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GO-COCOSERV AS A CORAL REEF CONSERVATION SERVICE BASED ON CHARACTERISTICS OF BREEDING LOCATIONS

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Abstract

This research aims to create cultivation of seedlings' online donation applications to increase coral reef locations, especially for locations that had a lot of damage. The application is implemented using the GIS method, which is determined by coordinating points in each coral reef area, and these coordinates will be integrated with an image that is linked to information on the condition of coral reefs. This research result is a donation application, where people can make donations by purchasing coral reef seeds and planting them by coral reef farmers based on the coral reef location chosen by the community. It is aimed at accelerating the healing of damaged coral reefs in a coastal area in West Java. So with this technology, it can encourage people to easily participate in saving coral reefs so that the conservation process or planting coral reef seedlings can be carried out sustainably, and it is hoped that the amount of damage to coral reefs can be reduced.

Keywords: Conservation, Coral reef, Donation online, GIS, System, Web.

1. Introduction

Indonesia is an archipelago country, with two-thirds of its territory being oceans. It is not just an ocean area. However, Indonesia is full of rich biodiversity. One of the biodiversity is coral reefs. Coral reefs are one of the most abundant marine resources in Indonesia. As inhabitants of marine ecosystems, Indonesia's coral reefs are ranked at the top of the world for their breadth and diversity. More than 75,000 km² or 14% of the world's coral reefs [1, 2]. The coral reef is a susceptible and sensitive ecosystem. If there is even the slightest damage, the integrity will be disturbed. That is due to dependence on thousands of creatures on coral reefs [3]. The process of forming coral reefs takes a very long time, up to millions of years. However, coral reefs' richness in Indonesia is not accompanied by their utilization; much damage has occurred. Damage to coral reefs can be caused by physical, biological, and human activities. Physical factors are generally natural such as changes in temperature and storms. Biological factors such as predation by biota are associated with coral reefs such as *Bulu Seribu (Acanthaster olandi)*.

Meanwhile, human activities can be in the form of sedimentation originating from logging, plantation, and mining activities, overfishing, and construction of facilities around the coast, reclamation, oil waste, household waste, and industrial waste around the coast. The most dominant factor is damage caused by human activities. It must be avoided as a protection for the preservation of coral reefs.

According to the observations of LIPI (The Indonesian Institute of Sciences), the damage to coral reefs in Indonesia has increased rapidly. This damage causes widespread pressure on natural ecosystems in marine waters. The data states that observations of 324 coral reef locations in Indonesia show that around 43% of coral reefs are damaged or can even be considered to be on the verge of extinction, while the ones that are still very good are only around 6.48% Soekarno [1] and Adriman [2]. Based on research results from the Research Center for Oceanography of LIPI (The Indonesian Institute of Sciences), from 985 stations recorded up to 2008, only 5.48% of coral reefs in Indonesia are in very good condition. Moreover, 1,135 stations until 2017 found 35.15% of the 2.5 million hectares of Indonesian corals in a damaged condition [3]. One way that can be done to overcome the problem of damage to coral reefs is by planting coral reef seedlings. Planting coral reef seedlings requires community participation. This role must be accompanied by public awareness of the importance of preserving coral reefs; the community must also have easy access to conserve coral reefs so that the community can participate directly in preserving coral reefs.

Therefore, we provide facility solutions that make it easier for people to preserve coral reefs directly through technology based on Geographical Information Systems. Many functions are given by this GIS, one of which is determining the fishing area by fishers between Indonesia and Malaysia. Therefore, there is no conflict of exploitation [4]. Another benefit of GIS is to protect the defense of coral reefs and mangroves in Biak, Papua, by conducting an inventory of coastal resources integrated with NDVI technology (Normalized Difference Vegetation Index) so that a mapping of the location of their ecosystem distribution is produced [5]. In addition, GIS can be used to measure the potential for ecotourism in an area [6], which results in an analysis of the carrying capacity of the utilization of Gili Labak Island.

