

Application of the *Kerthi Bali Economy* in a Web-Based Geospatial Visualization Information System

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Abstract: Traditional village is a unit of customary law community in Bali which has territory, position, original structure, traditional rights, own assets, traditions, and social manners of community life from generation to generation. One of the values of local wisdom that can be implemented in economic activities is Sad Kerthi, namely the six main sources of welfare/happiness of human life. The *Kerthi Bali Economy* is an economy to realize an Independent Bali in the Economic Sector, built and developed based on the values of Sad Kerthi's philosophy. Because the principle of *Kerthi Bali Economics* is a new concept, the researcher analyzes the contents and phenomena described in the *Kerthi Bali Economics* book and is associated with other economics references. At this stage will produce an indicator in measuring the economic principles of *Kerthi Bali*. There are 11 economic principles of *Kerthi Bali* that are harmonious with nature, culture and people. The development model used by the researcher uses the Waterfall Model. In this study, researchers used several stages in the waterfall model, including requirements, design, implementation, verification, and maintenance. The system design uses MySQL as the database as well as PHP and HTML for basic programming. This research succeeded in developing the Application of the *Kerthi Bali Economy* in a Web-Based Geospatial Visualization Information System. Testing the system using the Black Box Testing method, which produces all the pages tested in accordance with the expected results.

Keywords: Application, Geospatial, Information System, *Kerthi Bali Economy*, Visualization.

INTRODUCTION

In general, a village is a small community, which is bound to a particular locality both as a place to live and to fulfill their needs (Karyada, 2020). The new face of the village is a hope to accompany the enactment of Law Number 6 of 2014 concerning Villages, where the village has a new position, role, and authority (Karyada, Ayu, & Mahayasa, 2020a). The development model that used to be a government driven development system is now a village driven development system, where the village has the flexibility to regulate its activities to create an independent village (Karyada, Ayu, & Mahayasa, 2020b). The Village Law is used as a guide to form a politically and economically independent village that has a strong social, cultural and local wisdom foundation. This regulation also gives respect to the position of traditional villages. Based on the Regional Regulation of the Province of Bali Number 4 of 2019 concerning Traditional Villages in Bali, the Traditional Village is a unit of customary law community in Bali which has territory, position, original structure, traditional rights, own assets, traditions, manners of social life in the community (Wijaya, Kawiana, Wibawa, Paramita, & Karyada, 2022). Hereditary in the bond of the holy place, duties and authorities as well as the right to regulate and manage their own household. All problems in traditional villages are resolved on the principle of deliberation and consensus.

Until now, traditional villages have not been able to manage the potential to increase their village's original income. The trend of the potential village generation is more likely to choose to work in the city, causing the village to experience an intellectual resource crisis. When this situation cannot be overcome, it will have a wide impact on the whole community. In the midst of the Covid-19 pandemic situation and conditions that hit the world, Indonesia, including Bali, has changed the behavior of human life towards a new normal. The impact of

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the Covid-19 pandemic has slowed down various sectors, including the tourism sector. With the Covid-19 pandemic, it is time for Bali to reorganize the economy by balancing and harmonizing the structure and fundamentals of the Balinese economy in accordance with the genuine, including nature, manners, and Balinese culture based on local wisdom values. Through this paradigm, a new concept known as the *Kerthi Bali Economy* emerged, namely the economy to realize an Independent Bali in the Economic Field, built and developed based on the values of *Sad Kerthi's* philosophy. This concept will become a universal model for economic development that is harmonious with nature, green/environmentally friendly, maintaining local wisdom, based on local resources, quality, added value, competitive, resilient, and sustainable.

