SCHOOL OF COMPUTING

STIG6003
Geodatabase and Web GIS Application

ASSIGNMENT 2
Constructing a Geodatabase and Web GIS

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STIG6003
GEODATABASE AND WEB GIS APPLICATION
Assignment 2 (20 marks)

Assignment 2: Constructing a Geodatabase and Web GIS

Objective:

This assignment aims to construct a basic geodatabase and design a simple Web GIS application. This assignment will help you understand the processes involved in spatial data organization, management, and online visualization, as well as essential geoinformation and disaster risk reduction skills.

Instructions:

1. **Geodatabase Construction (40%):**
    - Create a geodatabase with at least two feature classes and one table relevant to a chosen topic wildfire risk in oil palm plantation in sepang
    - Organize the data in a structured, logical format and ensure that attribute fields are appropriately defined.
2. **Data Input and Attribution (20%):**
    - Populate your geodatabase with sample data (you may use real or hypothetical data).
    - Ensure the data includes accurate and meaningful attributes for each feature class and table.
3. **Web GIS Setup (30%):**
    - Use a Web GIS platform QGIS to create a web map or application that visualizes your geodatabase data.
    - Configure the Web GIS to allow users to interact with and view different layers, labels, or attribute information.
4. **Documentation and Explanation (10%):**
    - Provide a brief document (1-2 pages) explaining your geodatabase design, data input process, and Web GIS setup.
    - Include screenshots of your geodatabase structure and Web GIS application.

Submission:

- Submit the geodatabase file or a link to the Web GIS map/application, along with your documentation in PDF format.

Assessment Criteria (20 Marks Total):

Criteria	5 (Excellent)	4 (Good)	3 (Satisfactory)	2 (Needs Improvement)	1 (Poor)
Geodatabase Construction (8 Marks)	Well-organized geodatabase with clearly defined feature classes and logical structure.	Mostly organized geodatabase, minor issues in structure or attributes.	Basic geodatabase structure, somewhat organized.	Poorly organized geodatabase, lacking clear structure.	No clear structure or organization in geodatabase.
Data Input and Attribution (4 Marks)	Data is accurately and meaningfully populated, attributes are complete.	Data and attributes are mostly accurate and relevant.	Data is basic with limited attribution detail.	Data or attributes are incomplete or unclear.	Data input is missing or irrelevant to assignment.
Web GIS Setup (6 Marks)	Web GIS is fully functional, user-friendly, with well-configured layers and tools.	Web GIS is mostly functional with minor configuration issues.	Basic Web GIS setup with limited interactivity.	Web GIS setup is unclear or lacks user functionality.	Web GIS setup is missing or non-functional.
Documentation and Explanation (2 Marks)	Documentation is clear, detailed, and includes relevant screenshots.	Documentation is mostly clear with minor gaps in detail or clarity.	Basic documentation with limited Explanation or visuals.	Documentation is unclear or lacks key details.	No documentation provided, or irrelevant explanations.