Based on the results of three previous studies [5-7], GIS provides technological potential in describing the mapping of an area with specific objectives, which results in area category values based on the functions of each region. The benefits provided by GIS technology are in determining locations/areas that can accommodate processing storage, display digital spatial data, and even integrate various data, ranging from satellite imagery, aerial photographs, and maps to even statistical data. SIG is also capable of processing data quickly and accurately and facilitates displaying its data in the form of pictures [7]. Various research reveals that the application based on GIS provides ease in providing decisions to support the provision of information for its users; with the provision of GIS, the application can provide output in the presentation of information in reports, especially location/region information [8].

Therefore, from the advantages provided by GIS, we use GIS-based technology in carrying out conservation efforts on coral reefs in the form of providing appropriate coral reef conservation services based on the characteristics of the planting location in the form of a coral reef donation system. The coral reef donation system service is carried out through electronic media connected to the internet, commonly called online services. This service is in the form of a web application.

This application, built with spatial and non-spatial data. Spatial data is in the form of cultivation locations and locations for planting coral reef seedlings (in the form of shoots) in certain areas, while non-spatial data is in the form of donation data that will be provided by the community, whose information consists of price, type, several coral reefs, and personal data (name, identity number, and personal email). Farmers tasked with taking orders for coral reefs at coral nursery locations and planting coral reefs in predetermined locations will receive these spatial and non-spatial data. It is called a GIS-based donation system (Geographical Information System) [9]. We have named this coral reef donation system service the web GIS "GO-COCOSERV" (Go Coral Reef Conservation).

In this application, the community will easily participate in seeing the location of coral reefs in Indonesia and a description of the condition of existing coral reefs. The community can choose the coral reef's location in a damaged condition, which is represented by a red image, and then the application will forward information about the coral reef area and the stages of donating. With the GIS-based application, the location-based coral reef donation system on the web, GIS will make it easier for people who want to participate in coral reef conservation but do not yet have sufficient knowledge and the opportunity to plant coral reef seedlings directly on the seabed. Besides, the community can add "expression sentences," which can be used as a medium for writing moral messages (up to 50 characters) about everything they want to express, be it just names, messages, or hopes for the coral reef that is donated. With the web GIS, the community can easily participate in saving coral reefs so that the conservation process or planting coral reef seedlings can be carried out sustainably and it is hoped that the amount of damage to coral reefs can be reduced [9].

2. Material and Method

This research used the prototype method. It makes it easier to build and test applications. One of the stage processes is the identification of user needs. It clearly describes how detailed needs and problems occur, thus helping to list what data is needed in solving problems and providing solutions. The prototype stages include

identifying system requirements, making a prototype, testing, research evaluation, and implementation [10].

The current research is done only at the system requirement stage, and the stage makes a prototype in the form of the results of design analysis. The data source obtained is the data of coral reef reports in the Marine And Fishery Office of West Java, and data on coral reef types found in Indonesia obtained through the ilmugeografi.com, and the distribution of coral reef habitat locations throughout Indonesia obtained from the IUCN website (International Union for Conservation of Nature) [11]. After all the data is collected, the data analysis is done as a grouping of data in the application build. Explanations of these stages include:

2.1. System requirements

This analysis of user needs consists of primary and secondary data needs. For primary data, needs are obtained from observation data conducted in the Tengkulak Beach of Karawang area while for interviews conducted with the Marine And Fishery Office of West Java and farmers groups that do coral reef cultivation area. Secondary data needs are obtained from the data of coral seed planting reports by farmers and library data through the <https://ilmugeografi.com/biogeografi/jenis-jenis-terumbu-karang> page and distribution of existing coral reef types on the IUCN website through the <http://www.iucnredlist.org>. Once the data is obtained, the data processing process is carried out to produce a prototype. Data processing is required to determine the output of the application to be built [12].