Through the *Kerthi Bali Economy*, there will be a direct connection between leading sectors and can also grow new economic centers. The capacity of the Balinese economy will increase and in the end it can benefit from increasing the welfare and happiness of Balinese Krama (*niskala*). Traditional villages in Bali have a base of communal values, such as *tegen bareng*, *sagiluk saguluk*, *nyama braya*, *pang pade payu* or can easily be equated with togetherness, which can be used as a foundation in evoking the economic spirit of *Kerthi Bali*. This is because the *Kerthi Bali Economic* policy has become a reference for national programs through the Ministry of National Development Planning of the Republic of Indonesia/ National Development Planning Agency so that information on the condition of traditional villages in Bali is needed. Traditional villages can be the subject of green, resilient, and prosperous economic development based on the value of Balinese local wisdom. Information can be conveyed through digital visualization. In other words, data visualization turns data sets into simpler things to display. The main purpose of data visualization is to communicate information clearly and efficiently to users. Through good visualization, complex data that is displayed visually becomes more easily understood by ordinary people. Moreover, effective visualization helps users in analyzing and reasoning data.

LITERATURE REVIEW

A. *Kerthi Bali Economy*

The *Kerthi Bali Economy* is an economy to realize an Independent Bali in the Economic Sector, built and developed based on the values of *Sad Kerthi's* philosophy by applying 11 (eleven) principles (Koster, 2021). The principle is as follows. An economy that is built/developed from an attitude of being grateful/glorifying the wealth, uniqueness, and superiority of Bali's natural natural resources and their contents as a gift from the Creator. An economy that is built/developed according to the potential of Bali's local natural resources and their contents. The economy built/developed by Krama Bali is inclusive, creative, and innovative (Putri, 2021). The economy that is built/developed is based on traditional Balinese values, traditions, arts, culture, and local wisdom. An economy that is built/developed by maintaining a sustainable natural and cultural ecosystem. An economy built/developed to increase the capacity of the local Balinese economy, quality, added value, and competitiveness. An economy that is built/developed by accommodating the application/development of science and technology as well as digital technology. An economy that provides tangible benefits to improve the welfare and happiness of Krama Bali on a scale-by-step basis. An economy that is built/developed on the principle of gotong royong. An economy that is built/developed to increase resilience to the dynamics of the times locally, nationally, and globally. An economy that fosters a spirit of embarrassment and love/proud as Balinese Krama.

B. Data Visualization

Data visualization or data visualization is a graphical or visual display of information and data (Angreini & Supratman, 2021). In other words, data visualization turns data sets into simpler things to display. Data visualization refers to the techniques used to communicate data or information by creating them as visual objects (for example, points, lines, or bars) in a graph. The main purpose of data visualization is to communicate information clearly and efficiently to users.

C. Geospatial

The geospatial visualization data type represents the actual form of an object, or space that has data displayed (Arisanto & Pratiwi, 2022). Geospatial visualization is usually used to show sales penetration in an area, map business growth, to show flow in a user experience (UX).

D. Data Flow Diagrams (DFD)

Data Flow Diagram (DFD) is a graphical representation that describes the flow of information and information transformation that is applied as data that flows from input and output (Karsana & Mahendra, 2019, 2021). DFD is often used to describe an existing system or a new system that will be developed without considering the physical environment in which the data will be stored.

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E. HyperText Markup Language (HTML) and Protocol Hypertext Preprocessor (PHP)

HTML comes from the SGML (Standard Generalized Markup Language) language whose writing is simplified (Apriyan & Nugroho, 2021). HTML can be read by various platforms. HTML is also a flexible programming language, can be inserted or combined with other programming languages, such as PHP, ASP, JSP, JavaScript and others. PHP or Protocol Hypertext Preprocessor is a server-side web programming language that is open source (Adrianto, 2021; Putra & Novembrianto, 2021). PHP is a script that is integrated with HTML and resides on a server (server-side HTML embedded scripting). PHP is a script used to create dynamic web pages. Dynamic means that the page to be displayed is created when the page is requested by the client. This mechanism causes the information received by the client is always up-to-date. All PHP scripts are executed on the server where they are executed..

