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Descriptive Analytics System for Forest and Land Fire Patrol Data in Sumatra Indonesia

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Abstract To prevent and suppress forest and land fires, the Ministry of Environment and Forestry conducts forest and land fire prevention patrol activities by forming a fire fighter team for each operational area. Previously, a mobile application and website had been developed for data acquisition carried out by the patrol team for forest and land fire prevention in the Sumatra region. The data that have been recorded through the *Patroli Karhutla* mobile application are still primary data. Presentation of primary data into data that users easily understand can be done through a business analytics approach. This study aims to develop an application that allows users to easily view data from reports and patrol activities to support decision-making. This study uses a geographic information system to analyze the data from patrols for forest and land fire prevention. This study focuses on analyzing and developing information systems using descriptive analysis and prototyping. Data visualization is presented in the form of maps to monitor the patrol data that have been collected through the mobile application. The functionality of the system has fulfilled the user's requirements.

Keywords Descriptive Analytics, Forest Fires, Geographic Information Systems, Prevention Patrols, Prototyping

1. Introduction

Forest and land fires are an unresolved problem in Indonesia. In 2015, the Ministry of Environment and Forestry (MoEF) recorded that 2.6 million hectares of forest and land burned with 120 thousand hotspots. Forest and land fires in Indonesia once experienced a decline but eventually increased again in 2019, reaching 1.6 million hectares of forest and burned land [1]. Forest and land fires are one of the causes of the decreasing forest area every year and indicate deforestation or forest degradation. The results of the interpretation of Landsat Data Continuity Mission 8 OLI imagery by the Ministry of Environment and Forestry show that the deforestation in forest areas in 2016-2017 was 61.9%. Indonesia's deforestation in 2018-2019 has increased by 5.2% from the previous year [2].

Indonesia's causes of forest and land fires are unsustainable forest management and land preparation for agriculture [3]. Other contributing factors of forest and land fires other than the clearing of agricultural land that still relies on burning methods are the neglect of untreated and unattended land, high temperatures due to the drought, and drying of peat swamps as a result of deliberate action [4]. Forest and land fire disasters that occur every year, especially during the dry season, have been responded by the Presidential Instruction Number 11 of 2015 concerning increasing forest and land fire control. Forest and land fire control is carried out through the prevention and handling with mutual coordination and involvement of parties, including the surrounding community. An Android-based early detection system for forest and land fire has been

created and used by the community in Pelalawan Regency. This system can help the community and government to anticipate and know the location and potential point of fires [5].

One activity of forest and land fire control is hotspot monitoring. Indonesia has a hotspot monitoring system managed by the Ministry of Environment and Forestry to monitor hotspots in real-time, namely Sipongi. Hotspots in Sipongi have a confidence level that indicates the level of confidence that hotspots are actual fire events [6]. The government also issued the Minister of Environment and Forestry Regulation Number 32 of 2016 about the patrols to prevent and handle forest and land fire and monitor forest or land areas [7]. Government agencies are involved in managing forest and land fire problems through integrated patrols involving various parties. Prevention through integrated patrols in 2019 was carried out by Manggala Agni (fire fighters under the coordination of MoEF) personnel with Indonesia National Army (TNI) / Police and carried out in 1082 villages [2]. The team carries out forest and land fire control tasks, including prevention, suppression, and post-forest fire activities. The patrol is carried out by moving the integrated patrol team in rotation using two-wheeled vehicles or other transportation. The integrated patrol team conducts patrols and outreach to communities living around forest and land fires prone areas. The team collaborates with other parties to control forest and land fires. The results of field observations by forest and land fire prevention patrol officers are made into a file-shaped report. The report consists of some information that is used as reporting data.

The patrol data acquisition process is done manually, so it takes time to process the data and make decisions regarding prevention. Previous research has developed mobile and web applications that facilitate the data acquisition process obtained by forest and land fire prevention patrol teams in the Sumatra region. The mobile application that has been developed previously is based on Android and is called the Patroli Karhutla application [8]. Applications are built on the basis of HTML and CSS as the interface and Javascript and API from the back-end module as the content. The services and libraries provided by Google are used to support the application's functionality [9]. Patrol reports entered by the patrol team into the Patroli Karhutla mobile application are stored in an integrated database by a web-based application. This web-based application helps the user manage data inputted by the patrol team. Some examples of displays of mobile applications and web applications for data acquisition on forest and land fire patrols can be seen in Figure 2. This web application also functions to display the data that have been entered. However, data in the Patroli Karhutla mobile application and the website are still primary. The mobile app can display hotspot information from the SIPONGI website (Indonesia Forest and Land Fire Monitoring System) and manipulate forest fire patrol data. Moreover, the maps in the application were integrated using Google Maps, and this can be used in determining different positions [10].

The business analytics approach changes primary data into data that can be easily understood by users. Business analytics is divided into three levels: descriptive, predictive, and prescriptive [11]. A study by Primajaya et al. has implemented business analytics by using the Map-Server to convert the spatial data that contained a relational database into a layer so it can be sent to the client-side [12]. The study visualized the results from applying the ID3 decision tree algorithm to spatial data to predict the occurrence of hotspots as an indicator for forest and land fires. It can also be used to process patrol data inputted through the mobile application that has been created. A visualization module was developed for the cluster hotspot generated on Online Analytical Processing (OLAP) [13]. The data consist of hotspot data which are represented in a two-dimensional model, namely time and location. Other applications for descriptive and predictive analytics on hotspots were also developed using data mining techniques [14], [15], [16], [17].