2.2. Make a prototype

In this stage, the depiction of procedures/functions using structured approach methods on the grounds of depiction can be easily understood. The coral reef donation system begins by registering an account either as a community or as a company/agency. Communities/Companies/Agencies may make donations directly. After that, the selection of the location and type of coral seedling planting has been provided based on the West Java area's damage. Then, to proceed to the payment system to determine the amount of donation, the next step is for the community to make the payment stage by transferring to the registered account. In this case, the web GIS system will pass on the information to the Marine and Fishery Office for donations from the community or company to be purchased and passed on to farmers to conduct the process of planting coral seedlings. It is also designed to feature "expression sentences" with a maximum of 50 characters in the box provided. The stages of this prototype consist of 1) Selection of location, 2) Selection of coral reef, 3) Sign up/login, 4) continuous of information, 5) Coral reef donation, 6) Coral reef planting [9, 10].

3. Results and Discussion

3.1. Determination of coral reef type data

In this study, coral reef species data was obtained from the IUCN (The International Union for Conservation of Nature), a conservation agency for natural and biological resources. The IUCN website can be accessed at <http://www.iucnredlist.org>. The IUCN website's data shows the diversity of coral reefs scattered in Indonesia and the latest conditions of the reef. Information can be seen from images and tables of coral reefs. The data obtained from the IUCN Red List website is in the form of data presented in the form file as shown in Fig. 1.

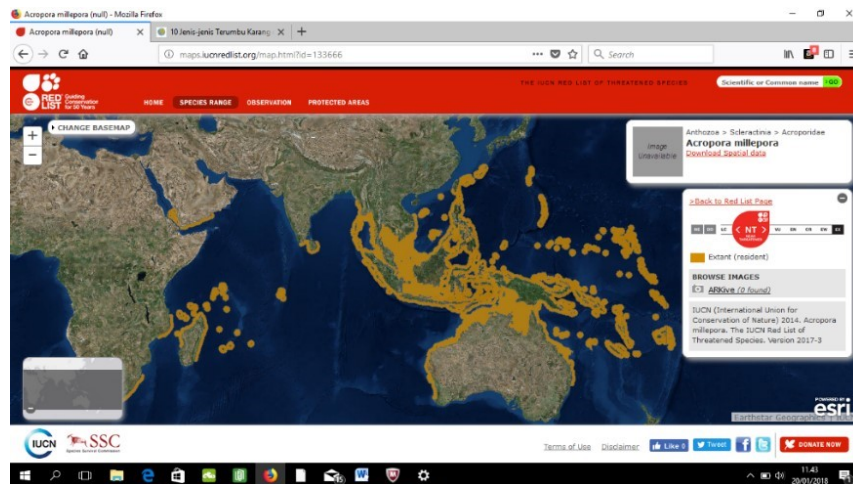


Fig. 1. Raw data from IUCN [11].

The data contained on the official website of the IUCN (International Union for Conservation of Nature) Red List consists of the distribution of habitats of each type of coral reef in Indonesia based on the <https://ilmugeografi.com/biogeografi/jenis-jenis-terumbu-karang>. As for the table below, there is an example of coral reef type data suitable for planting in some areas in Indonesian waters, taking into account temperature, salinity, water quality, and depth of flow. The type of coral reef used in the preparation of web GIS prototype "COCOSERV" is restricted to Acropora SP coral reef species, and Montipora SP is shown in Table 1.

Table 1 Genus and species of coral reefs used.

No.	Genus	Species
1	Acropora	Acropora Cervicurinis
2	Acropora	Acropora Elegantula
3	Acropora	Acropora Microphthalma
4.	Acropora	Acropora Millepora
5.	Acropora	Acropora Humilis
6.	Acropora	Acropora Grandis
7.	Montipora	Montipora Danae
8.	Montipora	Montipora Aquituberculata

3.2. Determination of the spread of the location of coral reefs of West Java Province.

Determining the planting of coral seedlings must be determined by the government's location and the community's conservation needs. We need data from the spread of coral reef conditions in West Java so that the community's donations can be channelled to locations that need conservation. The spread of coral reef conditions in West Java in 2016 is shown in Table 2.

Therefore, it can be concluded that the area of the reef is still relatively damaged. Moreover, some locations are still not well recorded. Therefore, the data collection is inaccurate for locations that have coral reef areas. The table information can determine the location of coral seed planting and provides access

for the community to donate to any damaged coral reef location or area in West Java for the plantings [9, 10].

Table 2. Coral reef damage area data 2016.