F. Database and MySQL

A database can be defined as a collection of interconnected data groups that are organized in such a way that they can be reused quickly and easily (Ginantra et al., 2020). The main principle is data management. The main goal is the ease and speed of data retrieval. More fully, the use of databases is carried out to meet the objectives of speed, convenience, storage space efficiency, accuracy, availability, completeness, security, and shared use (Lailiya, Ginantra, & Mahendra, 2022). Meanwhile, MySQL is an open-source structured query language (SQL) database management system (DBMS) software that manages databases to quickly accommodate very large numbers and can be accessed by many users (Fadila, Aprison, & Musril, 2021).

METHOD

A. Research Framework

This research uses research and development methods that are used to produce certain products. The initial stage is conducting a study on the economic principles of *Kerthi Bali* through an unobtrusive research approach, namely an observation method that does not change behavior (Kellehear, 2020). At this stage will produce an indicator in measuring the economic principles of *Kerthi Bali*. The second stage is to develop a system to describe the implementation of the economic principles of *Kerthi Bali* in the context of traditional villages. In system development using the waterfall model, which is an application development model whose stages are structured and have several stages, including requirements, design, implementation, verification, and maintenance. The final result of this research is software for visualizing geospatial maps of the *Kerthi Bali Economy* in traditional villages. The research framework can be seen in Figure 1.

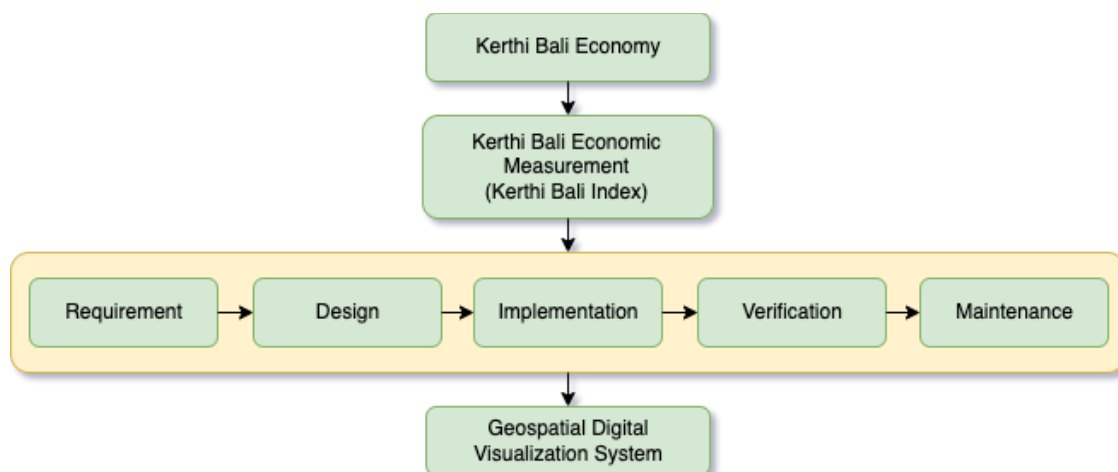


Fig. 1 Research Framework

B. Data Collection Techniques

Data collection in the development of a geospatial visualization system for the *Kerthi Bali Economy* using primary and secondary data methods. Primary data is a data collection method where data is obtained through direct information or observation to traditional villages, in order to get maximum results. This data was obtained through a focus group discussion (FGD) regarding the application of the 11 economic principles of *Kerthi Bali*, researchers went directly to the location and there would be a discussion and interview with traditional village prajuru regarding the economic condition of the village. Where the results obtained will be used as a basis or useful reference point for the assessment of customary villages. The results of discussions or interviews obtained using the primary data method are a philosophical basis for the development of the *Kerthi Bali Economy* and an element of assessment regarding the economic principles of *Kerthi Bali*. Data collection also uses secondary data

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methods where in this method researchers conduct literature studies from books, journals, and the internet in order to get maximum results about the Balinese kerthi economy to be able to develop it into a system.

