RMUTI) in Nakhonratchasima province. Presenting of trees' data on web GIS and expansion of the internet provide two key capabilities: 1) the Web allows visual interaction with data and setting up a Web Server, clients can produce maps and 2) clients can work on it from almost any location because of the near ubiquitous nature of the internet (Alesheikh et al., 2002). With the expansion of the internet and availability of Web GIS or Web mapping options, web GIS programming is becoming a commonly required skill set in may organizations (UCGIS, 2021). ArcGIS Server is a back-end server software component of ArcGIS Enterprise that makes your geographic information available to others in your organization and, optionally, anyone with an internet connection (ESRI, 2020). On the other words, ArcGIS Server is software that makes your geographical information available to others in your organization and optionally anyone with an internet connection (ESRI, 2019). At the same time, GeoServer is a web server that allows you to serve maps and data from a variety of formats to standard client such as web browsers and desktop GIS programs (GeoSever News, 2020). The aim of ArcGIS server and GeoServer are used for Web Map Service (WMS) but they have difference in the operation GetCapabilities and Getfeatures between Geoserver and ArcGIS server (Digital Geography, 2021). Thus, this study proposes guideline for creating web GIS application for trees' map on two approaches: ArcGIS server and Geoserver. This study can help us learning pros and cons of such two approaches and can be a case study of teaching in application of geospatial technology for study local natural resources.

2. MATERIALS AND METHODOLOGY

2.1 Study area

Nonraweing area is one educational place of Rajamangala University of Technology Isan (RMUTI) where locates in Nongraweing sub-district, Muang district, Nakhonratchasima province of Thailand. The area of Nonraweing cover 2,500 Rai with UTM between 176000-196000(X) and 1652000-1664000 (Y) or geographical location from 14-15 °N and 101-102 °E (as Figure 1).
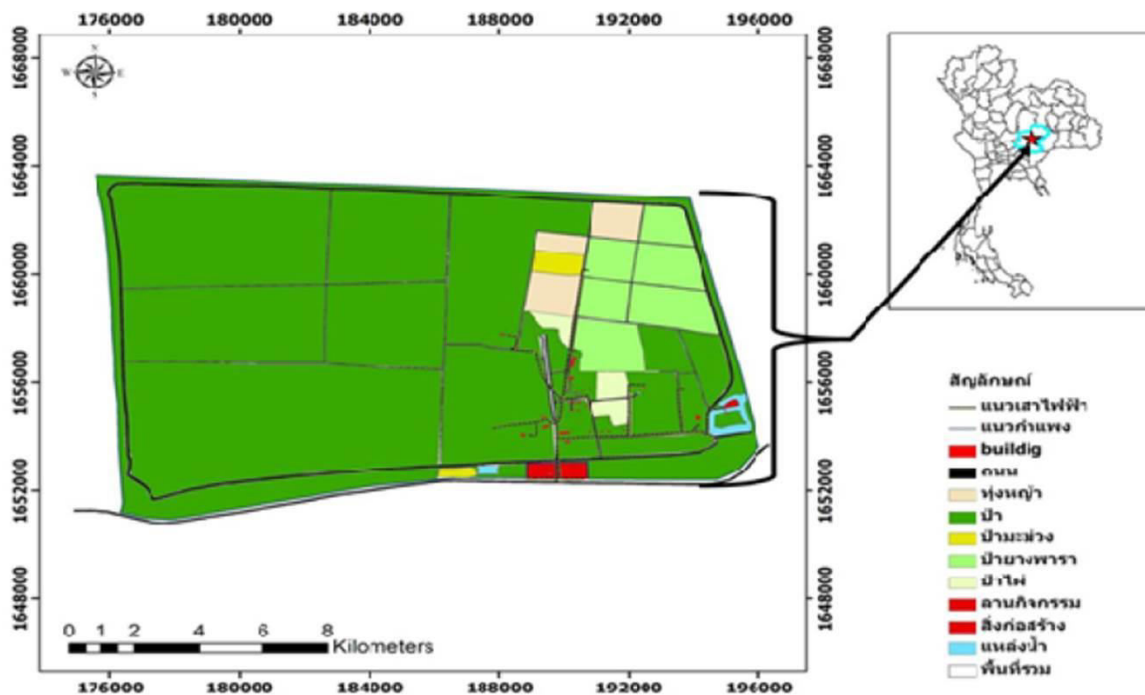

Figure 1. Nongraweing areaof RMUTI

2.2 Preparing geospatial data for web GIS

Geospatial data were prepared from using satellite imagery in Google Earth Pro for trees as follows:
   1) Geospatial data of tree was created by drawing and classifying tree canopy on satellite imagery in Google Earth Pro and then were saved as type: *kml(*.kml).
   2) File type of *kml(*.kml) was converted into to shapefile using QGIS and then was managed as ZIP.

