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RESEARCH ARTICLE

INFORMATION SYSTEM DESIGN SELECTION OF LOCATION-BASED LANDSCAPE PLANTS IN BADUNG REGENCY, BALI, INDONESIA

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Abstract

Plants have an important role, especially at this time where people cannot do normal activities due to the Covid situation. Plants can reduce stress caused by this pandemic. Demand for plants, especially landscape plants has increased in the midst of the Covid-19 pandemic situation in Denpasar by 80%. However, not all people understand the selection of plants that are appropriate with the conditions of their yard/planting area. The conditions referred to plant ecology, plant habitus, plant characters and functions to be achieved by the user. Therefore, to facilitate the selection of plants based on the conditions, a site-specific database was compiled to be inputted into applications that can be accessed by the general public. The preparation of this database is carried out gradually starting with Badung Regency. The results obtained parameters for landscape plant growth, including land type and topography, land slope level, rainfall and plant water requirements, light needs, land use and landscape plant functions. The types of landscape plants that were processed amounted to 50 species in Petang District and 60 species in South Kuta District. The system design that is made begins with the preparation of data flow designs, data preparation in the form of plant types and plant parameters, data grouping, data implementation and lay-outing, and system testing. The system design uses two ways of searching for data, namely by searching for data based on geographic/location that the user wants to choose and searching for data based on keywords (plant names, plant characters, and plant functions in the landscape)

Introduction:-

Garden is one of the works of landscape architecture that gives the value of beauty to a building. The selection of landscape plant species is highly dependent on the biophysical conditions of the site/land. Soil type conditions, temperature, humidity, light intensity, topography and so on are parameters in the selection of plant species that can live in certain locations. The selection of landscape plant species is highly dependent on the biophysical conditions of the site/land. The condition of soil type, temperature, humidity, light intensity, topography and so on are parameters in the selection of plant species that can live in a particular location. By looking at the many parameters in the selection of landscape plant species, many users/communities have limitations in choosing plant types, especially nowadays, there are thousands of types of landscape plants. In addition, in the midst of the current Covid-19 pandemic situation, gardening/cultivating in residential gardens has become a new trend in the midst of the community to beautify and fill

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the time at home. This statement is supported by (Supartika, 2020) which states that the demand for landscape plants has increased in the midst of the Covid-19 pandemic situation in Denpasar by 80%.

Landscape plants themselves are defined as plants that are planted with the aim of giving aesthetics to the environment. In addition, this plant must have a function (functional) or be used for architectural purposes (Hillagric, 2020). The grouping of plants based on their habitus can be divided into grasses, cover crop, shrubs, trees, vines, epiphytes and strangulation plants (Arkham HS, Arifin and RL Kaswanto, 2014). Norman Booth (1983) classifies the shape of the tree canopy into 7, namely slender and tapered (fastigiate), columnar, spreading, round, pyramidal, danglingand picturesque.

Seeing the phenomena that occur in the midst of society, this research is conducted to provide a solution regarding recommendations for selecting landscape plant species based on location. This research is made by utilizing a digital geographic information system (GIS) so that the public can use it with their electronic devices. The use of GIS can provide benefits to help disseminate information to the public (Rochman *et al.*, 2021). This is also supported by Kurniawan (2012) which states that geographic information systems are able to present information in the form of spatial data and its attributes in geographic form which is equipped with a dashboard displaying an executive summary report, so that the information obtained is more interesting and easier to understand.

Data source :-

Qualitative data and quantitative data obtained from data sources can be divided into two, namely data obtained from direct sources or called primary data, namely data obtained from main sources or directly at the research site, namely by: Observation, is a data collection technique by direct observation at the research site (Bungin, 2007), and data obtained indirectly or called as secondary data, namely data obtained is not from researchers but from publications published by several agencies that related to the research conducted.

Tabel 1:- Data Source.

No	Purpose	Data	Data Type	Source of data acquisition	
1	Growth Parameters	General description of the research area,	Qualitativeand	Primary:	Secondary:
	landscape plant	Map of distribution of soitypes,	Quantitative	Obeservation,	Badung
		topography, climate,species		documentatio n,	Regency
		landscape plant, etc.		interview	government
					BPS,
					BMKG Badung
2	Systeminformasidig ital	SIG data processingand	Quantitative	First problem	
		Maps API		Formulation	Regency
				Data	government
				Processing	BPS,
					BMKG
					Badung

Informant Determination Technique

The technique of determining informants and taking samples in this study is selected based on purposive sampling techniques / techniques of determining informants with certain considerations (Sugiyono, 2014). This is done because not all of the informants have the desire/hobby of gardening.

Research Design

The research design is a comprehensive plan of the research that includes the things that the researcher will do, starting from the explanation of the problem formulation to solving the problem which is finally concluded and given suggestions. To solve the research problem, quantitative methods are used, which are a combination of several methods in a study, which include interpretation and a natural approach to the interests of the subject(Groat and Wang, 2004).