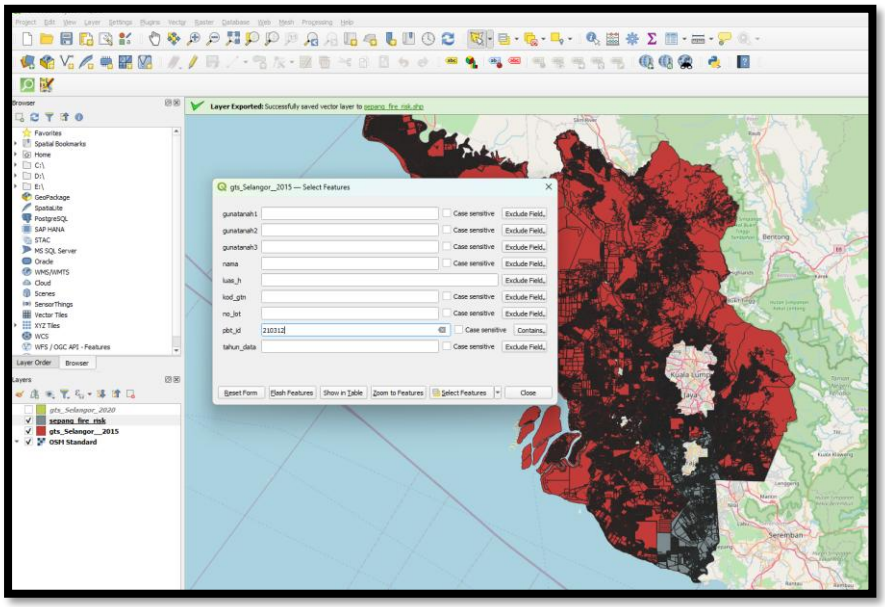
Total Score: ___ / 20

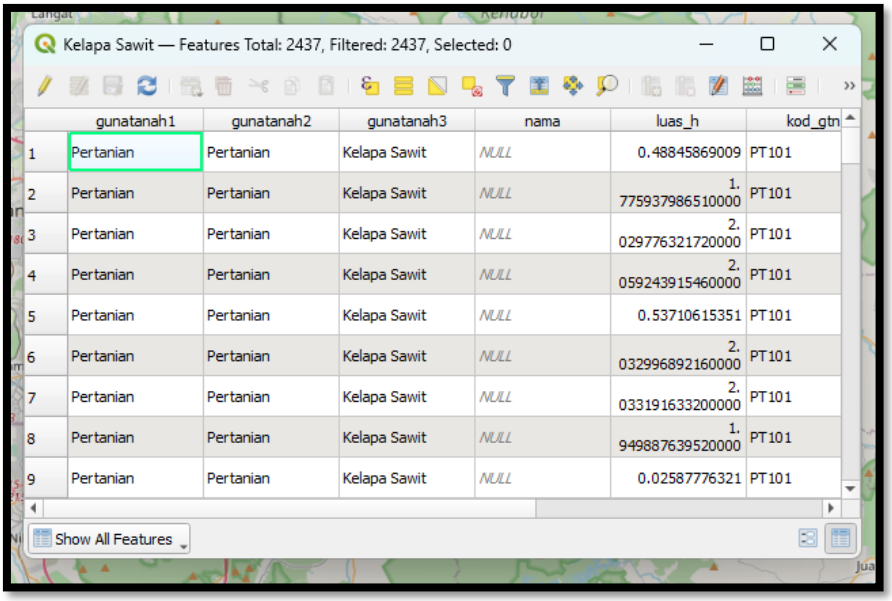
Objective:

This assignment aims to construct a basic geodatabase and design a simple Web GIS application. This assignment will help you understand the processes involved in spatial data organization, management, and online visualization, as well as essential geoinformation and disaster risk reduction skills.

1. Geodatabase Design

A geodatabase was developed using QGIS to manage wildfire risk data for oil palm plantations in Sepang. The data is stored in a GeoPackage (sepang_fire_risk.gpkg) which includes:





Kelapa Sawit — Features Total: 2437, Filtered: 2437, Selected: 0

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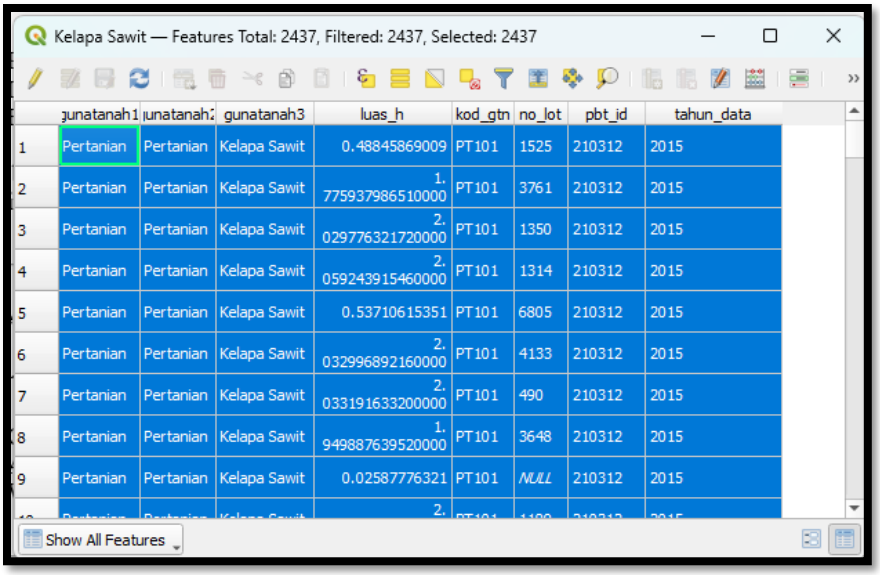
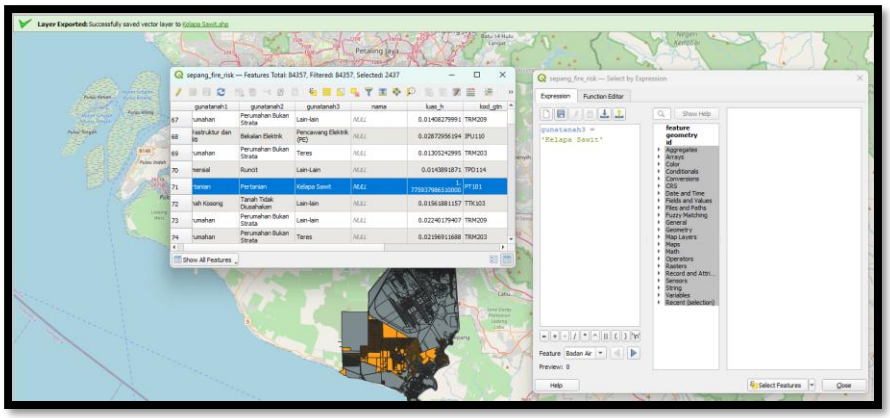
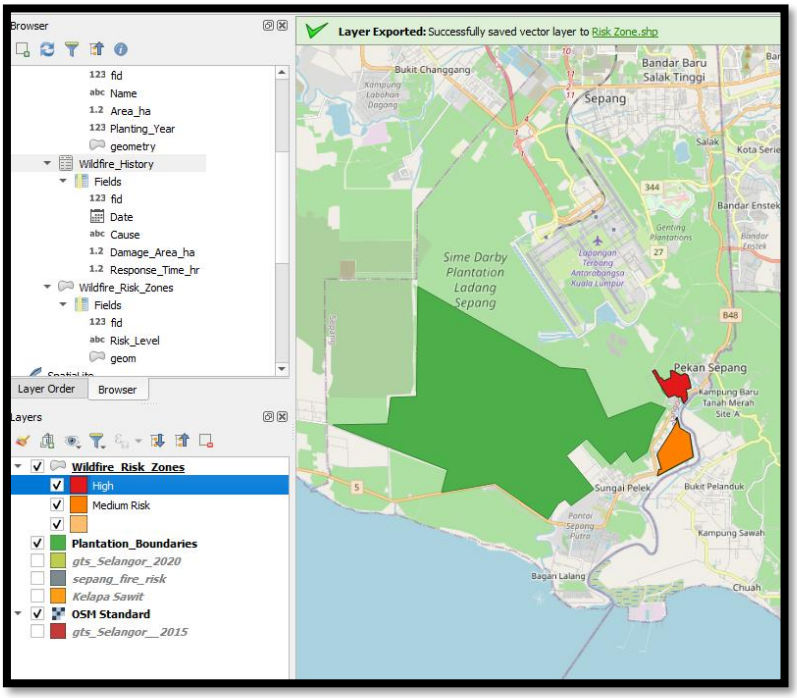
Show All Features



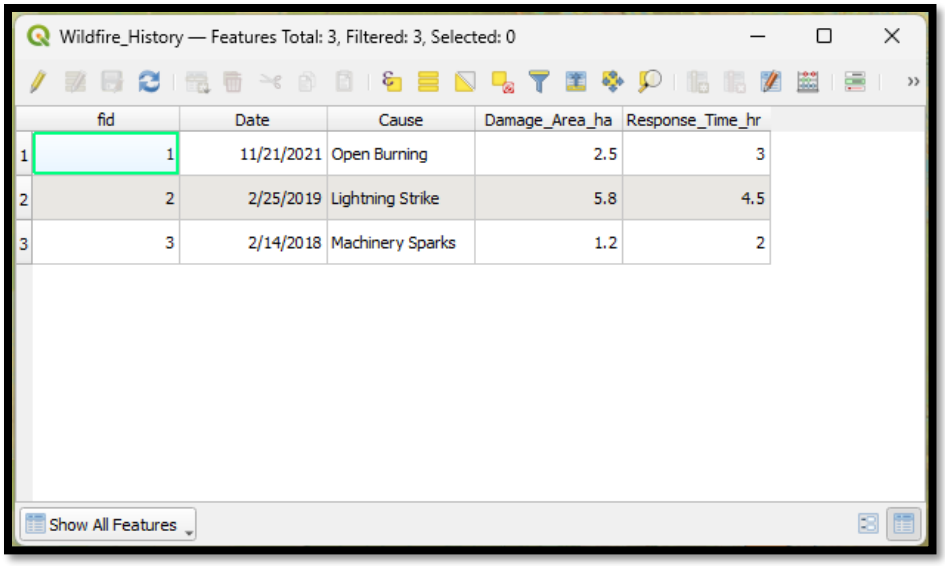


- Plantation_Boundaries (polygon): Shows oil palm plantation parcels with fields like Name, Area_ha, and Planting_Year.