No.	Coastal Regency/City	Condition of Coral Reefs (ha)				Percentage Damage
		Large	Good	Medium	Damaged	
1	Pangandaran Regency	1974.78	987.39	197.48	789.91	40%
2	Regency Tasikmalaya	155.25	7.25	111.00	37.00	23.83%
3	Garut Regency	525.00	489.00	32.75	3.25	0.61%
4	Sukabumi Regency	1562.20	134.56	522.27	905.37	57.95%
5	Karawang Regency	2091.47	50.00	889.00	1152.47	55.10%
6	Indramayu Regency	1225.00	556.00	334.00	335.00	27.34%
7	Cirebon City	7533.00	2.224.20	2.086.50	3223.00	42.67%
Total damaged coral reef areas						35.35%

3.3. Designing GO-COCOSERV application prototype through data analysis

To raise public awareness of the importance of preserving coral reefs and assisting in facilitating coral reef conservation activities, the community must have easy access to the coral reef cultivation or conservation efforts. Therefore, a coral reef conservation service system with the name web-GIS "COCOSERV" stands for "Coral Reef Conservation." This location-based coral reef donation system on web GIS will make it easier for people who want to participate in coral reef conservation but do not yet have sufficient knowledge regarding the right planting location and the opportunity to plant coral reef seedlings directly on the seabed. In short, with the "COCOSERV" web GIS, the community can purchase coral reef seeds / donate online through the web GIS to be donated and planted by farmer agents in the location that the community wants. The location provided is the location obtained from the results of spatial data analysis about the best location for planting coral reef seeds so that it can be ascertained that coral reef seeds can grow well in that location. With this web GIS, the process of conserving or planting coral reef seedlings can be carried out sustainably, and the number of damaged coral reefs can be reduced.

3.4. The Proposed online donation application analysis design

The online donation analysis proposed is described through Data Flow Diagram, Entity Relation Diagram ERD.

3.4.1. Online donation data flow diagram

This process is needed to describe the application functions and determine who is involved in facilitating the application flow. The result is information, and it is crucial to know three basic things, namely input, process, and output, in building an application [13-15]. These three things cannot be separated from who is the application manager, especially for processing data into information. The depiction is as follows.

3.4.1.1. Entity

This section is the part that shows the parties involved in the application. In this case, the users and managers are the agencies appointed by the Agency in information management, while users want to donate.

3.4.1.2. Process

The process shows the functions that will be built into the application. In this case, it is also shown what data is needed in the process to produce output in the form of data/ information needed by the manager or user. The process as follows:

a. Conservation location

This location consists of coastal areas in West Java, which have coral reef coastal areas. In this process, the GIS function is applied in determining the coordinates of the area. Every area with damaged coral reefs will be given a red sign indicating that the area needs conservation efforts through online donations. This GIS function will be integrated into a web-based application. This process is one of the goals to make it easier to determine the coordinate point of an area of the coral reef being conserved. In this section, each coast's coordinates will be determined so that when making the application, it is easier to determine the point in the form of an image that the public can see in determining the area in the donation process.

b. Donation process.

This process consists of 2 parts, namely donating coral reefs and money. This process is a description of the services in the web application to be built. This service is provided to people who want to participate directly. In this application, the services provided are accompanied by the location of coral reefs that are damaged, making it easier for people to see areas requiring community action/efforts through direct donations with choices of coral reefs suitable for the area. Moreover, the community can enter expressions freely, which will later be planted together with the coral reef seeds.

c. Confirmation process.

This process is a process of checking by the Marine and Fishery Office to double-check whether the data entered by the community is appropriate, especially for the determined coral reef locations. In this section, the community will be given a notification that the community's donation data is correct and has been received or not. Below is the proposed Online Donation Data Flow Diagram (DFD) is shown in Fig. 2.

3.4.2. Entity relationship diagram online donation

Because building an application requires a table to store information, it is necessary to share the table. Each table will store different data according to its attributes. Moreover, in this section, we also need a relation, where this relation states each function's relationship in the application. For example, the online donation function needs a community table, a donation table, a location table, and a confirmation table. Then the function generated by the application becomes valid [16]. From this, ERD can also determine how many tables to be created. So that the results of this process provide the accuracy of the overall application function. To be able to see the diagram, it is shown in Fig. 3.