B. Kerthi Bali Index

In its implementation, an assessment indicator was developed in order to be able to produce a comprehensive information on the implementation of the *Kerthi Bali Economy*. In measuring the implementation of the concept, you can use the index. In the field of statistics, the index is a method of measuring the performance of a group of data. In this research, the *Kerthi Bali* Index has been developed, which is one of the indicators in measuring the implementation of the Balinese Kerthi economy through the derivatives of 11 principles (Koster & Ramantha, 2022). The *Kerthi Bali* index is the level of assessment of the implementation of the *Kerthi Bali Economic* principles. The assessment is carried out by dividing the value of the implementation of the *Kerthi Bali Economic* principle by the total value of the principle. The following is the calculation used.

$$\text{Bali Kerthi Index} = \frac{\text{Principle Implementation Value}}{\text{Total Principle Value}} \times 100$$

The *Kerthi Bali* Index has several categories of values as follows.

0 – 40 = Very Low Category

21 – 40 = Low Category

41 – 60 = Medium Category

61 – 80 = High Category

81 – 100 = Very High Category

Each region will have a certain value, namely very high, high, medium, low and very low according to the results of the assessment. The higher the *Kerthi Bali* index value, the higher an area will implement the *Kerthi Bali Economy* that can support nature, culture and humans. With this index, a measurement system is needed in order to provide information on the implementation of *Kerthi Bali*. This system will be able to provide information according to conditions in the field so that policy makers can determine sustainable development strategy decisions.

D. System Development Method

The development of a geospatial map visualization system for the *Kerthi Bali Economy* uses the waterfall model as a framework that will be used in system development (Asmarajaya, Sanjaya, Putra, Mahendra, & Hasanah, 2021; Mahendra, 2013; Nugraha, Wardani, & Sukarmayasa, 2021). The stages of the waterfall model include requirements, design, implementation, verification, and maintenance (Mahendra, 2022).

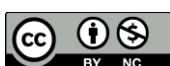
1. Requirements

In the first stage, requirements are a process to obtain and understand the software that will be produced and the limitations on the software developed. Usually, to get these results is done by using the methods of interviews, discussions, and surveys. The development of the *Kerthi Bali Economic* geospatial map visualization system is expected to allow users to register, display map visualizations, and fill out questionnaires regarding the customary village of each user who registers correctly. The system can register users online via the web, the system can visualize geospatial maps well and the system can process the questionnaire data properly.

2. Design

The next stage is the stage of doing the design before the implementation process is carried out. This stage is used to provide a complete picture of what the system has to do and how the appearance of a system is desired. The design of the *Kerthi Bali* index assessment system starts from the design stage of the Event List (EL), Context Diagram, Use Case Diagram, and the design of the geospatial map visualization system. Context Diagram or context diagram is the lowest level in the DFD which describes the system interacting with external entities. The context diagram can be seen in Figure 2. Use case diagram is a diagram that represents a system work process in general. Use case diagram of the *Kerthi Bali* Index assessment system can be seen in Figure 3. The difference between admin and user in the *Kerthi Bali* Index assessment system lies in the *Kerthi Bali* Index Questionnaire Input, which can only be done by the admin.

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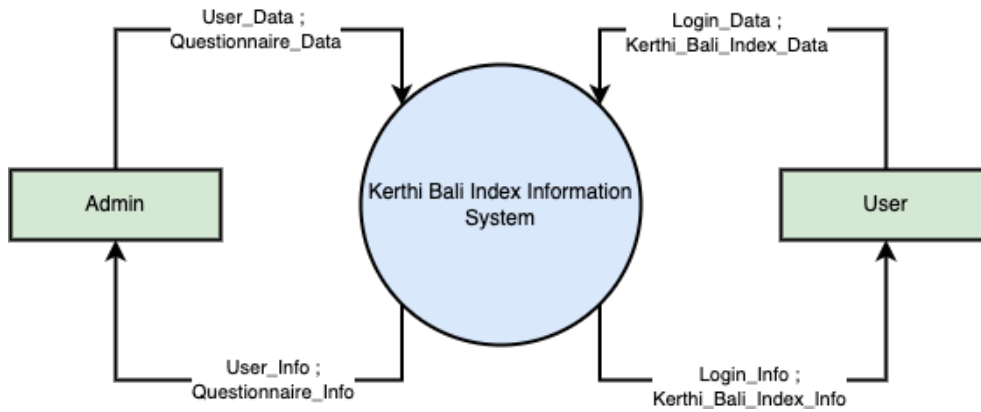


