

## Design of A Web-Based Geographic Information to Show Spatial Information of Land Used for Horticulture

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**Abstract.** Information technology is necessary today, especially to present information on land planted with horticultural crops in an area. The need to obtain fast, precise, and accurate information with the existence of an internet network via smartphones has proven to be very helpful in presenting information to local governments and buyers of horticultural products in obtaining products that can be traded to the public. Often the difficulties that occur in several agricultural areas, the information available is only in the form of location data tables and the exact location is unknown. The problem is that this information is not yet available in some areas. Therefore this study aims to create a web-based information system by compiling, storing and showing information about existing horticultural plants by taking a case example in Girian District, Bitung City, North Sulawesi Province. Web-based information is created by combining the information using a geographic information system (GIS) that displays descriptive text, tables, and images based on spatial location. The results of this study are expected to be useful for farmers in Girian District and local governments in planning and evaluating horticultural farming more easily. The research was conducted by building a web using the Windows 10 pro operating system platform, ArcGIS 10.8 software, Google Earth, Microsoft Word, and XML as a web server, and WordPress 5.4.1 as a content management system. Websites that have been built are tested for performance with gtmatrix with good results. The website that has been built can provide information related to horticultural crops in Girian District, Bitung City, especially information about Girian District and also the location of horticultural crops in Girian District, Bitung City.

**Keywords:** agriculture; horticulture; information; system; webGIS

### INTRODUCTION

Technological developments, especially in the era of the industrial revolution 4.0, are currently taking place very quickly (Koh et al., 2019). Information technology has become commonplace and necessary in all aspects of life (Lloyd, 2020). Not only that, currently information technology has even become the backbone of human life in providing and providing information (Chatterjee et al., 2020). The existence of timely, fast and accurate information is very important for human survival. The data and information needed must be easily accessed effectively and efficiently by various interested parties (He et al., 2021)(Saragih et al., 2023).

Geographic Information System is a combination of database management in collecting and storing large amounts of geospatial data, together with spatial analysis capabilities to determine the geospatial relationship between the entities of each data used, coupled with screen maps that function to describe the relationship of geospatial data in two and three dimensions in the form of

maps (Chinnaswamy et al., 2019) (Breunig et al., 2020).

Horticulture is an important crop for human daily needs. Horticultural crops need special treatment for their cultivation including physiological handling after harvest (Chilundo et al., 2019). The growing Girian District is expected to be able to increase the quantity and quality of agricultural management, especially horticultural crops as the main force and at the same time the basic capital in an effort to improve the standard of living and welfare of the community (Sadeghi et al., 2020). In an effort to realize the above, a system is needed that can provide information directly to people who want to obtain general information about integrated horticultural crops, especially in Girian District without having to take a long time, but the delivery of limited information and the lack of ability of the system to communicate is one of the obstacles in development, especially in agriculture (Liu et al., 2021). With the existence of a web-based Geographic Information System, information about the location of horticultural crops and other food

crops in Girian District can be more easily accessed by related agencies and local communities (Manoppo et al., 2018).

### **Research Objective**

This research aims to compile, store and display information about Horticultural Plants in Girian District in a Geographic Information System (GIS) based website both in the form of descriptive text, tables, images and in the form of maps.

### **Research Benefits**

The application program created will also be useful for farmers in Girian District even throughout Indonesia and can be used as material for further research in related fields. With the data of this research can be utilized as well as possible by farmers as a reference material to realize the planning and targets to be achieved in maximizing agricultural land in Girian District.

## **METHODS**

### **Time and Place of Research**

This research will begin in October 2021-November 2022 with two stages, namely data collection at the research location of Girian Subdistrict, Bitung City and data processing and creating a WebGIS of Horticultural Crop Agricultural Land Search Locations in Girian Subdistrict, Bitung City.

### **Research Method**

The method used is the SDLC (Systems Development Life Cycle) method or the System Development Life Cycle, with a waterfall (Kramer, 2018), model approach this research is carried out with several stages, namely investigation, analysis, design, implementation and maintenance then descriptive analysis is carried out which explains the observation variables using the analysis of the Arcgis 10.8 application.

### **Research Procedure**

#### **Data Collection**

In this research, the technique of collecting data is literature research and field research. The Field research was obtained by using several instruments such as documentation, field survey, observation, and interview (Heinrich et al., 2018)

#### **Spatial/Graphical Data Entry**

Entering secondary data in the form of location maps and digitizing the ArcGIS 10.8 application to determine the specific location points to be studied.