- Wildfire_Risk_Zones (polygon): Shows zones categorized by fire risk (High, Medium, Low), based on vegetation type, road proximity, and historical fire records.



- Wildfire_History (table): Stores details of past wildfire events, including Date, Cause, Damage_Area_ha, and Response_Time_hr.



The structure supports spatial analysis, querying, and web map visualization of fire risks across Sepang's plantations.

2. Data Input and Attribution

The geodatabase was populated with a combination of real and hypothetical data:
Plantation boundaries were digitized from open sources and satellite basemaps by using USGS. Risk zones were manually defined using visual interpretation and assumed vegetation/fire-prone areas. Wildfire events were based on local news reports and simulated data for educational purposes.

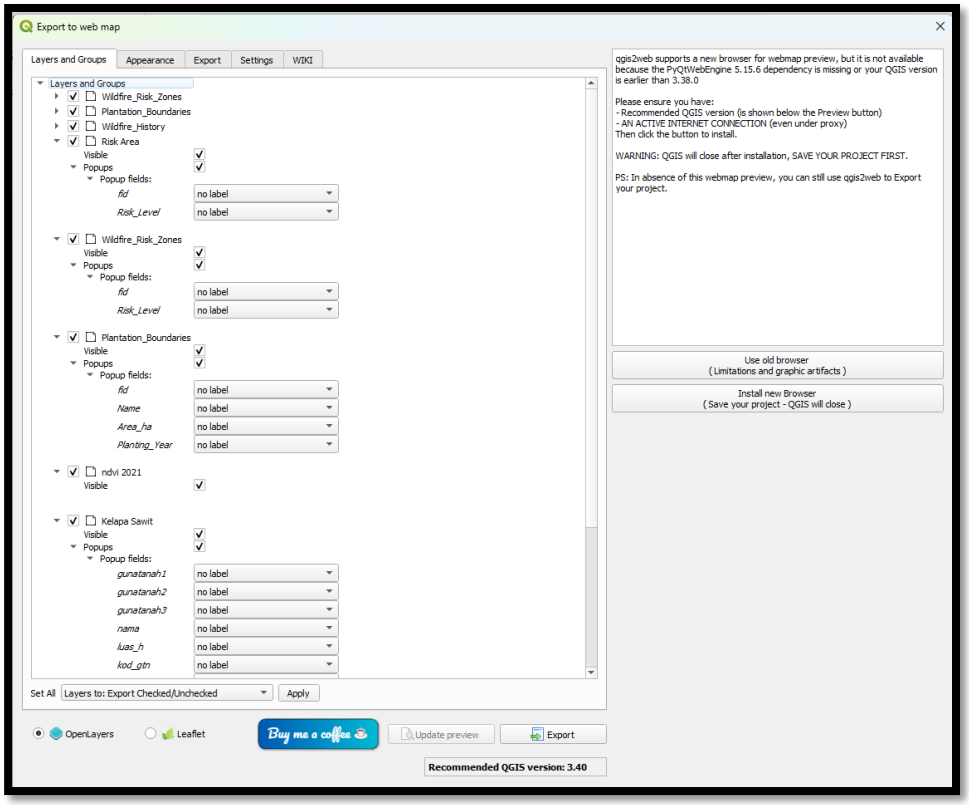
Wildfire_History:

Date	Location	Cause	Damage_Area_ha	Response_Time_hr
2021-11-21	Kelapa Sawit 2	Open burning	2.5	3
2019-02-25	Kelapa Sawit 3	Lightning Strike	5.8	4.5
2018-02-14	Kelapa Sawit 1	Machinery Sparks	1.2	2