Matherials And Method:-

Matherials

In conducting research with qualitative and quantitative techniques, research tools are needed in collecting and analysing data. The research tools are as follows:

1. Observation Guidelines: details of topics that will be used as objects of observation so as to facilitate data collection and the data collection process to be effective and efficient.
2. Interview Guidelines (question list): basic guidelines when conducting community interviews.
3. Recorder: a recording device is very helpful in documenting the results of the interview, given the possibility of recording errors or the researcher's lack of memory.
4. Digital camera: a tool to document facts and realities in the field in the form of photos/images. Stationery, stationery is used in recording research results that have been obtained through observation and interviews.
5. Computer, a computer is a tool used to write, process data, analyse and present the results of the analysis.

Method of collecting data

This research method uses a data flow diagram which is a system model to describe the division of the system into smaller modules so as to provide benefits and convenience for users who has less over control the computerto understand the system being worked on (Khasanah *et al.*, 2020).The information system development process uses the waterfall development method with a process of analysis, system design, system implementation, and system testing, in line with research Syahputra *et al.*, (2019) which uses the same method in different case. The waterfall model has five stages, namely analysis, design, coding, testing and maintenance (Viona *et al.*, 2018).

Analysis Method

SIG and GoogleMapsAPI

Geographic Information System (GIS) is a computer-based system that is usually used to store, manipulate, and analyse geographic information. Geographic Information Systems (GIS) can be used to manage spatial data or data that are referenced to terrestrial space (Alamsyah, Erpurini and Setiawan, 2021). According to Susianto *et al.*, (2017) states that GIS has a data input sub-system that can accommodate, process data, store and retrieve data, manipulate and analyse and report by presenting data in the form of tables, graphics and maps. This plant GIS creation data will use Google Maps API technology as the main foundation in making map data input and output. Google provides various APIs (Application Programming Interface) which are very useful for web developers and desktop applications to take advantage of various features provided by Google such as: AdSense, Search Engine, Translation and YouTube (Danang and Febryantahanuji, 2018).

Spatial Analysis

Is a technique or process that involves several or a number of calculation functions and evaluation of mathematical logic that can be carried out on spatial data, in order to obtain added value, extraction and new information with spatial aspects. Spatial analysis is quite broad in scope. One of them is in GIS or Geographic Information System.

Measurements for spatial analysis can be done by means of the measurement function. The stages of this research are described as follows:

The stage of collecting data base parameters/conditions for plant growth and collecting types of landscape plants.

1. Grouping the types of landscape plants based on the parameters/conditions of plant growth,the beauty of plant architecture, plant level, and plant functions;
2. Data processing with Location Base Service (LBS) technology;
3. System Design: According to (Fitriani and Labani, 2020) The data obtained at the analysis stage are represented in the form of DFD diagrams, UML, flowcharts for information on functional specifications and procedures applied in the system. Data specifications are represented in tables and information system infrastructure;
4. System Implementation: build an information system based on the results obtained from the system design stage. Build a cloud-based system infrastructure and use Location-Based services (LBS);
5. Stages of System Testing: Testing User Acceptance Test is carried out to find out that the use of the system has been able to solve problems in the field and achieve research objectives.

Results:-

Parameter Analysis Based On Location In Petang District

Soil type and land topography

Soil type and land topography: Petang District has relatively fertile soil fertility conditions. Types of soil in Petang District divided into four (4) categories, including: Andosol Gray Brown, Yellowish Brown Latosol, Yellowish Brown Regosol and Humus Regosol. Andosol soil type is a potential soil type for agricultural land which is technically-agronomically able to support the growth of seasonal and annual plants optimally(Sukarman and Dariah, 2014). Furthermore, according to(Salem, Hastuti and Rusmarini, 2016)states that latosol and regosol soils are classified as fertile soil, where in their research fertile soil is used as a research medium for oil palm seeds. Based on the level of land slope, Petang District is divided into 5 categories of land slope, namely land slope: category 1 (3-8%), category 2 (8-15%), Category 3 (15-25%), Category 4 (25-40 %) and Category 5 (> 40%). When viewed from the slope of the land, the types of landscape plants are grouped based on the functions they have. The grouping starts from landscape plants to support aesthetic functions and social functions in homes/settlements and offices where, the location of the settlements is in an area that has a slope of land category 1 and category 2. The second grouping is based on its function as a road landscape supporter. Road conditions in Petang District have varying slopes or fall into all categories.

Rainfall and water demand

Rainfall in general in Badung Regency is moderate, which can be assumed that plants growing in Badung Regencyreceives sufficient rainfall throughout the year. So that rainfall in Petang location does not become a barrier in plant growth.

Temperature conditions and land elevation

Temperature is a determining factor in plant growth, in addition to paying attention to plants that already exist and grow well in Petang District, plant species are enriched that are able to grow in the highlands with a temperature range of 20.5 C to 30(Central Bureau of Statistics of Badung Regency, 2020).Petang District is located at an altitude of 650 – 1110 meters above sea level. The category of coastal plains 0 - 30 meters above sea level, lowlands > 30 - 700 meters above sea level, and high > 700 meters above sea level.