Descriptive analytics summarizes what has happened and forms the basis of many ongoing alerting and monitoring systems. Transactions that occur are compared with benchmarks and thresholds set based on ratios and analysis of historical data trends [18]. The study uses four perspectives in applying descriptive analytics to accounting information systems: financial, customer, internal processes, and learning. Descriptive analytics use visualization techniques that provide a comprehensive picture of the performance achieved by each aspect. The main elements of descriptive analytics are reports, dashboards, OLAP analysis, and descriptive models of the application domain [19]. Descriptive analytics consists of data visualization, query compilation, data storage, model transformation, and pattern analysis [20]. Descriptive analytics of forest and land fire prevention can be applied to determine the fire weather index, size and shape of forest and land fires, forest and land fire severity, daily perimeter growth, fire duration, and resource use [21].

This study aims to develop a geographic information system (GIS) as an extension of the previous patrol system because users find it difficult to understand the data that have been entered if only primary data that have not been processed are presented. The development of a GIS allows users to easily understand data from reports and patrol activities to support decision-making. This study uses a GIS by offering a visualization of data that has been entered through a mobile application in the form of a map to monitor forest and land fire patrol activities and reports. This study focuses on analyzing and developing information systems using descriptive analytics and prototyping.

2. Method

2.1. Research Data

The development of the application used the data that the prevention patrol team had entered through the *Patroli Karhutla* mobile application. The database structure has been created and adjusted to user requirements by current developers using PostgreSQL. The reports entered through the *Patroli Karhutla* mobile application are divided into 3 data: general data, ground data, and observation data. The general data includes the categories of patrols carried out, daily activities carried out, members of the patrols present, patrol inventories used, and hotspots satellite. Ground data contains location, weather conditions, and general conditions where patrols are conducted. Observation data of measured results from the patrol team consists of test results, water source conditions, vegetation conditions, soil conditions, socialization, coordination, and early suppression of forest and land fires.

2.2. Research Stages

The stages in this study consist of data analysis and information system development. At the data analysis stage, the method used is the descriptive analytics of the previously entered data. The method used in the information system development stage is the Prototyping method [22]. The prototyping method stages are communication, quick plan, quick design modeling, prototype construction, deployment, delivery, and feedback. The research stages can be seen in Figure 1.

The first stage of this method is the communication stage. At this stage, a meeting is held with users and stakeholders of the *Patroli Karhutla* web application. This meeting aims to determine the data needs and the form of data to be displayed in the information system to analyze forest and land fire prevention patrols. The discussion results at this stage are in the form of a user story to find out the data needed in developing a GIS and its boundaries.

The next stage is the quick plan with an analysis of the user stories that have been made and the adjustments of the available data. The results of the user story analysis are used to clarify the scope of the development of a geographic information system prototype, followed by making use-case diagrams and acceptance test criteria. Furthermore, modeling quick design is carried out, which contains interface design using a template that is adjusted to the features built and the selection of graphic visualizations, maps, and the correct data. The results of the quick plan analysis are used for making activity diagrams to describe the system's flow. At this stage, data grouping is also carried out to develop a geographic information system. The next stage is making a prototype to implement the quick plan analysis and the modeling quick design analysis using ArcGIS WebBuilder.

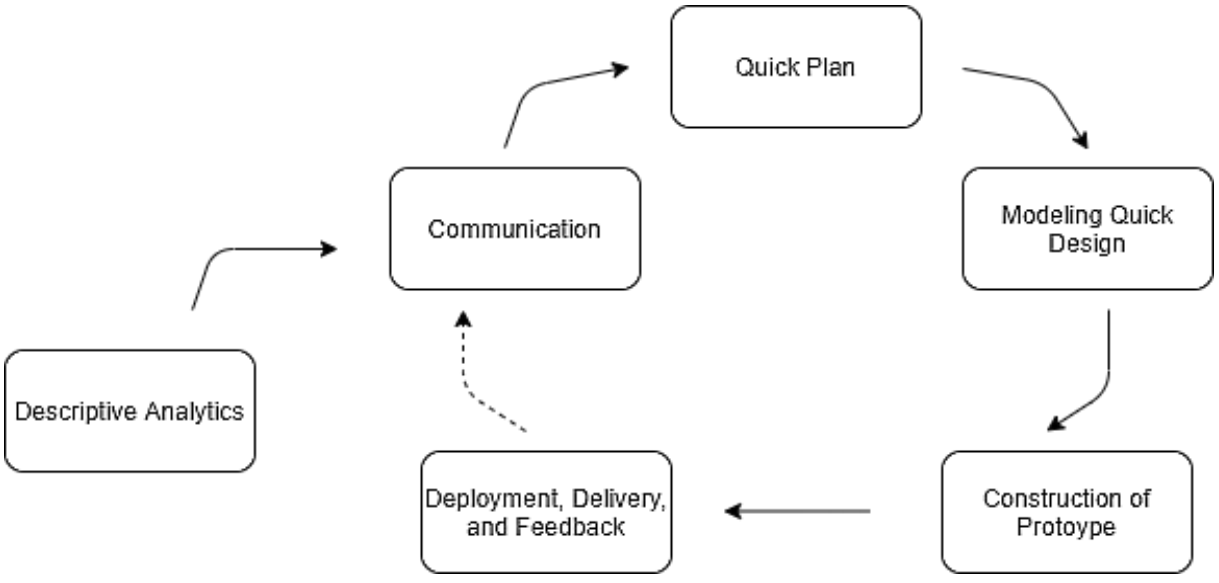


Figure 1. Research Stages

The final stages of the prototyping method are deployment, delivery, and feedback. The information system prototype for analyzing the forest and land fire prevention patrol is tested on its system functionality using the black-box method. In black-box testing, the testing is done by only knowing the information that can be entered into the system and seeing the output from the system [23]. Tests are carried out to determine the suitability of the data displayed for user needs. If the system's functionality is still not fulfilled, it can return to the communication stage.