2.3 Developing web GIS on ArcGIS Server and GeoServer

This study focuses on comparison of client applications' working on WMS by appending parameter to the service's URL.WMS service published to ArcGIS Server and GeoServer support the following operations (ESRI, 2021):
   - Requesting metadata about the service (GetCapabilities)
   - Requesting a map image (GetMap)
   - Requesting information about features in the map (GetFeatureInfo [optional])
   - Requesting user-defined style (GetStyles)
   - Requesting legend symbols (GetLegendGraphic)

2.3.1 Developing web GIS on ArcGIS Server

   1) Registration at https://www.esri.com/en-us/arcgis/products/create-account and fill out user name and password
   2) Presenting data on ArcGIS online
      3.1) Opening ArcGIS online and login
      3.2) Go to menu named, 'map' and selected add layer from file from topic 2.2
      3.3) Customize size or color in ArcGIS online and press OK, DONE and SAVE respectively.

2.3.2 Developing web GIS on GeoServer

1) Downloading and installing programs such as Java (at https://www.java.com/en/download/), Tomcat (at https://tomcat.apache.org/download-90.cgi) and GeoServer (at http://geoserver.org/)

2) Opening http://localhost:8080/geoserver and login to add new workspace, store and shapefile

3) Filling out data included data source name, description, shapefile location, DBF charset , and save and click publish

4) Editing layer included adding title, abstract etc.

5) Using previewing the layer to display geospatial data from topic 2.2 on OpenLayers

3. RESULTS

This study developed web GIS application for trees' map on ArcGIS Server and GeoServer in the case of Nongraweing area where is educational place of Rajamangala University of Technology Isan. Tree map is presented, is in pattern of tree canopy as Figure 2. Differences of ArcGIS Server and GeoServer can be shown as Table 1.
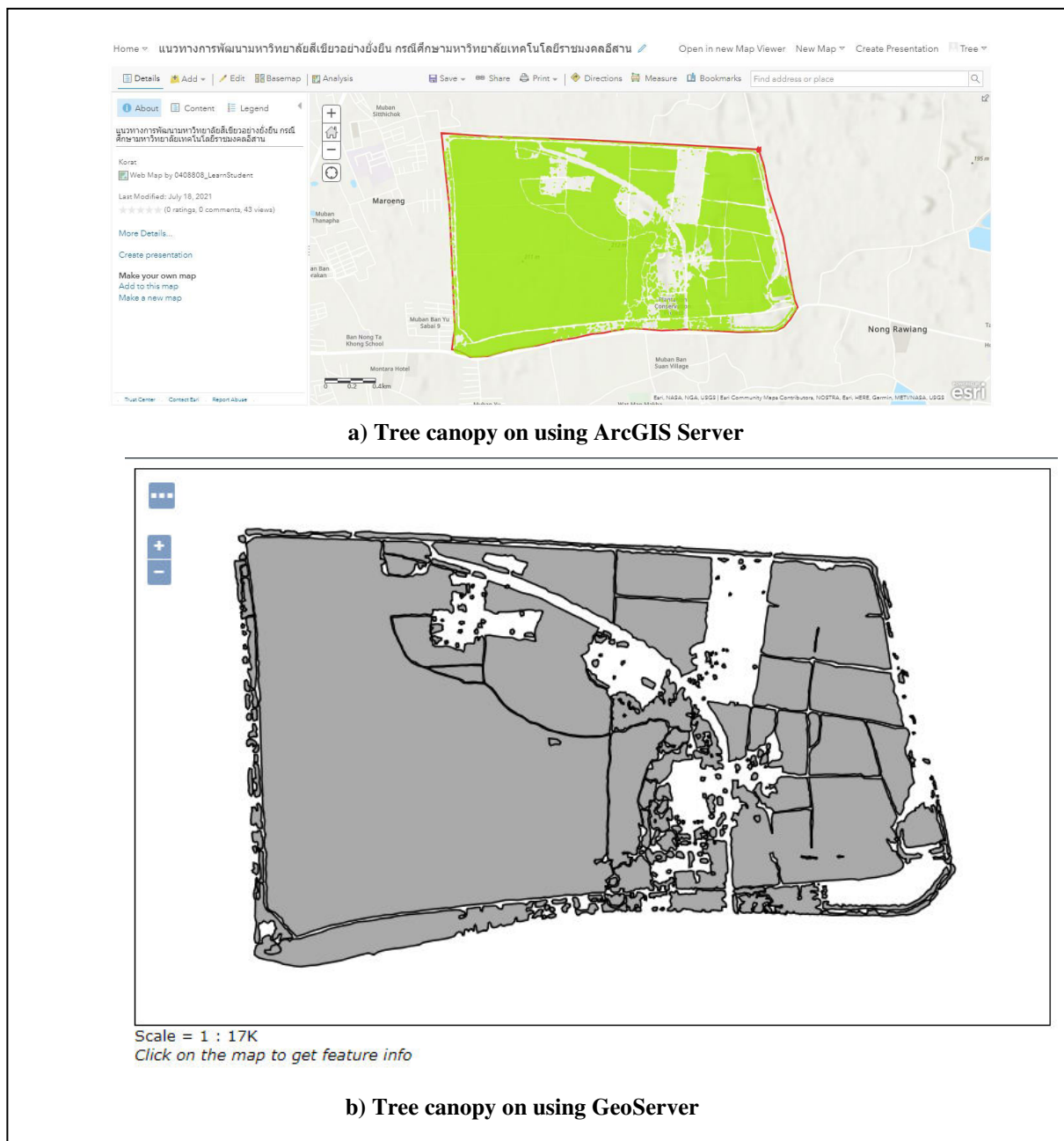