Light conditions

The climatic conditions of the site in the climatic classification according to (Schmidt and Ferguson, 1951)are determined based on the average number of wet and dry months. In general, Badung Regency has a tropical climate with sun rays that are almost all year round. However, some types of landscape plants require shade to maximize their growth. Especially on the type of ornamental plant leaves. The grouping of landscape plants that require minimal light refers to the existing literature study.

Land use

Grouping is done by collecting data based on the designation of settlements, offices, agriculture and forests, roads, public green open spaces, steep areas/slopes, and watersheds and accessibility. This grouping is based on landscape plants supporting existing land functions. So that the recommendations given can function properly.

Parameter Analysis based on Location in South Kuta District

Soil type and land topography

South Kuta District has two types of soil, namely reddish-brown latosol and reddish brown Mediterranean. Types of latosol and litosol including types of soil that are classified as fertile. Most of the southern Kuta area contains soil types that are less fertile so it is not recommended to be used as agricultural land. However, to plant types of landscape plants, it is necessary to add nutrients to the soil through the addition of fertile soil. Based on the level of land slope, South Kuta District is divided into 6 categories of land slope, namely land slope: category 1 (0-3%), Category 2 (3-8%), category 3 (8-15%), Category 4 (15-3%) 25%), Category 5 (25-40%) and Category 6 (> 40%). The grouping starts from landscape plants to support aesthetic functions and social functions in homes/settlements and offices where, the location of the settlement is in an area that has a slope of land, category 1, coastal area, category 2, 3, 4 tourist accommodation, settlements, roads and offices, category 5 and 6 rocky slopes.

Rainfall and water demand

Based on rainfall data, Badung Regency generally receives sufficient rainfall throughout the year. So that in some areas in South Kuta District plants can grow naturally well in vacant land areas. Selection of landscape plants based on location, water requirements are the main elements that need to be considered, therefore, it is necessary to group

plants. The grouping of plants is also done based on various sources of literature.

Temperature conditions and land elevation
Plant species capable of growing in coastal plains and lowlands with a temperature range of 23.5 C to 32 C. The enrichment of this plant species is based on literature studies. South Kuta District is located at an altitude of 0-500 meters above sea level. Categories of coastal plains 0 - 30 meters above sea level, lowlands > 30 - 700 meters above sea level, and high > 700 meters above sea level.

Light Conditions
The climatic conditions of the site in the climatic classification according to (Schmidt and Ferguson, 1951) are determined based on the average number of wet and dry months. In general, Badung Regency has a tropical climate with sun rays that are almost all year round. However, some types of landscape plants require shade to maximize their growth. Especially on the type of ornamental plant leaves. The grouping of landscape plants that require minimal light refers to the existing literature study.

Land Use
The grouping of landscape plants based on land functions in the South Kuta District is carried out by collecting data based on the designation of settlements, offices, tourism accommodation, roads/access, public green open spaces, coasts, slopes and accessibility. This grouping is based on landscape plants supporting existing land functions. So that the recommendations given can function properly.

The Role of Plants/Softscape in the Garden
According to Hakim (1991) plants have architectural values and visual artistic values, among others: as a visual control, physical barriers, climate control, protection from erosion control, and provide aesthetic values. In addition, according to the plant has the character of forming and ornamental space, namely:
1. Ground cover: plants that form the impression of the floor / ground cover;
2. Plant walls: plants that form the impression of the wall;
3. Barrier plants , guiding and shaping views;
4. Roofing or Shading Plants;
5. Plants as Ornaments and Space Fillers.

Data flow design
After the data needs and entities have been collected, then proceed with the design of Data Flow Diagrams (DFD) to be able to understand how data moves from one entity to another.

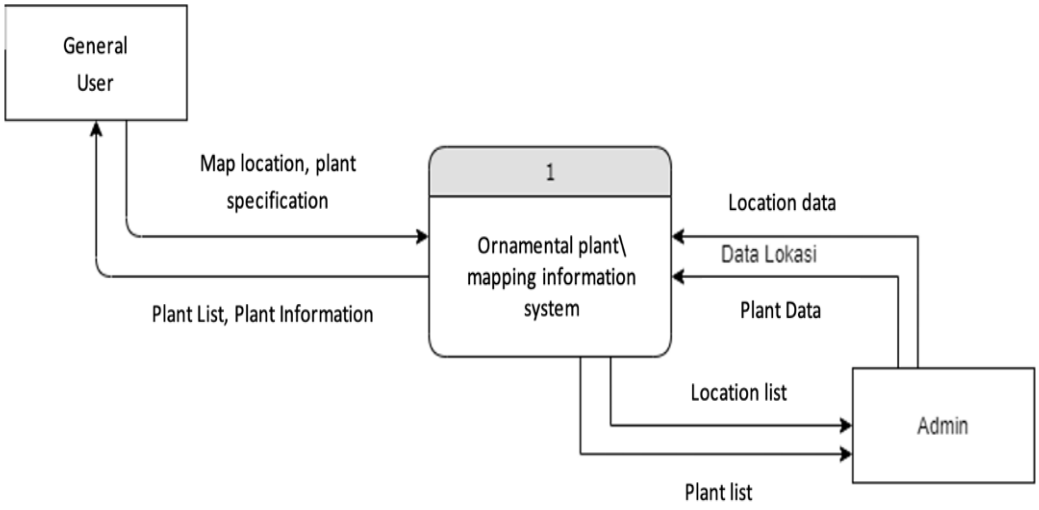

Figure 1:- shows DFD Level 0 on the Ornamental Plant Mapping Information System.