An analysis of the data entered by the integrated patrol team through the application is carried out at the descriptive analytics stage. After that, the data are grouped according to their categories. The observational data are paired with each data's latitude and longitude points so that data queries can be performed. Data queries are also performed based on the locations to convert data into spatial data. Data queries are also carried out based on data from field observations. One of the main aims of descriptive analysis is to innovate ways to summarize data [24]. Descriptive analysis is the simplest form of analysis using simple descriptive statistics, data visualization techniques, and business-related queries to make sense of past data. The first technique used at this stage is data collection by queries. A query is a method to get, manage, filter, or manipulate data in a database/repository [25]. At this stage, data collection is carried out using specific queries to obtain the required observation data from the forest and land fire prevention patrols.

The following technique is simple descriptive statistics to calculate, describe, and summarize to examine data logically, meaningfully, and efficiently. Descriptive statistics can be explained numerically in manuscript text or tables and graphically in figures [26]. This stage aims to understand the general description of the data to be used with a statistical approach. The last descriptive analysis technique is data visualization which is used to provide an overview of the phenomena that occur as a consideration in the decision-making process. There are many ways to perform descriptive analysis, one of which is data visualization with a dashboard that displays information [27]. Data visualization at this stage displays the location distribution of previously obtained observation data based on the specified categories.

3. Result and Discussion

3.1. Descriptive Analytics

The Database management in the system uses PostgreSQL, which has been made in previous studies. Tables in the database contain user and report data. Data are divided into general reports, ground reports, and observation reports. The diagram that explains the table and attributes of the database can be seen in Figure 2. General reports can be found in the *laporan_header* table. The daily activity and patrol inventory in the *laporan_header* table contain only the id that relates to the id in the *aktivitas_harian* table. *Kategori_patroli* attribute contains an id that relates to the *referen*ce table. The ground report is contained in the *laporan_darat* table. The table consists of location data, weather, and land conditions in the patrol area. The attributes of *cuaca_pagi*, *cuaca_siang*, *cuaca_sore*, and *aksesibilitas* contain an id that can relate to the id in the *cuaca* and *aksesibilitas* tables. The attributes of *kondisi_karhutla*, *potensi_karhutla*, FFMC, FWI, DC, and *aktivitas_masyarakat* contain id that relates to the *referensi* table.

The observation report is divided into three tables, namely the *laporan_observasi_header*, *laporan_observasi_group*, and *laporan_observasi_value*. One report consists of several observation data. One observation data consists of several groups of observation types. *Laporan_observasi_group* table contains the observation id and the *laporan_header* id to link the general report with the observation report. The *laporan_observasi_header* table classifies observations according to their locations. *Laporan_observasi_value* contains the values entered by the user. A reference is needed in the *atribut_ jenis_observasi* table and *jenis_observasi* table to get the types of observations and attributes. Meanwhile, the value that contains the id depends on the id of the reference table.