#### **Entering Non-Spatial/Attribute Data**

Attribute data that will be entered are observation variables.

#### **Data Analysis and Presentation**

Analysis is carried out in 3 stages, namely:

1. Overlay is the process of integrating data from different layers or placing a digital map on another digital map along with its attributes and producing a combined map of both that has attribute information from both maps.
2. Calculate Geometry, which is an automatic calculation procedure in ArcGIS based on the geometry of the GIS data depicted and the coordinate system used.
3. Field Calculator is the process of manipulating, calculating, and analyzing attribute data to get new data from the available data. In this research, the field calculator is used to calculate the number of existing horticultural plants. (Franz et al., 2018)

#### **Research Tools and Materials**

The tools used in this research were divided into hardware and software. In the hardware part, the researchers used laptop Asus X550IU, Processor AMD Quad Core FX-9830P 3.7 GHz, 1 TB Harddisk, 8.00 GB RAM, GPS (Global Position System) Garmin, and Xiaomi Poco F2 Pro / Xiaomi Redmi Note 5 smartphone.

Meanwhile, for the software part, the researchers used Windows 10 Pro Operating System, ArcGIS 10.7 software, Google Earth & Google Maps software, Microsoft office word 2016 software, Microsoft office excel 2016 software, MS4W (MapServer for Windows), XAMPP, Mozilla Firefox, and Google Chrome.

The researcher also used some materials related to the research topic to conduct this research. The materials used in this research are Horticultural Crop Specific Data, Digital map of Girian Subdistrict obtained from the Central Bureau of Statistics of Bitung City in 2020, Bitung City digital map obtained from the Indonesian Geospatial Information Agency, and Supporting data related to GIS in Girian Subdistrict

#### **Observation Variables**

In this research, several variables are observed. The observation variables are Number of Horticultural Plants, Type of Horticultural Plants, and Distribution of Horticultural Plants in Each Village. These variables are the variables that the researcher can observe.