The process of the Ornamental Plant Mapping Information System consists of more detailed processes, such as location (area) data management, plant data management, and the process for searching for plants based on elemental data and plant growth factors.

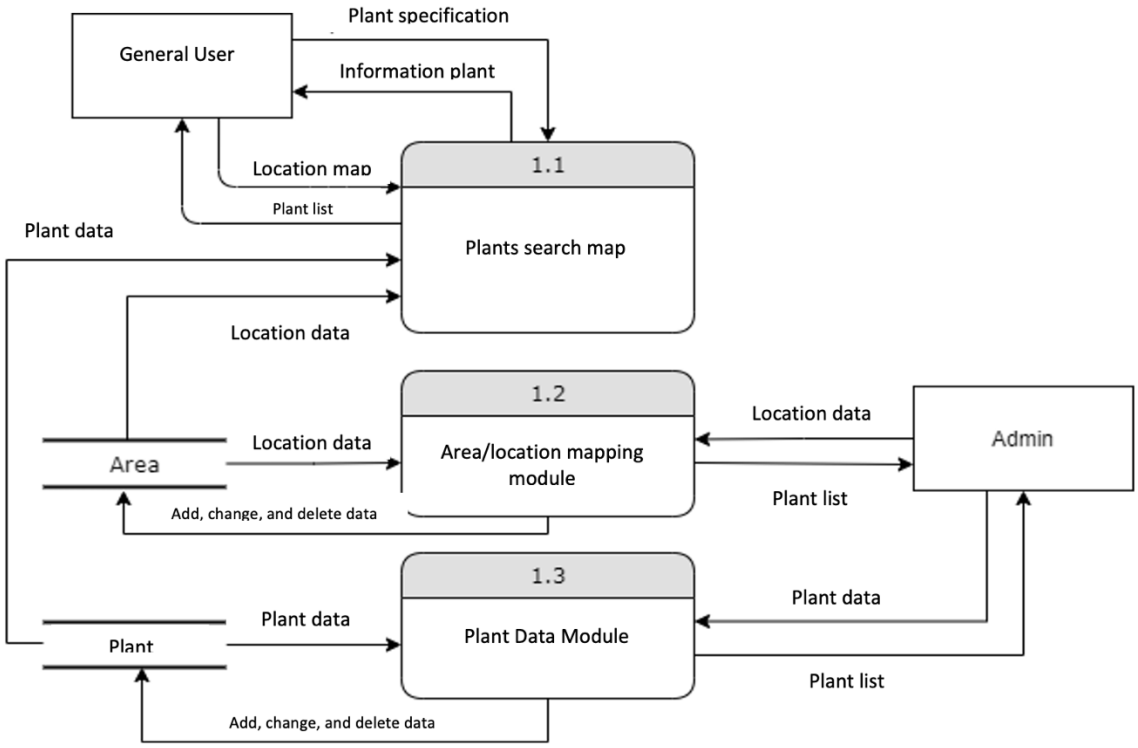

Figure 2:-Data Flow Diagram by Plant Growth Factor.

Data storage design

The design of the database on the Ornamental Plant Mapping Information System is described in the form of an ERD (Entity Relationship Diagram).

User Entity

Users in the Ornamental Plant Mapping System have more functions to manage master data. General visitors to this system do not use the user entity directly, but will be considered as guests.

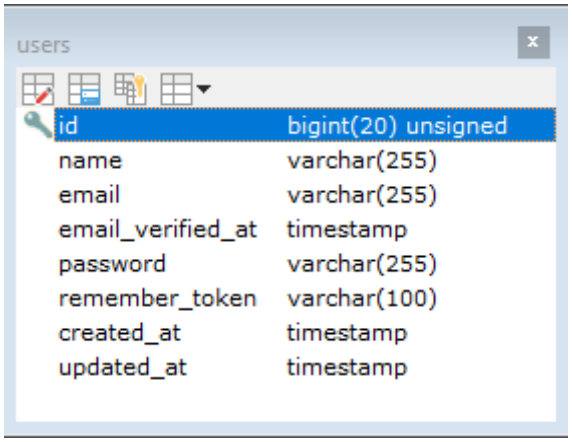

Figure 3:-The design of the table in the database of the user entity.

Plant entity

Plants consist of several elements and growth factors where the storage of these elements needs to be redesigned in the form of entities so that the system can understand how the data can be retrieved properly.