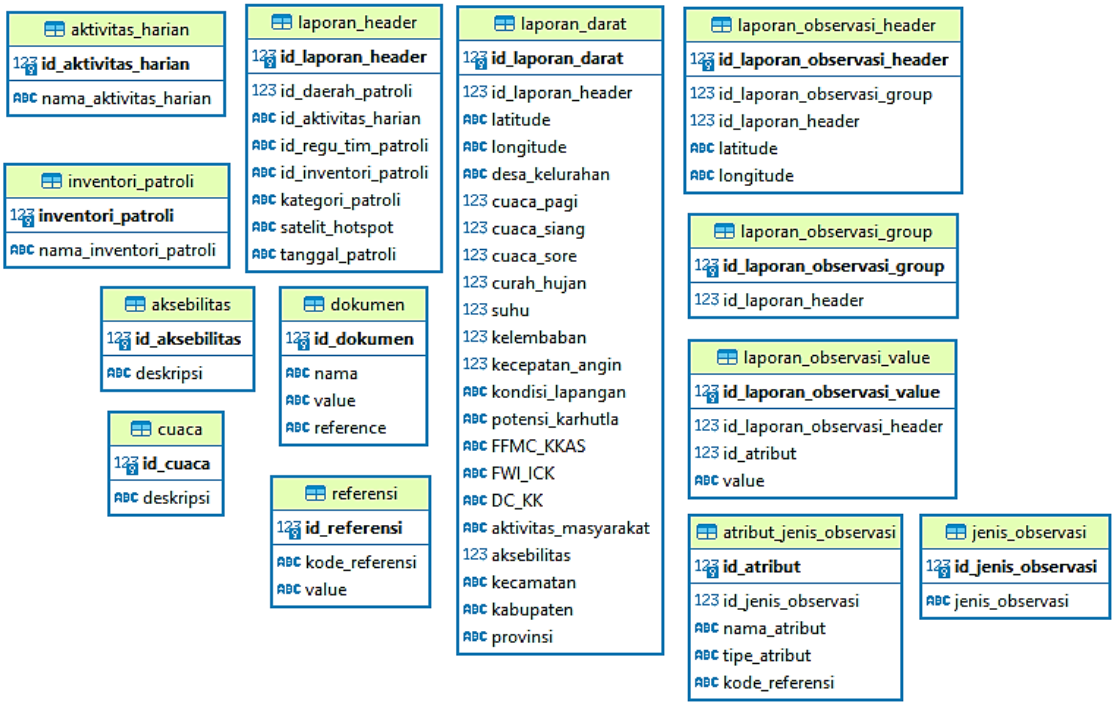


Figure 2. Database Diagram

```
SELECT laporan_observasi_group.id_laporan_header,
laporan_observasi_header.latitude, laporan_observasi_header.longitude,
laporan_observasi_header.geom, ct.id_laporan_observasi_header,
ct."Nama Pengujian", ct."Nilai Pengujian",
ct."Hasil Pengujian", ct."Pengujian Gambut",
nmp.value AS nama_pengujian, np.value AS nilai_pengujian,
hp.value AS hasil_pengujian, pg.value AS pengujian_gambut
FROM ((((((laporan_observasi_group
JOIN laporan_observasi_header ON
        ((laporan_observasi_header.id_laporan_observasi_group =
        laporan_observasi_group.id_laporan_observasi_group)))
JOIN ( SELECT ct_1.id_laporan_observasi_header,
ct_1."Nama Pengujian", ct_1."Nilai Pengujian",
ct_1."Hasil Pengujian", ct_1."Pengujian Gambut"
FROM crosstab('SELECT
id_laporan_observasi_header,
nama_atribut, value::text
FROM public.atribut_jenis_observasi
        JOIN laporan_observasi_value ON laporan_observasi_value.id_atribut =
          atribut_jenis_observasi.id_atribut
WHERE id_jenis_observasi = 1
ORDER BY 1'::text, 'VALUES ("Nama Pengujian"::text), ("Nilai Pengujian"::text), ("Hasil
        Pengujian"::text),("Pengujian Gambut"::text)'::text)
        ct_1(id_laporan_observasi_header integer, "Nama Pengujian" text, "Nilai
        Pengujian" text, "Hasil Pengujian" text, "Pengujian Gambut" text)) ct ON
        ((laporan_observasi_header.id_laporan_observasi_header =
        ct.id_laporan_observasi_header)))
LEFT JOIN referensi nmp ON ((ct."Nama Pengujian" = (nmp.id_referensi)::text)))
LEFT JOIN referensi np ON ((ct."Nilai Pengujian" = (np.id_referensi)::text)))
LEFT JOIN referensi hp ON ((ct."Hasil Pengujian" = (hp.id_referensi)::text)))
LEFT JOIN referensi pg ON ((ct."Pengujian Gambut" = (pg.id_referensi)::text)));
```

Figure 3. Query table of test result conditions

The database is a relational database, so additional extensions are needed to make spatial data, namely PostGIS. After the PostGIS installation is complete, a geom column can be created based on the latitude and longitude values in the *laporan_darat* and *laporan_observasi_header* tables. The type of latitude and longitude data in the database is char, so it is necessary to convert the data type to double precision to get the geometry of the object (geom). In the observation report, latitude and longitude data are found in different formats, so they need to be changed first, and conversion can be done later with double precision data.

Geom attributes added to ground reports and observations from latitude and longitude data convert the data into spatial data so that layers can be generated. The layers are grouped based on the types of observation, namely the condition of the test results, the condition of the water source, the soil condition, the socialization, coordination, and early forest fire suppression. The layer is obtained from the query result view table using the crosstab() function because all types of observations are combined in one observation report table. The crosstab() function can be used after installing the extension tablefunc() in PostgreSQL. The query results are added to the View table so they can be accessed and converted into layers. Figure 3 shows an example of a query used to create a table of test results conditions, and the results are shown in Figure 4. Then a query is performed to combine all data into one table. The data displayed is only official data marked with a team that already has a decree to eliminate the test result data.

Descriptive statistics are performed using RStudio to see the attributes' general description and the distribution of data. Descriptive statistics are carried out on two forms of data, namely numeric and categorical. In numerical data such as rainfall, humidity, temperature, and wind speed, is done by looking at the mean, median, and histogram. The temperature has a mean and median of 30^{o} Celsius, and humidity has a mean and median of 70% RH, wind speed has a mean and median of 7 km/h, rainfall has a mean of 11 mm and a median of 2.6 mm. The difference in mean and median rainfall indicates that there are outliers due to user input errors which affect the actual average rainfall. Descriptive statistics on categorical data are carried out by looking at the frequency of categories and plotting the data. Categorical data carried out by descriptive statistics are fire potential and fire conditions. The results show that the medium and low categories dominate the fire potential data, and the no fire category dominates the fire condition data. Descriptive statistics on numeric and categorical data can be seen in Figure 5.