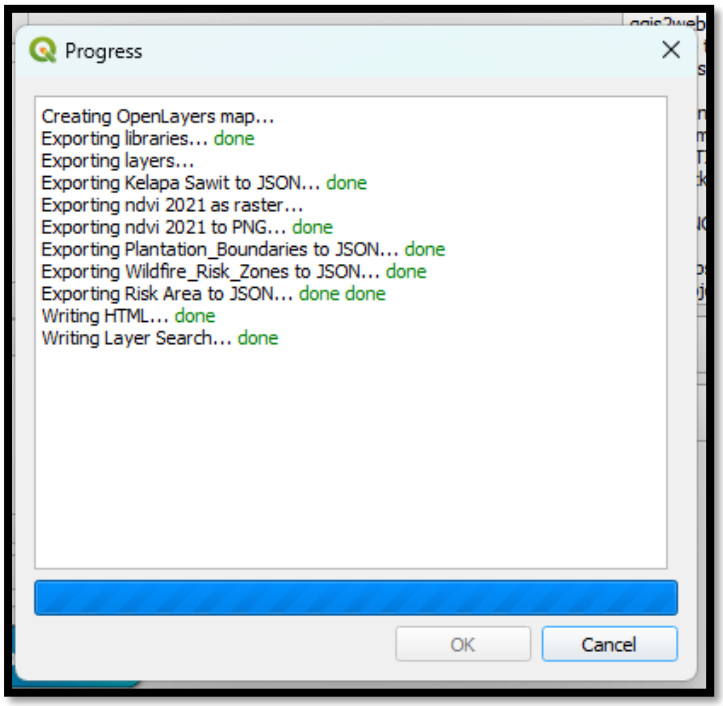
3. Web GIS Setup

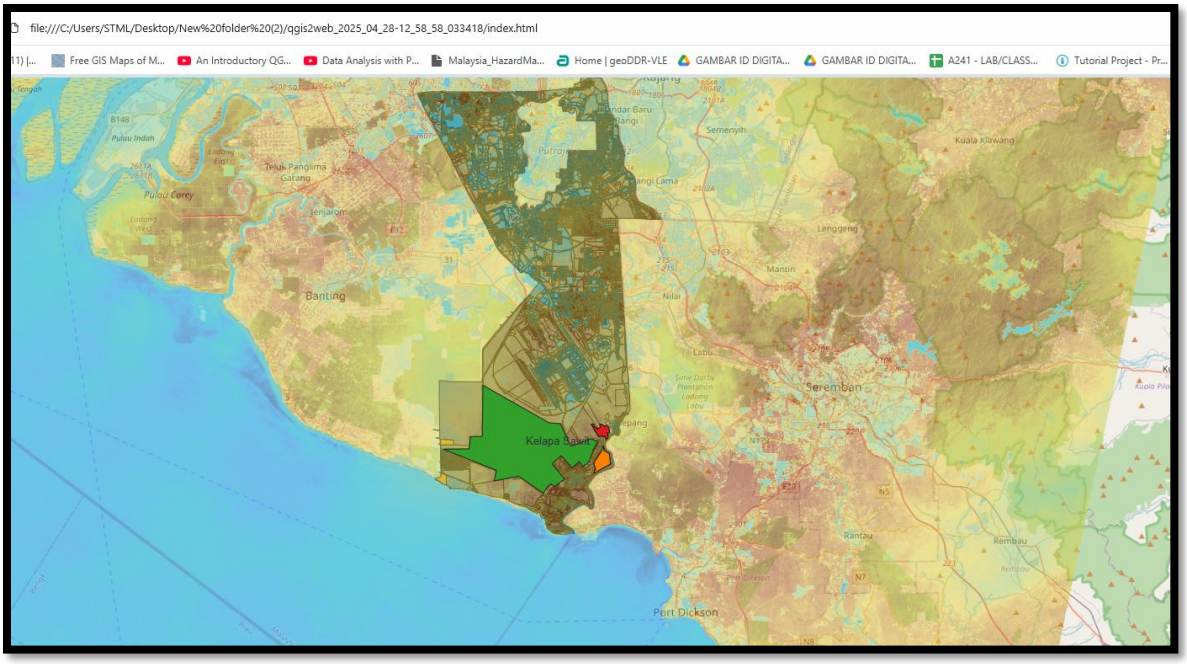
A simple interactive web map was created using the qgis2web plugin in QGIS 3.38. The map includes:

- Risk zones styled by Risk_Level (Red = High, Orange = Medium, Green = Low).
- Popups for all layers with key attributes (e.g. plantation name, fire causes).
- Layer toggles, zoom, and basemap switching enabled.
- Exported as a Leaflet web map.