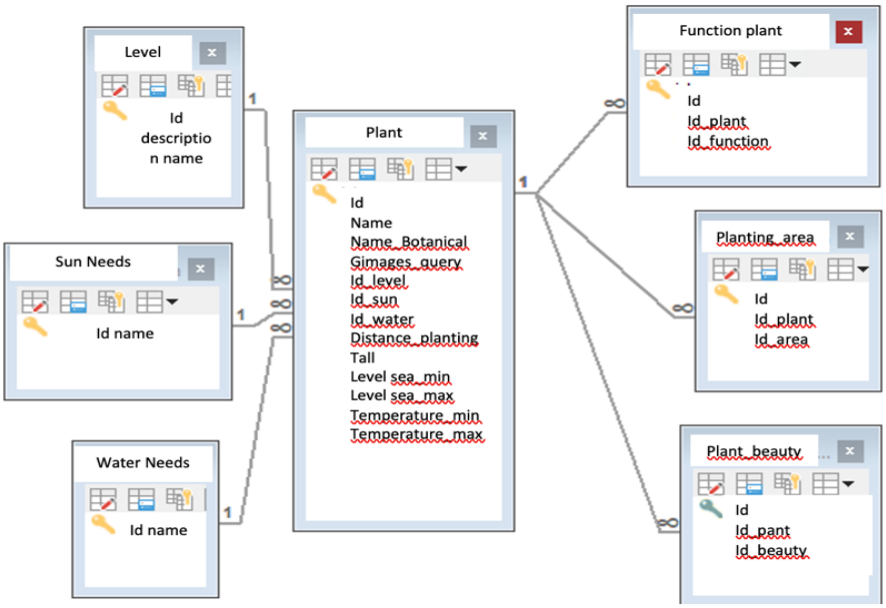

Figure 4:-The design of the table in the database of plant entities.

Location or area entity

The location entity is used to store geographic locations obtained from digital maps. The coordinates that have been stored will then be used for the process of matching the characteristics of the elements that are owned by ornamental plants.

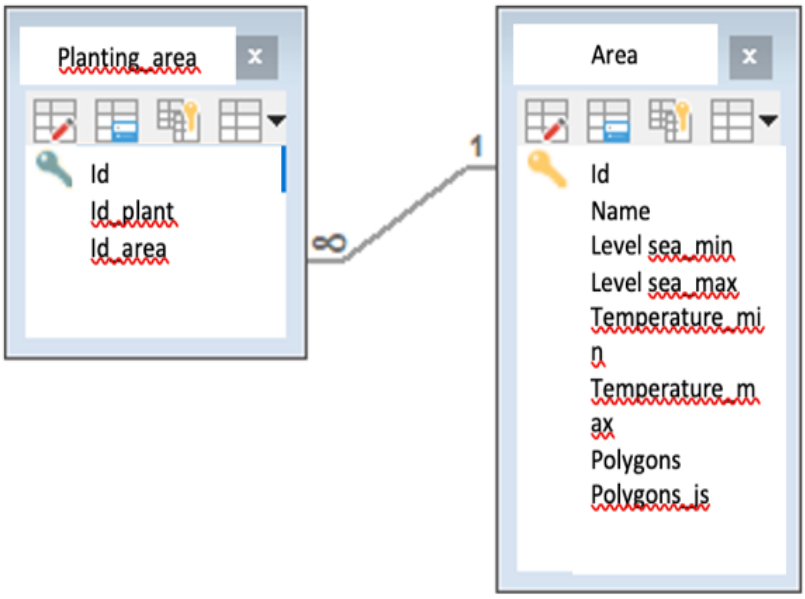

Figure 5:-Table design of location entities.

System implementation

According to (Sasoeng *et al.*, 2018) Implementation is a stage of translating the layout that has been made in the design of the interface into the form of the system implementation display as a whole. The next step is the implementation of the information system based on the design that has been done previously. At this stage, development is continued by utilizing web application technology with the help of Hypertext Preprocessor (PHP), MySQL as a Relational Database Management System, and Google Map Platform for geographic mapping technology. MySQL is a Multiuser Database that uses SQL or Structured Query Language, which is the standard language used to access the database server (Prihadi, 2019). The implementation is divided into two stages, namely the backend implementation to manage data by the system admin and the frontend for data interpretation to public users. This is also in line with the research conducted Pranatawijaya *et al.*,(2019)where the system is made, namely admin users and visitors.