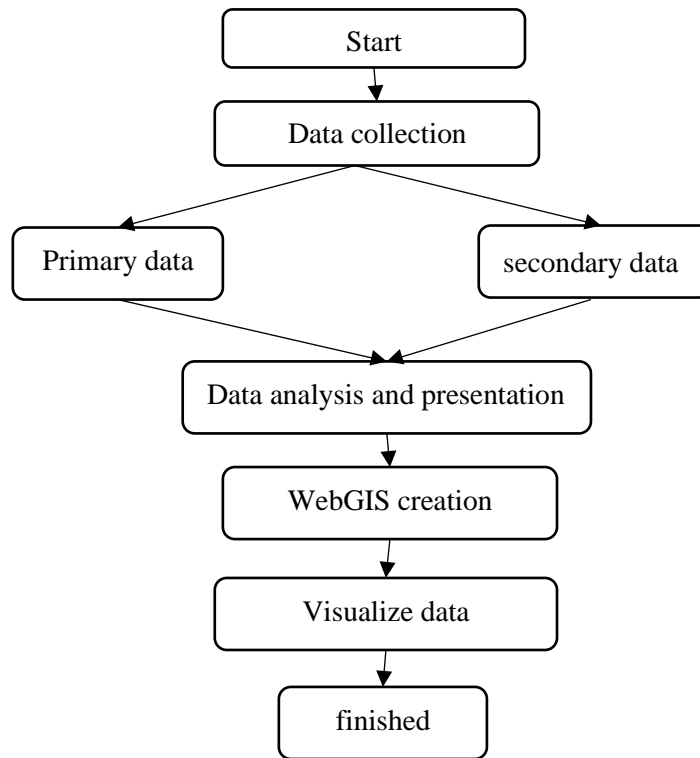
#### **WebGIS Development**

The website page is divided into two, namely the main page which can only be

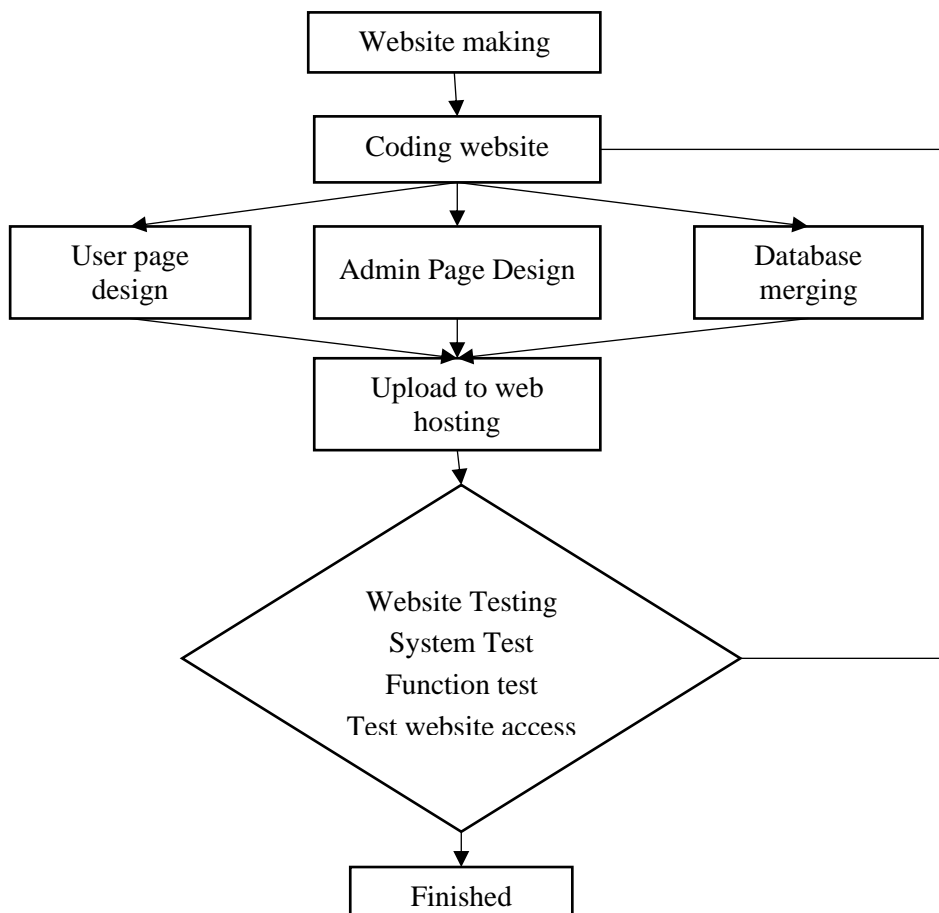
accessed by users or users and the admin page which is useful for managing and changing data and map digitization so that the data presented on the main page can be changed so that it is said to be a dynamic website. To be able to enter the admin page requires a special username and password that has been created in the database. Making a site map of the main page and admin page is important because it defines the framework of the parts of the entire world wide web formed in a diagram or outline (Kurita et al., 2019).

#### **Flowchart of research**

The research flowchart begins with data collection, involving secondary and primary data gathering, followed by data analysis and presentation. The creation of a WebGIS to display spatial information and data visualization is central to the project. The parallel website development process provides the platform for hosting the WebGIS, including coding, design, and database merging. The website is uploaded to web hosting, tested for functionality, and, once completed, serves as the medium for public access to the WebGIS, enabling users to interact with the research's spatial information (**Figure 1-2**).



**Figure 1.** Flowchart of research



**Figure 2.** Flowchart of website development

## RESULTS AND DISCUSSION

### Requirements Planning

#### User Needs Analysis

Users need information such as the distribution, number, type, location of land and other important things related to Horticultural crops in Girian District, from the agency of the Department of Agriculture and Food Security of Bitung City. Based on this, secondary data collection is carried out in the form of the number, type, leading commodities and distribution of horticultural crops at the Department of Agriculture and Food Security of Bitung City. Then collect primary data by conducting direct surveys in 7 villages in Girian District to identify existing horticultural crops(Thevenin et al., 2021).

Based on the results of the survey in the field there are superior horticultural commodities that turned out to be very good results such as chili, eggplant, long beans and there are some shallots scattered in several villages in Girian District. There are 3 villages where the results of horticultural crops are very good, namely in Girian Weru Dua Village, Girian Indah Village, Girian

Permai Village. When conducting surveys in each Kelurahan in Girian Sub-district, no other horticultural commodities were found so they only took the location of horticultural crops in the field (Permana et al., 2021).