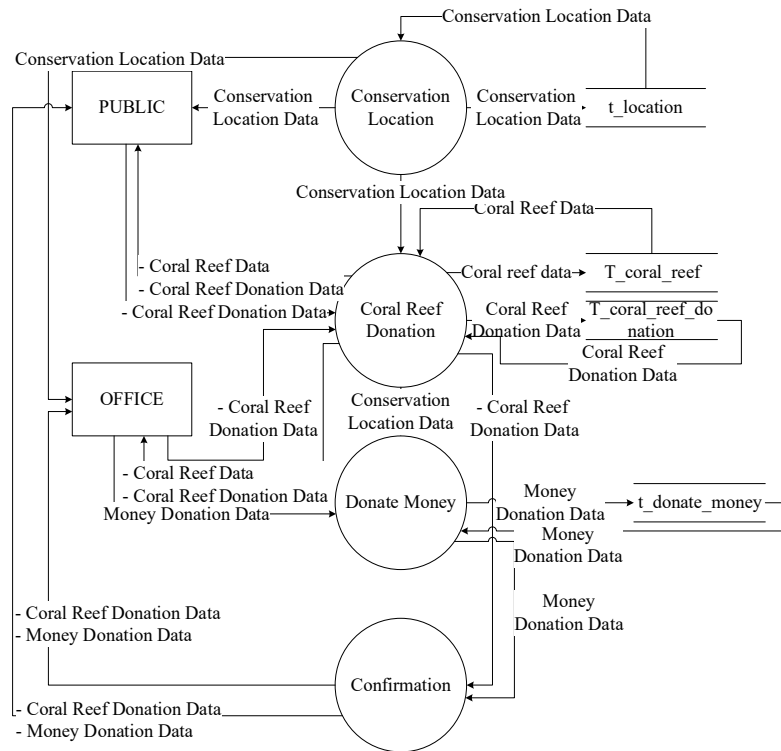


Fig. 2. Online donation data flow chart.

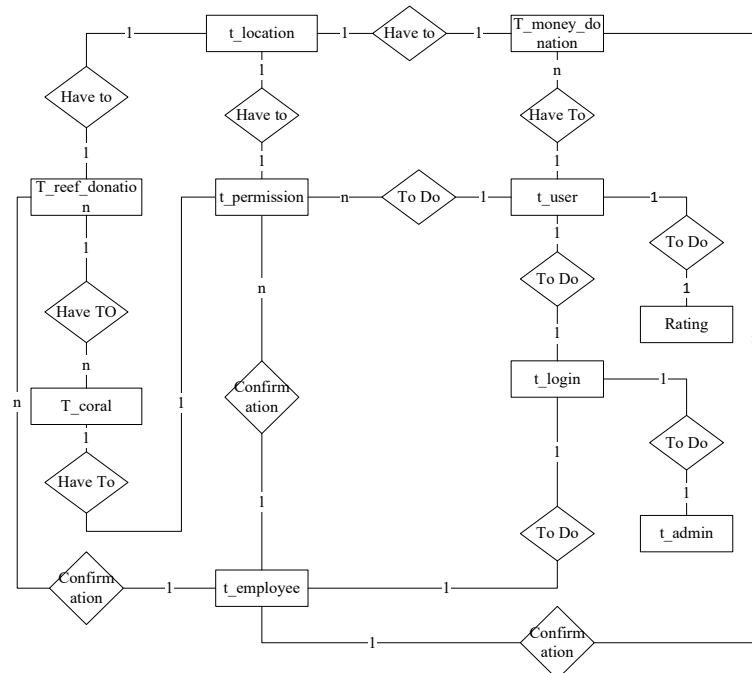


Fig. 3. ERD Online donation.