a) Tree canopy on using ArcGIS Server

Scale = 1 : 17K
Click on the map to get feature info

b) Tree canopy on using GeoServer

Figure 2. Comparison of tree canopy on using ArcGIS server and GeoServer

Table 1 Comparison of client operations between ArcGIS server and GeoServer

Operations	ArcGIS server	GeoServer
1. Requesting metadata about the service (GetCapabilities)	- - The response is a Capabilities HTML, XML, and plain text	- The response is a Capabilities XML document
2. Requesting a map image (GetMap)	- ArcGIS Server provides CVS and Shapefile	- GeoServer provides a wide variety of output formats, described in WMS output formats[1]
3. Requesting information about features in the map (GetFeatureInfo [optional])	- There is XSLT template, then does the work of "translating" the XML into a specified format, such as HTML or plan text, which makes the final response readable. works for translating	- The one advantage of GetFeatureInfo is that the request uses an (x,y) pixel value from a returned WMS image. This is easier to use for a naive client that is not able to perform true geographic referencing. - Server-styled HTML is the most commonly-used format.
4. Requesting user-defined style (GetStyles)	- Map Viewer allows you to explore different styling options using smart mapping defaults at Change Style[3]	- GeoServer uses API – SLDReader.
5. Requesting legend symbols (GetLegendGraphic)	- WMS GetLegendGraphic in 4.x JavaScript API with custom SLD not working	- It generates a legend based on the style defined on the server, or alternatively based on a user-supplied SLD[2].

Remark: - Extensible Stylesheet Language Transformation (XSLT) and

- [1] https://docs.geoserver.org/latest/en/user/services/wms/outputformats.html#wms-output-formats

- [2] https://docs.geoserver.org/latest/en/user/services/wms/get_legend_graphic/index.html#get-legend-graphic

- [3] https://enterprise.arcgis.com/en/portal/latest/use/change-style.htm#ESRI_SECTION1_C8F654A7EF384CCB823F9D1B59995D38

4. CONCLUSIONS

This study developed web GIS application for trees' map on ArcGIS Server and GeoServer in the case of Nongraweing area. Both approaches return the same number of features, attributes and metadata for the test datasets, and download time and file size of given datasets. However, the most significant differences occurred in the operation GetCapabilities and Getfeatures. In the first operation, file size is generated by Geoserver regarding the geometry type and the request described. The second operation is similar with minor variations but the Web Feature Service (WFS) files created by ArcGIS server are larger than those created by Geoserver. Moreover, those requests were done by a python script so we need to take a second look on the common consumer side with the Desktop GIS. For nongraweing area, this area is not so big so trees' data is not large too. We suggest that should use developing GIS web on ArcGIS server because it is easy for using and not complex for learning.

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