#### System Requirements Analysis

In building a website based on Geographic Information Systems or WebGIS, of course, it requires various components to become a complete website. The following are the needs in building a WebGIS (Unrau & Kray, 2020):

##### 1. Website development

This WebGIS design uses the Wordpress Content Management System (CMS) which supports the PHP programming language and MYSQL as a database storage. In this website, there is a front-end part, namely the website page that can be seen by users and the back-end, namely the part of the website page that the admin controls as the WebGIS manager.

##### 2. Software Requirements

The software needed in WebGIS is presented on (Table 1).

**Table 1.** Software requirements

No	Software	Usability
1.	Windows 10 Pro 64-bit (10.0, build 19044.23)	Operating System
2.	XAMPP v3.3.0	Web Server
3.	ArcGIS Desktop 10.8	Map Analysis
4.	Google Chrome	Browser engine
5.	WordPress 5.4.1	Content Management System
6.	Google Maps	Operating Map

#### Hardware Requirements

The hardware needed in building WebGIS are Laptop Asus X550IU for managing data and information and Xiaomi Mobile Phone for taking pictures and locating points.

#### Implementation

In its implementation, this system was initially run on a local server (localhost) apache available on XAMPP offline, this is

useful for seeing whether the system built is running well or there are still problems with the system, before being published widely using the internet network. Then the author buys a domain and hosting at NiagaHoster, which is a paid domain and hosting provider with various specifications. The website that was previously run on a local server is then imported to NiagaHoster Cpanel. The domain and hosting used are valid for one month starting on November 10, 2022 and can be

extended according to the author's wishes. It is intended that users or users can access WebGIS online by typing <https://websitegis.xyz> in the URL of a search engine such as Google Chrome. In terms of security, the author uses comodo possessiveSSL on the hosting service site at NiagaHoster (Hossain et al., 2022).

## 1. User Page

### Header



Figure 3. WebGIS header area

On the header area there is a logo and website name as well as a home, data, gallery, map and contact menu bar as shown in the picture above. The header area in a WebGIS (Web et al.) serves as the top section of the web page. It plays a vital role in providing users with essential tools and information. It typically includes the organization's logo, a descriptive title, a navigation menu for accessing different sections, a search bar for location and data queries, user account details and settings, language and preferences options, links to help and support resources, alerts, and notifications, and often quick map controls. This area aims to enhance the user experience by facilitating navigation, customization, and communication while interacting with geographic data and spatial tools within the WebGIS application (Permatasari et al., 2022) (Figure 3).

#### a. Body/Content

In the body/content area there are several pages, namely:

## WebGIS Display

The WebGIS display is designed using the wordpress elementor template in the wordpress CMS. In managing WebGIS, the admin is greatly helped by the existence of various plugins that can be installed and used as needed. The user page design consists of Header, Image, content/body and footer(Zhang & Jiang, 2021).

### 1) Home Page

On the home page, there is a glimpse of the research location, namely Girian Subdistrict, Bitung City, which is made using a google map and then embedded on the website so that it can be seen on the home page. There is also a glimpse of information about the purpose of the website. Created using the elementor plugin available in wordpress. The header area of a home page on a website is the topmost section that serves as the entry point and central hub for users. It typically includes the website's logo or branding, a clear and concise title or slogan that conveys the website's purpose, and a navigation menu providing links to the main sections or critical features of the site. The home page header is essential in making a solid first impression and guiding users to the content or actions they seek, ensuring a user-friendly and intuitive browsing experience (McConnaughy & Wilson, 2018) (Figure 4).