Data visualization is done by converting the table view into layers. Geoserver is used to convert relational table data into Web Map Services (WMS) or Web Feature Service (WFS). WMS or WFS service on Geoserver can convert tables in PostGIS into spatial formats such as KML, SHP, or GeoJSON. Geoserver and PostGIS integration is performed after Geoserver installation on the server. The next process for displaying data is to create a simple web based on HTML, CSS, and Javascript. A simple web that is made can access data in the form of GeoJSON or WMS Service from Geoserver that has been created. The base layers used on the web are taken from the existing open street maps and open layers.

id_laporan_header_... integer	latitude character vary	longitude character varyir	geom geometry	id_laporan_observasi_ integer	Nama Pengujian character varying (	Nilai Pengujian character varying (1	Hasil Pengujian character varying (	Pengujian Gambut character varying (1	tanggal_patroli character varying (32)
2938	-3.65997	13.23407	0101000020E6100...	5728	Uji Remas Seras...	Sedang	Lembab	[null]	2020-11-26
2939	-3.04804	104.56991	0101000020E6100...	5735	Uji Remas Seras...	Rendah	Basah	[null]	2020-11-26
2943	-3.92618	13.80594	0101000020E6100...	5748	Uji Remas Seras...	Sedang	Lembab	[null]	2020-11-27
2945	-3.08452	104.56516	0101000020E6100...	5761	Uji Remas Seras...	Rendah	Basah	Mentah	2020-11-27
2946	-3.08452	104.56516	0101000020E6100...	5766	Uji Remas Seras...	Sedang	Lembab	Mentah	2020-11-27
2948	-3.61786	13.14604	0101000020E6100...	5774	Uji Remas Seras...	Sedang	Lembab	[null]	2020-11-27
2959	-0.4515076	102.9962063	0101000020E6100...	5810	Uji Daun Tunggal	Tinggi	Lembab	Mentah	2020-12-05
2962	-3.30063	104.36604	0101000020E6100...	5811	Uji Remas Seras...	Rendah	Basah	[null]	2020-12-09
2963	-3.23111	104.09709	0101000020E6100...	5814	Uji Daun Tunggal	Rendah	Basah	[null]	2020-12-09
2965	-3.77015	13.46009	0101000020E6100...	5826	Uji Remas Seras...	Sedang	Basah	[null]	2020-12-09
2966	-3.75891	13.44526	0101000020E6100...	5831	Uji Remas Seras...	Rendah	Basah	[null]	2020-12-10
2967	-3.17578	104.16759	0101000020E6100...	5833	Uji Daun Tunggal	Rendah	Basah	Mentah	2020-12-10
2967	-3.17639	104.16789	0101000020E6100...	5834	Uji Daun Tunggal	Rendah	Basah	Mentah	2020-12-10
2968	-3.18661	104.48846	0101000020E6100...	5835	Uji Remas Seras...	Rendah	Basah	[null]	2020-12-10
2971	-3.17474	104.42666	0101000020E6100...	5852	Uji Remas Seras...	Rendah	Basah	Mentah	2020-12-11
2973	-3.7632	13.4527	0101000020E6100...	5865	Uji Remas Seras...	Rendah	Basah	[null]	2020-12-11
2974	-3.2297	104.16701	0101000020E6100...	5867	Uji Daun Tunggal	Rendah	Lembab	Mentah	2020-12-11