Backend Implementation

At this stage, the implementation of processes related to the main data storage in the form of plant elements and plant growing factors on the map. At this stage is the stage of admin activity in entering and processing data so that the data can be sorted to be displayed in the system. According to (Sya'rani, Puspitasari and Wibowo, 2021) the admin diagram activity explains that the admin enters the geographic information system and then completes the login process, the admin performs data management activities starting by selecting the data menu, then selecting which data to add, changed or deleted. Here is the modules implemented for the backend implementation:

Plant data management

A module for managing ornamental plant data that will be displayed on public pages according to the suitability of the growth factors on the map. Filling in altitude and temperature is an important factor for matching existing data to geographic coordinates. Meanwhile, other inputs on the form will assist in providing more detailed information to public users

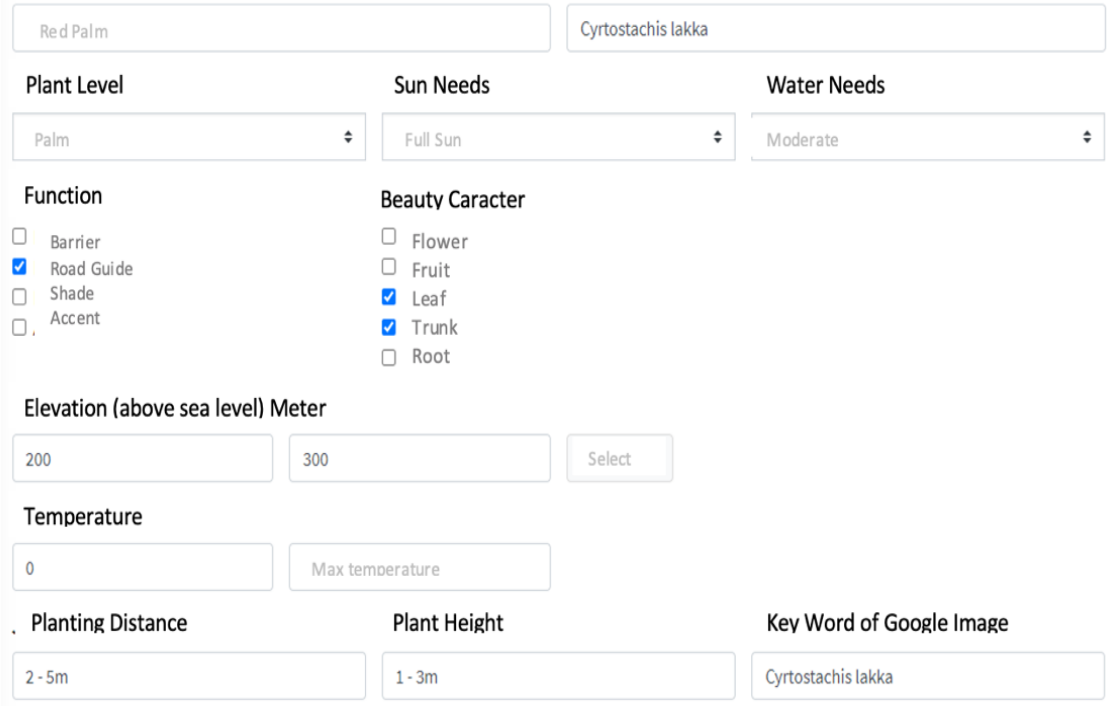

Figure 6:-Filling in ornamental plant data.

Thesystem also provides a feature to add certain locations on the map, where plants should be able to grow but not according to altitude and temperature conditions.

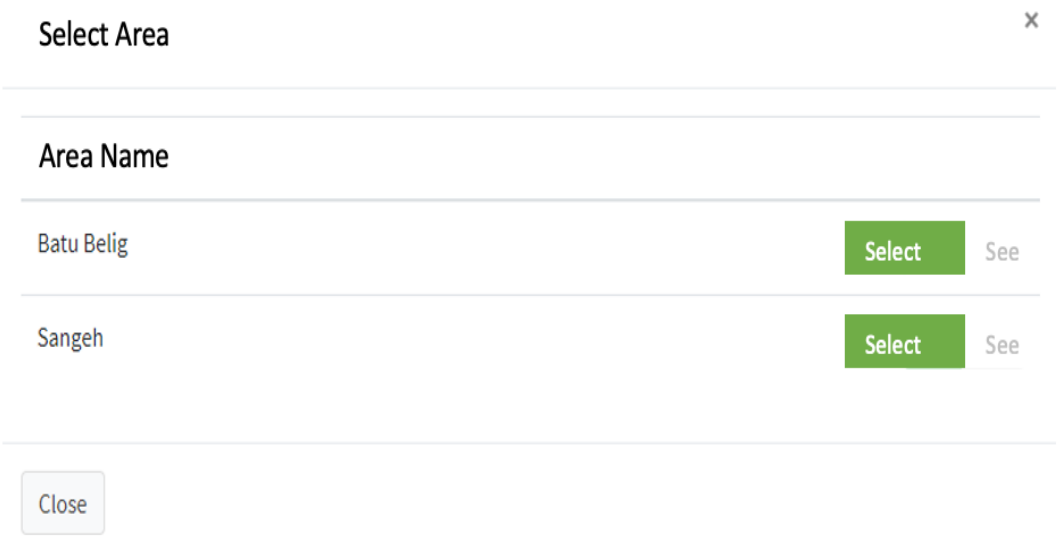

Figure 7:-How to add a specific growing location for ornamental plants.