## 2) About Page



Figure 4. Home Page

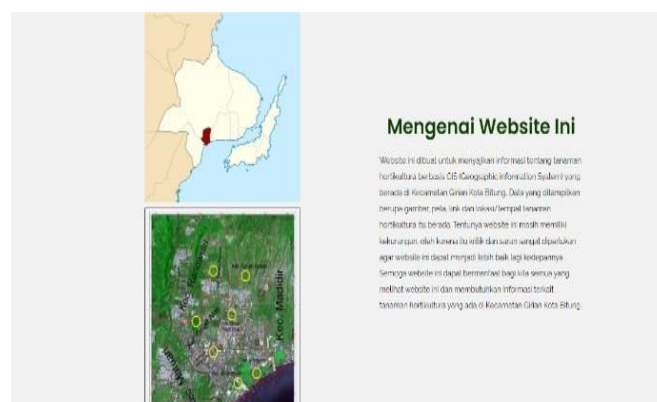


Figure 5. About Page

On the “About” page of this website, you can find an administrative map of Girian Subdistrict within Bitung City, which has been created using ArcGIS Desktop 10.8. This map visually represents the geographic boundaries and features of Girian Subdistrict, providing an overview of its layout and divisions. In addition to the map, there is an explanation of the profile of Girian Subdistrict in Bitung City. This profile offers valuable information about the subdistrict, including details about its demographics, economic activities, infrastructure, and any significant developments. Users can click on this profile to access more comprehensive and in-depth information about Girian Subdistrict, as the data used for the profile has been sourced from the Bitung City Statistics Agency website, ensuring the accuracy and reliability of the information provided. This combination of a map and detailed profile serves to inform and educate visitors about

Girian Subdistrict, enhancing their understanding of this administrative region within Bitung City (Teixeira Da Silva, 2018) (Figure 5).

## 3) Gallery Page

The "Gallery" page on this website showcases visual documentation of various locations where horticultural crops have yielded exceptional results. These locations have been identified based on the outcomes of field surveys conducted in several villages within Girian District, Bitung City. The visual content includes images and possibly other media formats that highlight the lush and productive horticultural landscapes, serving as a testament to the agricultural success in the area. What is noteworthy is that this gallery page has been developed using the Elementor plugin, a popular and user-friendly tool available within the WordPress Content Management System (CMS).

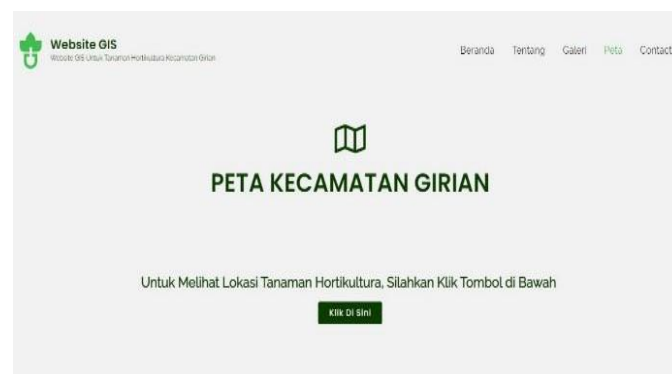
Elementor enables easy and versatile design and layout customization, making it possible to create an engaging and visually appealing presentation of these agricultural achievements in Girian District, Bitung City.

This combination of stunning visuals and user-friendly web development tools aims to communicate the region's horticultural prosperity to website visitors effectively (Chandra et al., 2022) (**Figure 6**).



**Figure 6.** Gallery Page

#### 4) Map Page



**Figure 7.** Map Page

The map page displays information on horticultural crops in the form of locations, which when clicked will display specific information from that location and also locations around the area. The map displayed is made first in ArcGIS desktop 10.8 software, then the data analysis results are imported into ArcGIS online and then do a little editing on the horticultural plant map of Girian Subdistrict, namely by using the Google Maps API to process the map page

while visualizing the editing of the Girian Subdistrict map. After that, if all the information needed has been fulfilled, the map in google maps is then embedded on the existing page in the wordpress CMS by copying the google API share link of the Girian District horticultural crop map in google maps and then pasted on the map page in wordpress (“Maps Follow Page,” 2023) (**Figure 7**).

#### 5) Contact Page

The "Contact" page on this website provides users with essential information to get in touch with the website administrator or relevant contacts. This page typically includes details such as the administrator's name, email address, phone number, and

possibly a physical address. These contact details serve as a means for users to ask questions, seek assistance, or provide feedback about the website's content or functionality. A well-designed contact page ensures clear and direct communication, enhancing user engagement and facilitating any necessary correspondence with the



website's administration (Agrez, 2018) (Figure 8).