Figure 4. Table view of test result conditions

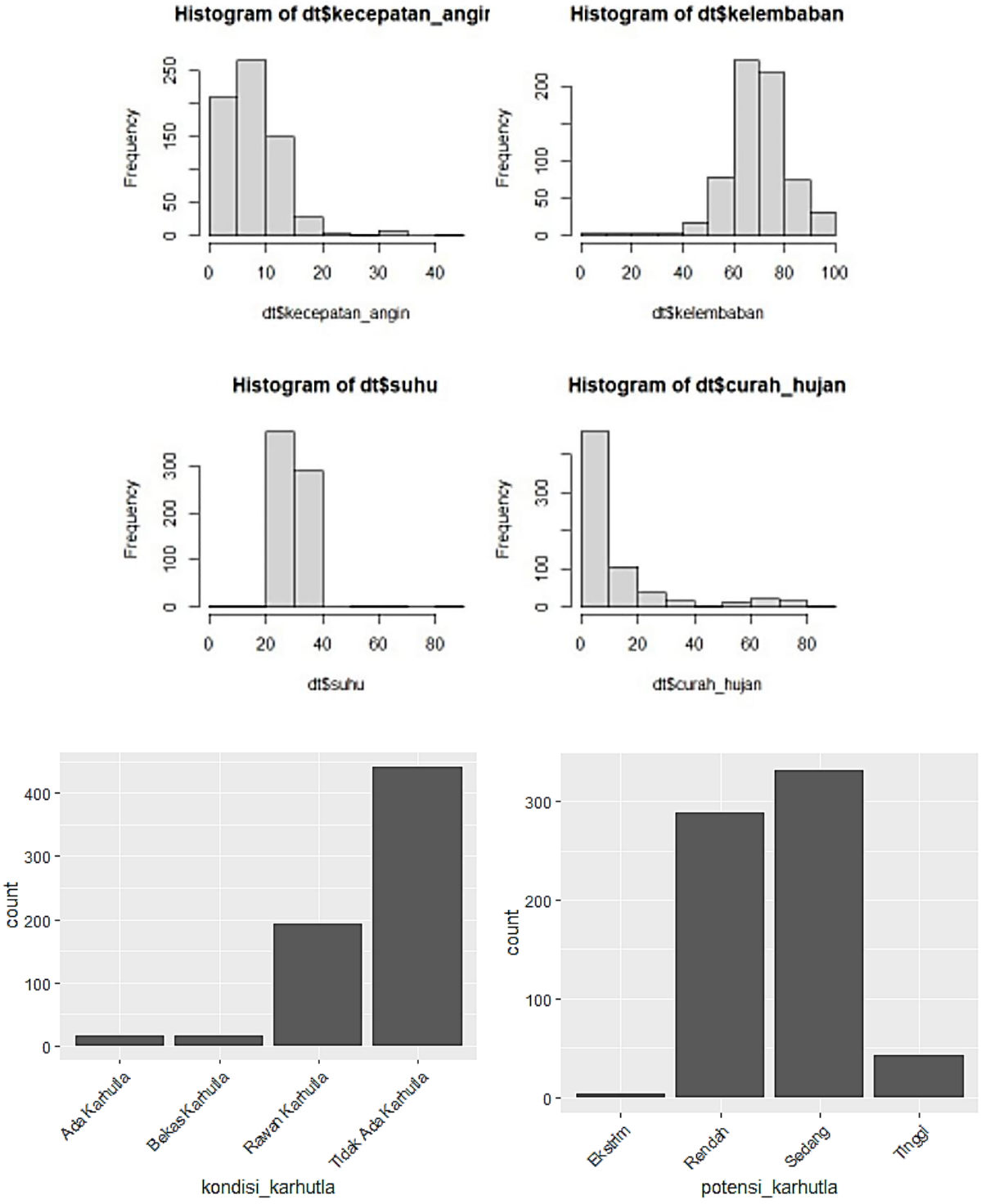


Figure 5. Descriptive statistics of numerical and categorical data

3.2. Prototyping

Communication with users and stakeholders was held online on February 10, 2021. Users consist of the Directorate of Forest and Land Fire Control (PKHL), the Center for Control of Climate Change and Forest and Land Fires in Sumatera, and the Ministry of Environment and Forestry. At this meeting, the types and categories of data to be displayed in the information system were generated to analyze the forest and land fire prevention patrol. This meeting resulted in a user story for developing a geographic information system and its boundaries. The user story generated from the communication stage can be seen in Table 1. User stories that have been created in the previous stage are adjusted to the available data. Based on the user story analysis results, a use case diagram is produced, which can be seen in Figure 6.

The design of the interface was carried out using templates contained in ArcGIS Web then appropriate visualization and data were selected. The selected template is foldable, and changes to the logo and color are made. Next, buttons for selecting layers, displaying symbols, and other features such as filters and printing are adjusted. Activity diagrams are made based on the results of a quick plan analysis. Furthermore, data grouping is used in system development. The use of the system begins with the layer selection displayed and ends with the layer printing based on the filters that have been applied.

Table 1. User story of the system for patrols prevention of forest and land fires

Number	User Story	Explanation
1	Patrol Categories	As a user, I want to see the distribution of patrols by category (Independent, Routine, Integrated)
2	Fire Conditions	As a user, I would like to see the distribution of patrols based on the conditions of forest and land fires (There are Fire, Ex-Fire, Prone to Fire, No Fire)
3	Fire Potential	As a user, I want to see the distribution of patrols based on the potential for forest and land fires (Low, Medium, High, Extreme)
4	Community Activities	As a user, I would like to see the distribution of patrols based on community activities (present or absent)
5	Accessibility	As a user, I want to see the distribution of patrols based on accessibility (Water, Walk, Wheel 2, Wheel 4, None)
6	Test Results	As a user, I want to see the distribution of test results based on Test Values (Low, Medium, High) and Test Results (Wet, Moist, Dry) and display the details of the test results
7	Water Sources	As a user, I want to see the distribution of water sources based on the type of water sources (lake, pond, ditch, etc.) and display the details of the water source
8	Vegetation	As a user, I want to see the distribution of vegetation based on the vegetation condition category (Wet, Moist, Dry) and display vegetation details
9	Soil Conditions	As a user, I want to see the distribution of soil conditions based on soil (Peat, Mineral, Swamp, Peat Soil) and display details of soil conditions
10	Socialization	As a user, I want to see the distribution of socialization based on village potential and display the details of the socialization
11	Coordination	As a user, I want to see the distribution of coordination by agency type and display coordination details
12	Early suppression	As a user, I would like to see the distribution of blackouts based on the results of the blackouts (Off or Not yet) and show the details of the blackouts
13	Time Period	As a user, I want every data that is displayed to be filtered based on a certain time/date period
14	Location	As a user, I want to be able to search data based on location
15	Save Data	As a user, I want data to be saved in a certain format.