This web map helps visualize plantation distribution, fire-prone zones, and past fire incidents interactively. This project demonstrated how spatial data organization, attribution, and visualization can support wildfire risk monitoring in oil palm plantations. The use of a structured geodatabase and Web GIS tools enables informed decision-making in disaster risk management.

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Lenggeng
Mantin
Nilai
Labu
Seremban
Kelapa Sawit
Rantau
Rembau
Port Dickson

Wildfire Risk Assessment in Oil Palm Plantations: A Geodatabase and Web GIS Application for Sepang, Malaysia

Abstract

Wildfire risks are an increasing threat to Malaysia's agricultural sector, particularly in oil palm plantations. This study presents the development of a geodatabase and a Web GIS platform to assess and visualize wildfire risks in Sepang, Selangor. A GeoPackage was constructed to organize plantation boundaries, risk zones, and historical fire data. Using QGIS and the qgis2web plugin, an interactive web map was generated to enable dynamic exploration of wildfire risk levels. This research highlights the potential of geospatial technologies for disaster risk reduction and plantation management.

1. Introduction

Wildfires pose significant environmental and economic risks to Malaysia's oil palm industry. In regions like Sepang, factors such as dry seasons, open burning, and dense plantation structures contribute to heightened fire vulnerabilities. Geographic Information Systems (GIS) and Web GIS platforms offer vital tools for organizing, managing, and communicating spatial data critical for wildfire monitoring and response. This study aims to construct a geodatabase and a web-based mapping application to assess wildfire risks in oil palm plantations in Sepang.

2. Methodology

2.1 Geodatabase Construction

A spatial database was developed using the GeoPackage format (sepang_fire_risk.gpkg) in QGIS 3.38. The geodatabase comprises:

- **Plantation_Boundaries**: Polygon layer delineating oil palm plantations with attributes such as area and planting year.
- **Wildfire_Risk_Zones**: Polygon layer categorizing areas into High, Medium, and Low wildfire risk zones based on proximity to roads, vegetation types, and historical fire occurrences.
- **Wildfire_History**: Non-spatial table containing historical wildfire events, including the date, cause, affected area, and response time.

Data were sourced from USGS concession maps, satellite imagery, local news reports, and, where necessary, hypothetical simulation for academic purposes.

2.2 Web GIS Development

The qgis2web plugin was utilized to export the project into an interactive Leaflet-based web map. Symbology was applied to visualize varying risk levels, and pop-ups were configured to display attribute information. The web map allows users to toggle between layers and interact with spatial features.

3. Results

The completed geodatabase successfully integrated plantation boundaries, wildfire risk zones, and historical fire data into a coherent spatial framework. The Web GIS application provides an interactive platform where users can:

- Visualize plantation areas and fire-prone zones.
- Access detailed attribute information through pop-up windows.
- Explore past wildfire events and spatial risk patterns.

Risk zones were classified with a clear visual distinction: high-risk areas marked in red, medium-risk in orange, and low-risk in green. Historical fire incidents, such as an open-burning event on 21 November 2021 affecting 2.5 hectares, were documented within the system.

4. Discussion

The integration of geospatial data into a structured database and a web-accessible platform enhances wildfire risk monitoring capabilities. Plantation managers, disaster response teams, and policymakers can benefit from timely and spatially explicit information to plan preventive measures and rapid responses. However, the accuracy of risk zones depends heavily on the quality of input data, such as updated vegetation cover maps and validated fire reports.

This project demonstrates the feasibility of deploying simple but powerful GIS and Web GIS tools even at a local scale. Future work could incorporate real-time fire detection from satellite sources like USGS and Sentinel-2, coupled with automated risk modeling.

5. Conclusion

The development of a wildfire risk geodatabase and Web GIS application for Sepang's oil palm plantations offers a practical solution for spatially informed wildfire management. By leveraging open-source GIS tools, the project enhances local disaster risk reduction efforts, supports agricultural resilience, and illustrates the critical role of geoinformation technologies in environmental risk management.

1. References

- Food and Agriculture Organization (FAO). (2020). *Fire Management: Global Assessment 2020*.
- RSPO Concession Map Data. (2023). Retrieved from RSPO Website.
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- QGIS Development Team. (2024). *QGIS Geographic Information System*. Open Source Geospatial Foundation Project.
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