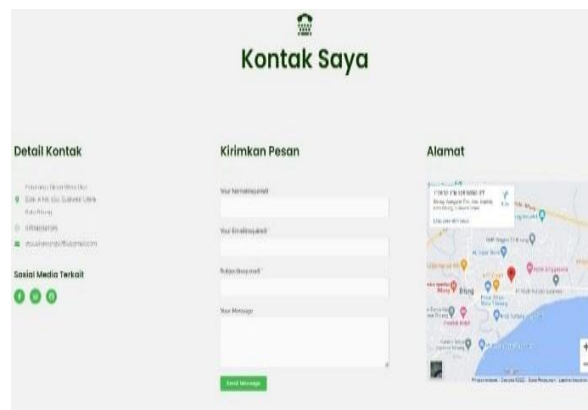


Figure 8. Contact page

b. Footer



Figure 9. Footer Area

The "Footer Area" of a web page serves as the bottom section, where vital information is often displayed, such as the copyright notice. In the context of this WebGIS, the footer area contains copyright information, which typically includes details about the creator or organization responsible for developing and maintaining the WebGIS platform (Cepeda & Salazar, 2023). The copyright notice may encompass the creator's name, the year of creation, and any associated

legal statements to protect intellectual property rights. It is a crucial element for asserting ownership and informing users of the terms and conditions regarding using the WebGIS content. This area ensures transparency and compliance with copyright regulations while offering users a clear understanding of the source and ownership of the platform (Parashar et al., 2020) (Figure 9).

1. Admin Page

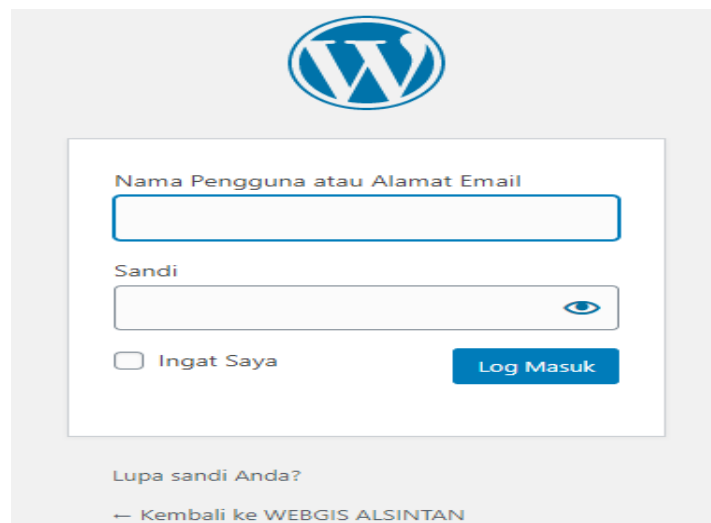
a. login page

The "Login" page on a website is a secure access point that presents a login form, where the administrator must provide the correct username and password to gain entry

to the website's dashboard. This login form is a fundamental security measure that ensures that only authorized individuals, in this case, the administrator, can access the protected areas and features of the website. Successful login validation is a prerequisite for navigating to the "Dashboard" page, which typically offers access to advanced functions,

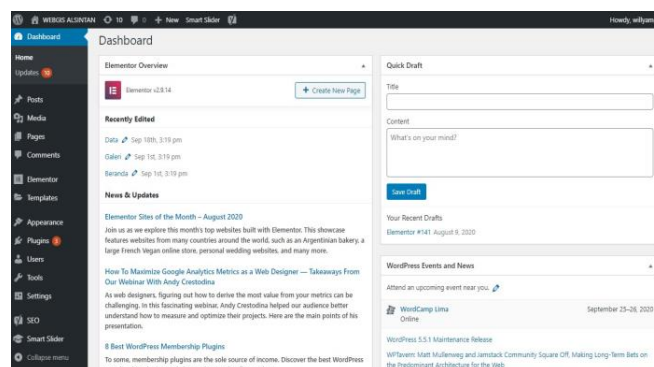
content management, and other administrative controls. The login page is a critical component of user authentication and

access control, safeguarding sensitive information and website functionality(Wang et al., 2022) (**Figure 10**).