3.4.3. Prototype design of online donation application functions

3.4.3.1. Prototype GIS in application

Geographical Information Systems in online donations can be used to make it easier to get data that has been processed and stored as attributes of a location or object. The data processed in GIS consists of spatial data and attribute data in digital form. This system relates spatial data (geographic location) with non-spatial data. Thus helping create maps and to analyse the information in various ways and purposes [17]. The purpose of implementing GIS in the application is to facilitate the determination of coral reefs' location with the coordinates obtained by the GPS.

The specific objectives are as follows.

- i. GIS uses spatial data (name, identity number, and community email) and attributes in an integrated manner. Data is needed for the registration and donation process, where this data produce information in the form of confirmation from both the office and community.
- ii. GIS can separate the form of presentation and database. The presentation form in the application will include information on the area of coral reef land, coastal locations, and the area of coral reefs that are damaged or not.
- iii. GIS has a very good ability in visualizing spatial data and its attributes. Coral reefs will be visualized in two colours, namely green and red. Green means that the coral reef is in good condition, while red indicates that the coral reef is damaged.
- iv. All GIS operations can be performed interactively. In this application, every point on the map will be integrated into the donation function that will be made by the community. The public can vote for any point. In this application, donations are directed to the location of the red point.

The real application of GIS can be seen from an example of a plan to open a new land in a location/area to be used as a coral reef conservation. The database for the area used as conservation has been obtained from the respective coastal areas in West Java. The area's database is a digital map with attribute data, such as coral reef data, location/coral reef data, salinity data, vulnerability data, clarity data, and others needed to plan for conservation [18]. The depiction of the GIS function prototype in the application is shown in Fig. 4.

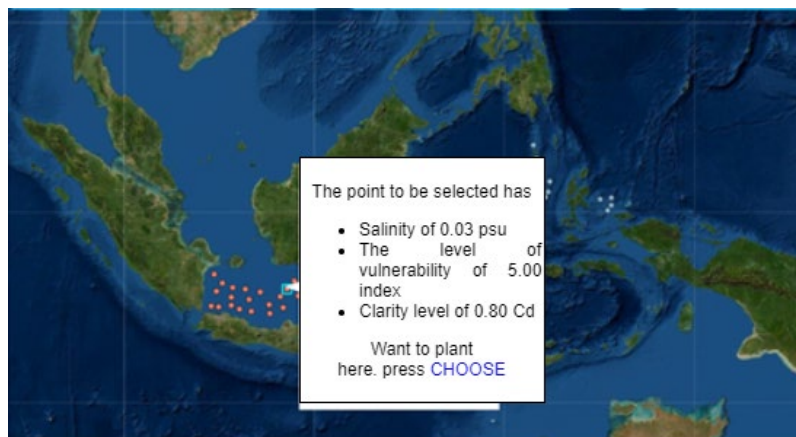


Fig. 4. Prototype SIG in application.

3.4.3.2. Online donation application prototype

3.4.3.2.1. Coral reef donation

In this donation application function, after the community determines the location for planting coral reef seeds in the application, the community will be given the following page. This page stores data on transactions carried out by the community, such as how many coral reef seedlings can be donated. The form of donation is in the form of coral reef seeds. This form consists of transaction information table data and percentage data in the form of a bar chart of community donations in each coral reef location/area. Figure 5 shows the function of coral reef donation.

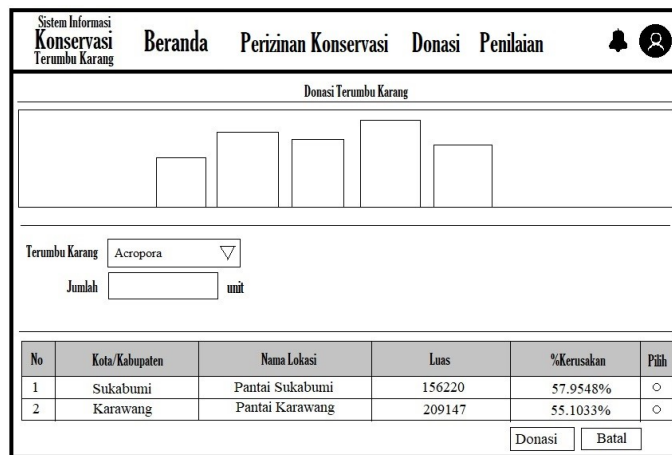


Fig. 5. Coral reef donation.