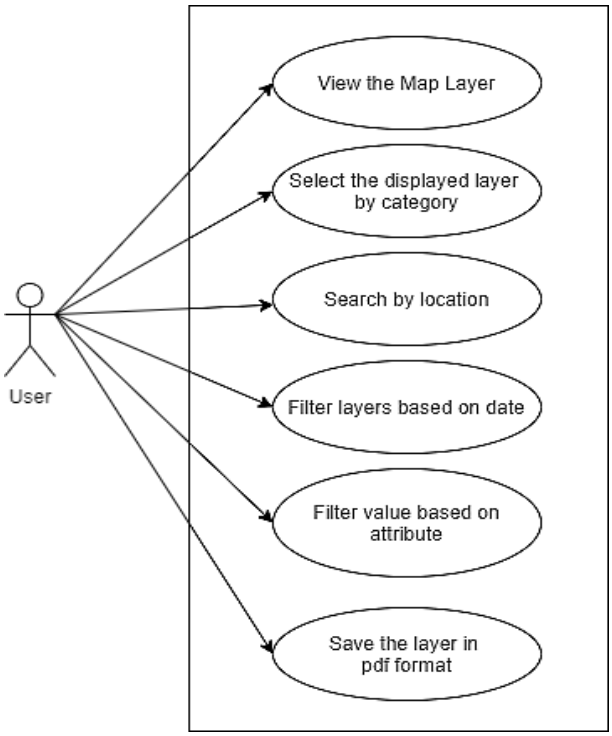


Figure 6. Usecase Diagram

The implementation of the analysis results is carried out using ArcGIS Web. The data have been modified with GeoServer and entered into ArcGIS. The data displayed is the official data dated 13th October 2020 – 1st April 2021 (already has a decree) and is taken from the geoserver and entered manually on ArcGIS. The layers are divided based on the desired category, namely the patrol category layer, the fire potential, fire conditions, test results, water source conditions, soil conditions, vegetation conditions, socialization, coordination, suppression, and observation. The user can select the displayed layer using the layer button located on the top right of the layer. There is a legend button to display the legend and symbols of the currently active layer on the left side of the layer button. Users can also view attribute information for each data or point selected by clicking the desired point. The display of selecting layers and viewing attribute information can be seen in Figure 7.

Users can zoom in and out on the layer and find the current location using the cursor or the buttons on the top left. Users can also search by location through performing a location search on the search menu. Other features such as base map selection, data filtering, and layer printing can be accessed by using the button under the search menu. The first button at the bottom of the search menu is the button for selecting the base map. The next button's function is to filter data based on attributes. The attributes that can be selected are the patrol category, the fire potential, fire conditions, test value, water sources, soil type, vegetation category, the village's potential, the type of agency, and the results of suppression. Figure 8(a) shows the vegetation category layer filtering that has a dry value. Users can filter data based on the time when a patrol is carried out by using the third button. Figure 8(b) shows the results of filtering data on the vegetation category layer of forest and land fires taken on February 18, 2021 - February 19, 2021.

Users can print the currently active layer and the symbol information of that layer. The button to print the layer is next to the data filter button. Users can also choose the layout and file format of the layer to be printed. The results of the information system prototype testing for forest fire prevention patrol business analysis using the black-box testing method can be seen in Table 2. The system's functionality has been fulfilled, so there is no need to return to the communication stage.

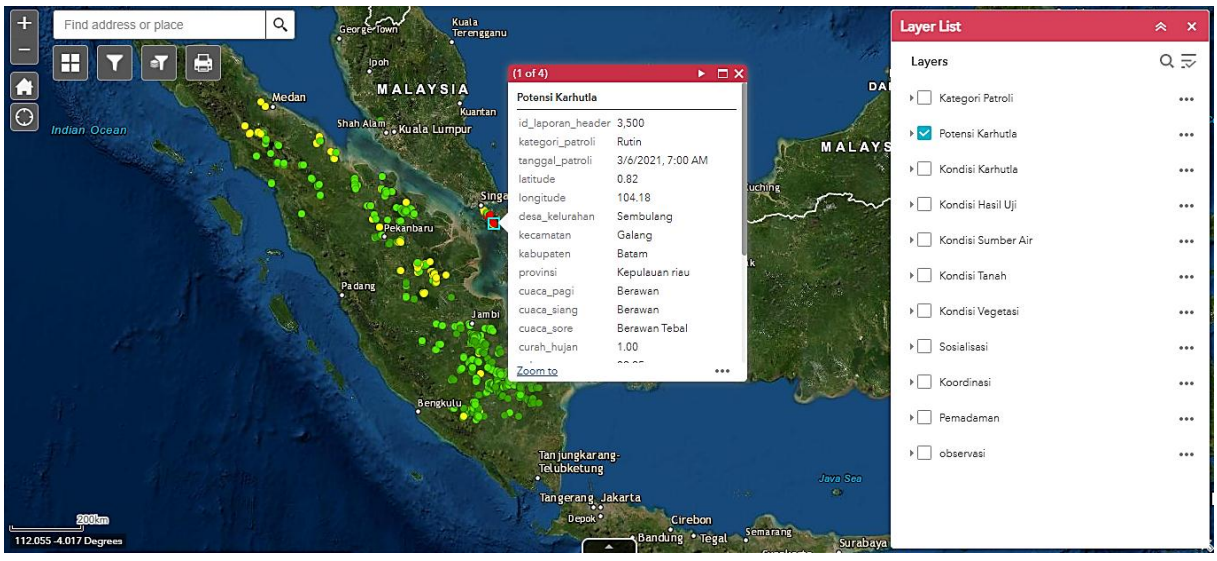
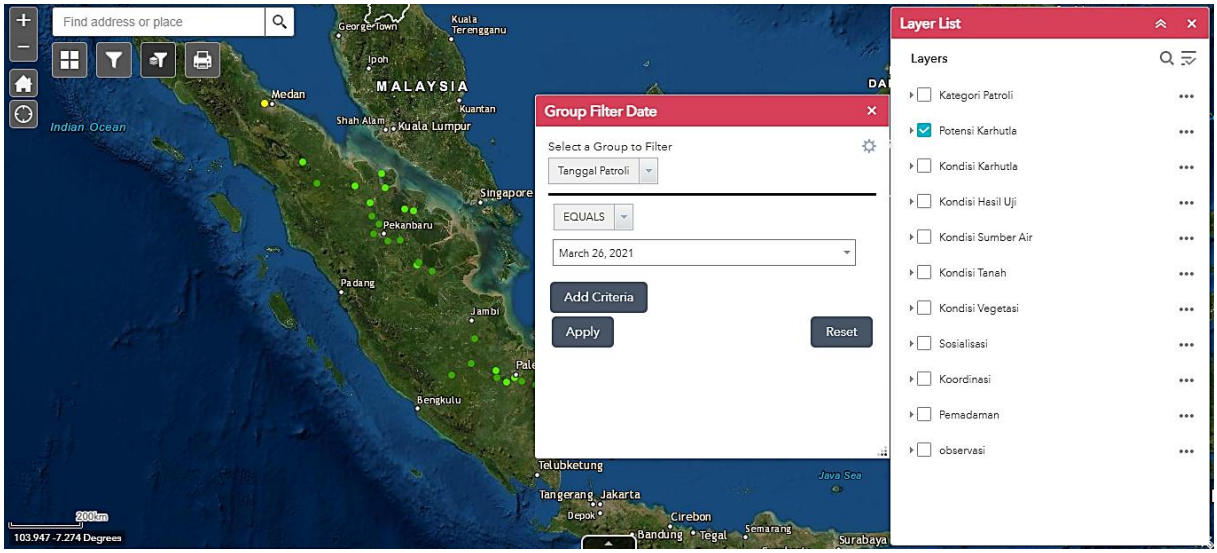