**Figure 10.** Login Page

## b. Dashboard Page



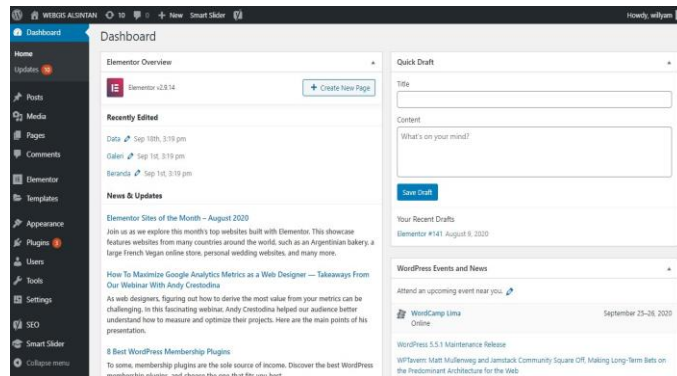
**Figure 11.** Dashboard Page

The "Dashboard" page is the central control panel of the website, specifically designed for the website administrator or authorized users. On this page, various powerful tools and features are provided to facilitate the organization and management of all the content within the WebGIS. These tools typically include content management systems (CMS), data editing and upload functions, settings and customization options, and other administrative controls. The dashboard serves as the nerve center for overseeing the WebGIS, enabling the administrator to make updates, add or remove content, configure settings, and perform various tasks essential for the smooth

operation and maintenance of the platform. It empowers the administrator to efficiently manage and optimize the WebGIS, ensuring that it provides accurate and relevant geographic information to users (Kummer et al., 2019) (**Figure 11**).

## WebGIS Test Results WebGIS Access Speed Test

For this testing process using one of the free tools, GTmetrix, which functions to see how well the performance of this WebGIS is in terms of speed, which can be seen in **Figure 11**.



**Figure 12.** WebGIS Speed Test

Based on the provided image, it is evident that the report's results concerning the speed of webGIS access have yielded a very positive outcome, with a grade of "B." This grade indicates that the webGIS platform's performance and accessibility are excellent, with efficient response times and minimal delays.

Users can expect fast and reliable access to the geographic information and tools provided by the webGIS, ensuring a smooth and responsive user experience. The "B" grade underscores the platform's ability to deliver data and services in a timely and effective manner, which is crucial for any web-based application, particularly one as data-intensive as a Geographic Information System (GIS). This positive assessment of webGIS speed will likely contribute to user satisfaction and efficient data handling within the system (Yin & Zhang, 2010) (**Figure 12**).

**Black Box Testing Trial**

In the **Table 2** above, it can be seen that testing using the blackbox testing method

carried out by users in running each function of the system can run well.

Research on Geographic Information Systems (GIS) has been conducted extensively, including the study titled "Geographic Information System for High School Education Services - covers the entire city of Semarang." In this research, an application was developed to provide information about educational services for high schools in Semarang City.

The application presents data that includes the location of schools and other supporting facilities or objects. However, the application does not address the suitability of facilities, student ratios, or the level of human resources, particularly teachers.

This is consistent with the findings of the research conducted which states that the system developed can facilitate service activities (Dewi et al., 2021)(Pardede, 2019)(Abdeta et al., 2022).

**Table 2.** Black box testing

No	Test Case	Output Display	Actor	Description
1.	Enter address: <a href="https://websitegis.xyz">https://websitegis.xyz</a>	WebGIS home page	User	As per
2.	Select the about menu	Display the about page	User	As per
3.	Select the gallery menu	Display the gallery page	User	As per
4.	Select the map menu	Display the map page	User	As per
5.	Select the contact menu	Display the contact page	User	As per

## CONCLUSION

Based on the results of the research that has been carried out, it can be concluded that geographic information system-based website or commonly called WebGIS can provide information related to horticultural crops in Girian District, Bitung City. This website is very helpful and makes it easier for anyone who needs data and information about Girian Subdistrict and also the location of horticultural crops in Girian Subdistrict. In addition, the website created will also be useful for farmers in Girian District even throughout Indonesia and can be used as material for further research in related fields. The results also show that there are superior horticultural commodities that have very good results such as chilies, eggplants, long beans and there are some shallots that are scattered in several villages in Girian District. There are 3 villages where the results of horticultural crops are very good, namely in Girian Weru Dua Village, Girian Indah Village, Girian Permai Village. This research also finds that the information system development using one of the modeling of the System Development Life Cycle (SDLC) method, namely Rapid Application Development (RAD) modeling has been implemented and is running well. By using paid domain and hosting services from NiagaHoster. WebGIS can be accessed online by users by typing <https://websitegis.xyz> in the URL in the address bar of a search engine such as Google Chrome.

The need to show area and description of horticultural crops in sub-district in Girian so that the mapping can be more detailed. The data presented is not fairly complete, it would be nice if the data displayed is complemented and updated so that the information provided becomes more detailed.

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