3.4.3.2.2. Coral reef donation confirmation menu

After filling in the coral reef seed donation data, the community only needs to wait for confirmation from the office to verify the data that has been filled in, so if received, the status will change from confirmation to accepted status, whereas if not accepted, the status will be given a statement of rejection, it is shown in Fig. 6.

No	Kota/Kabupaten	Nama Lokasi	Luas(Ha)	%Kerusakan
1	Tasikmalaya	Pantai Tasikmalaya	15525	23.8325 %

No	Nama	Jenis	Jumlah	Nama Lokasi	Kota / Kabupaten	Status
1	Elegans	Acropora	100	Pantai Tasik	Tasikmalaya	Konfirmasi Tidak

Fig. 6. Confirmation of coral reef donation.

3.4.3.2.3. Money donation

As for the donation of coral reefs, the only difference is that the community donates in the form of an amount of money transferred via the donation button. The donation button is used to verify data in the form of proof of transfers that the community has made. This money donation will later be allocated to purchase coral reef seeds and handed over to farmers for planting. This section also contains a table of information on coral reefs' area/location and the percentage of damage for each area, equipped with a bar chart feature for each region, it is shown in Fig. 7.

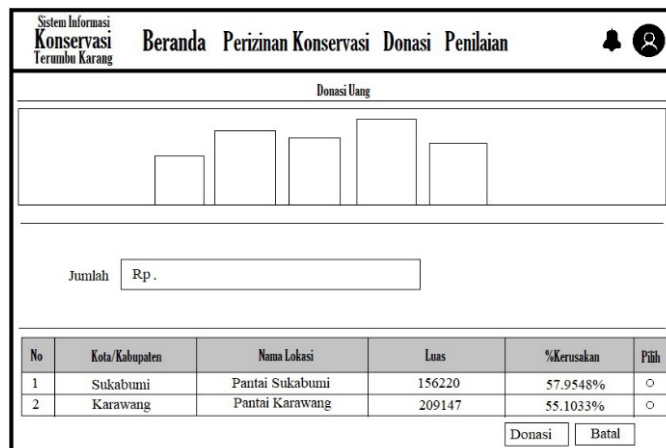


Fig. 7. Money donation.

3.4.3.2.4. Money donation confirmation menu

After filling in the money donation data, the public only has to wait for confirmation from the service to verify the data that has been filled in, so if received, the status will change from confirmation to accepted status, whereas if it is not accepted, then the status will be given a statement not accepted, it is shown in Fig. 8.

Sistem Informasi
Konservasi
Terumbu Karang

BerandaPerizinanKonservasiDonasiPenilaian



Lokasi yang akan ditanami terumbu karang

No	Kota/Kabupaten	Nama Lokasi	Luas(Ha)	%Kerusakan
1	Tasikmalaya	Pantai Tasikmalaya	15525	23.8325 %

No	User	Kota/Kabupaten	Nama Lokasi	Nominal Uang	Bukti Transfer	Status	
1	Sandi Kurnia	Tasikmalaya	Pantai Tasik	1.000.000	Lihat	Diterima	Tidak diterima

Fig. 8. Money donation confirmation menu.

4. Conclusion

Overcoming coral reef damage that occurs either accidentally due to natural and environmental factors and deliberate factors by human actions, the best effort is to provide a solution by conserving the coral reef. This effort is made by creating an application with the name GO-COCOSERV. This application aims to increase public awareness through online donations. This online donation consists of donations from coral reef seeds and donations in the form of money to buy seeds. The application is built based on the web while determining the location/area of coral reefs applied to GIS. GIS will make it easier to provide information on coral reef areas and plant coral reef seeds that require conservation in West Java. The information provided by the GIS is information on the size of the area and the percentage of damage to the area. Online donations will be applied to points in the GIS. In this application, the dots in red are points that require donations from the public. Therefore, the red dot will be integrated with the online donation function/module in the application. The final process of donation is that the public will receive progress reports on each donation given.

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