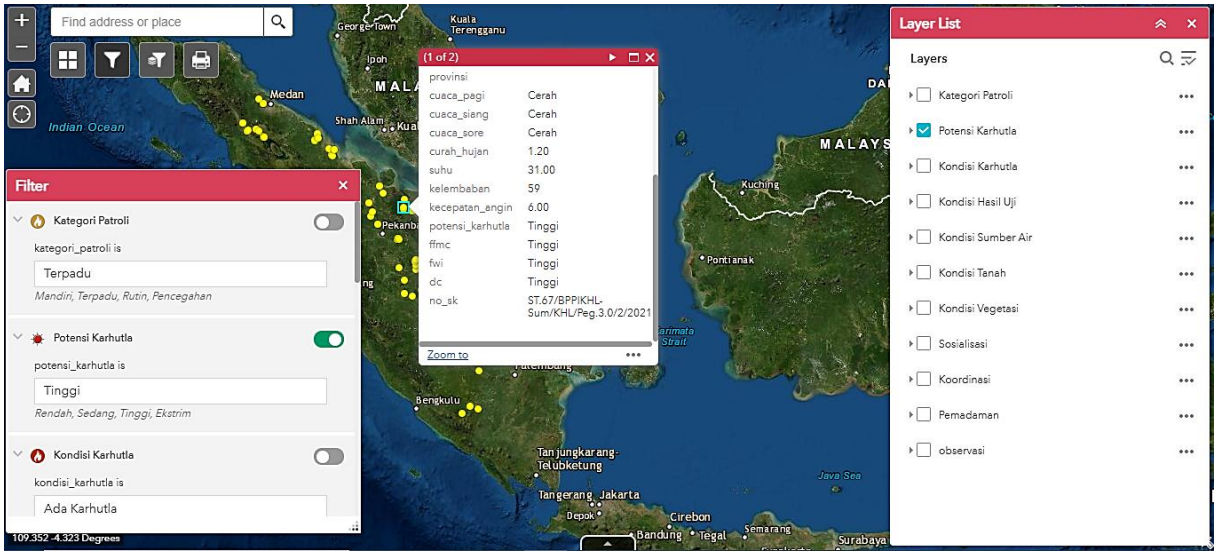
Figure 7. The interface when selects the layer and views the attribute of patrol data

Table 2. The results of testing the application with the black-box testing

Features	Scenario	Expected Results	Test Results
Selecting a layer	The user selects the displayed layer category	The layers displayed on the map match the selected layer	Success
Viewing attributes	Users click a point to see attributes	There is attribute information from the selected point	Success
Filter by attribute	The user selects the attribute group displayed	Attribute groups that display only those selected by the user	Success
Filter based on the date	The user selects the date from the displayed attributes	The attributes appear according to the selected date	Success
Filter by location	Users search for places on the search menu	The layer automatically zooms in according to the selected location	Success
Print layer	The user selects the print menu and prints the layer.	A pdf file contains the layers that are displayed and can be printed.	Success
Change base map layer	The user chooses the base map layer	Basemap layer changes according to user choice	Success



(a)



(b)

Figure 8. The interface when filtering data, (a) Based on attribute information, (b) Time-based filtering of data

4. Conclusions

Developing an information system with descriptive analytics and prototyping to visualize the integrated patrol of forest and land fires in Sumatra has been successfully carried out. The system created is part of the previous system. The query results are added to the View table so that they can be accessed and converted into layers. Geoserver and PostGIS integration is performed on the server. A simple web-based on HTML, CSS, and Javascript is created as the process for displaying data. The development of the system allows users to understand data from reports and patrol activities easily. User stories that have been created in the previous stage are adjusted to the available data. The interface design is carried out using templates contained in ArcGIS Web. The implementation of the analysis results has been conducted using ArcGIS Web. Users can select the layer, filter the data based on its attribute or date, search the data by location, select the base map, and select the layout and layer file format to be printed. The system's functionality has been fulfilled, therefore there is no need to return to the communication stage. This system can assist users in analyzing spatial data on forest and land fire patrols, which is useful in making decisions regarding the prevention of forest and land fires.

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