Geographic location management

A module for managing locations on a map consisting of location shapes, altitude and temperature. The data stored in this module will be used more for matching plants that can grow at a height and temperature in accordance with the location that has been formed based on the polygon shape on the map. With the help of mapping technology, it is also possible to fill in the estimated altitude directly.

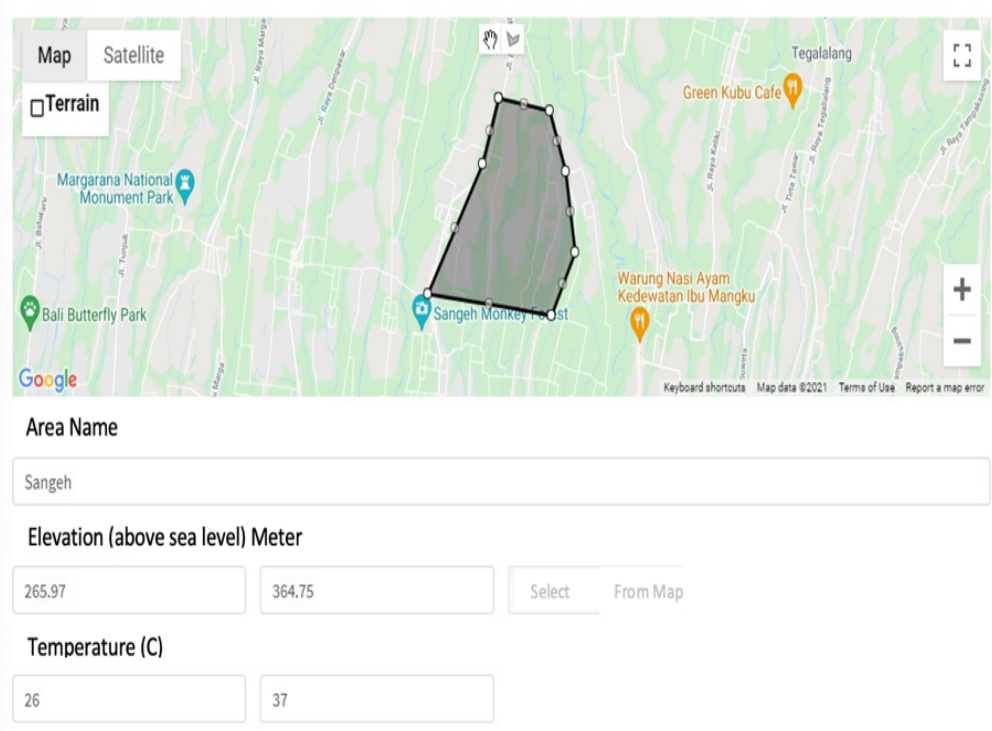

Figure 8:-Geographic location management.

Fronten Implementation

At this stage, the implementation of the process related to the search for data that has previously been added to the system. The search is done by matching the point selected by the user to the location data owned by the system. The search is carried out using the Ray Tracing method. Here are the modules produced in frontend implementation.

The process of selecting points on the map

This module functions to generate coordinates from the map that can be understood by the system for further processing and displaying the results of the search data. Users only need to click on the desired location on the map.

Figure 9:-Location selection display on the system.

Filter and search results data: filter or results filter tool consists of keywords and some basic plant elements that function to display search results data that match the criteria desired by the user. Filters can only work when the coordinates on the map have been determined.

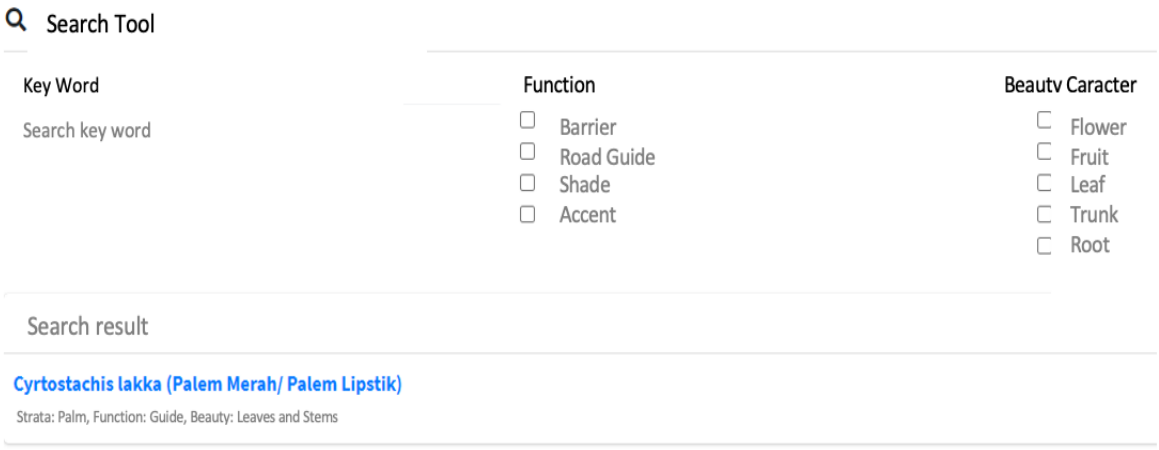

Figure 10:-Filter view and data browsing.

Detailed search results: is an additional information screen that aims to display ornamental plant data in more detail.

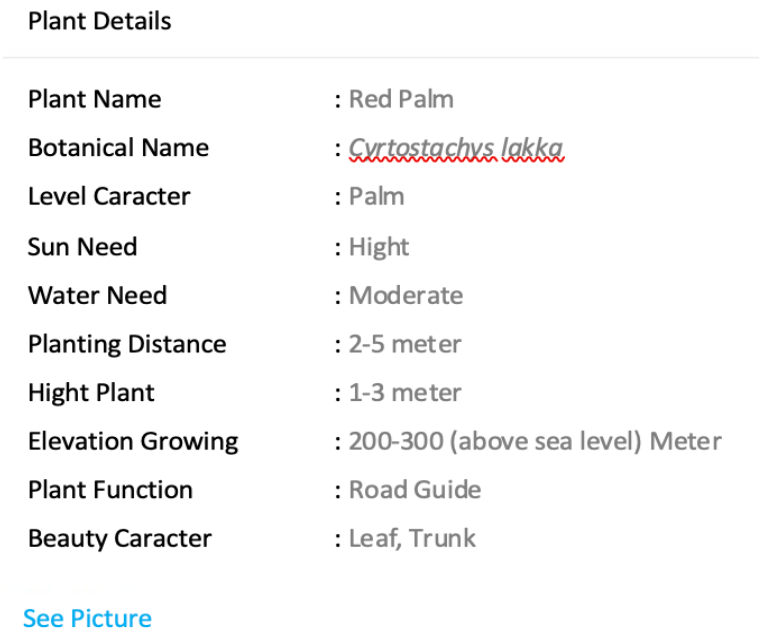

Figure 11:-Detailed view of plants in the system.

Plant details can also help users to get visual information based on data generated from Google Images. Public users will be redirected directly to the Google Images page.

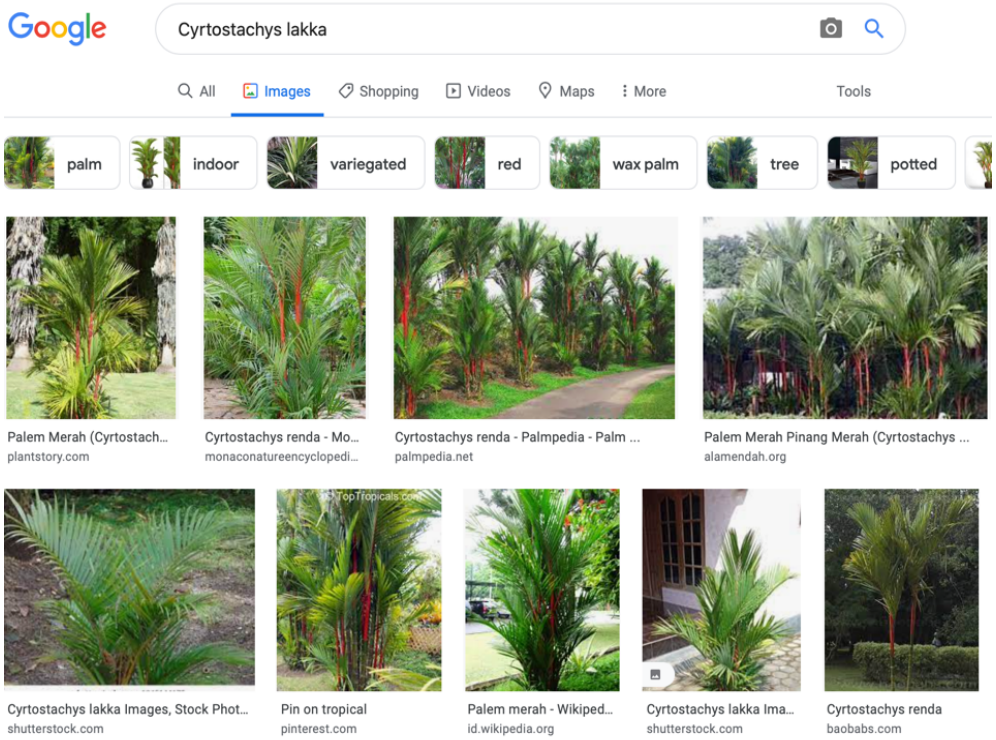

Figure 12:-Synchronized display of plant photos to google image page.

Conclusion:-

The parameters of landscape plant growth used in this study include land type and topography, land slope level, rainfall and plant water requirements, light requirements, land use and landscape plant functions. The types of landscape plants that are processed amounted to 50 species in Petang District and 60 species in South Kuta District.

The system design that is made begins with the preparation of data flow designs, data preparation in the form of plant types and plant parameters, data grouping, data implementation and lay outing, and system testing. The system design uses two ways of searching data, namely through data search based on the geography / location that the user wants to choose and data search based on keywords (plant names, plant characters, and plant functions in the landscape).

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