Fig. 2 Context Diagram

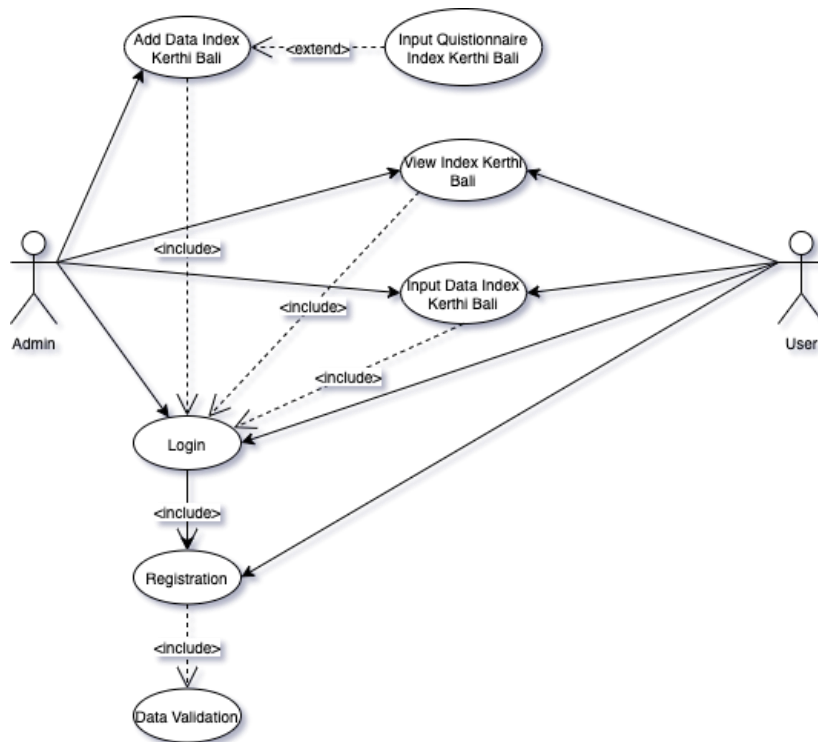


Fig. 3 Use Case Diagram

3. System User Interface Design

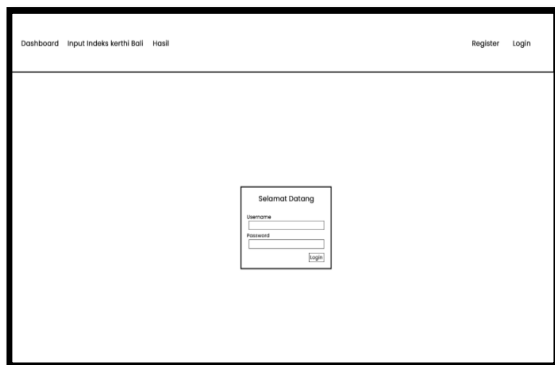


Fig. 4 Login Display Design

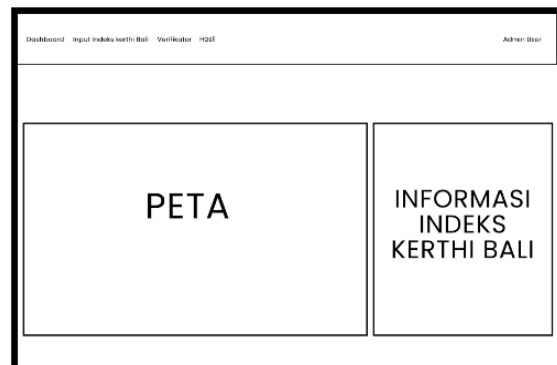


Fig. 5 Dashboard Display Design

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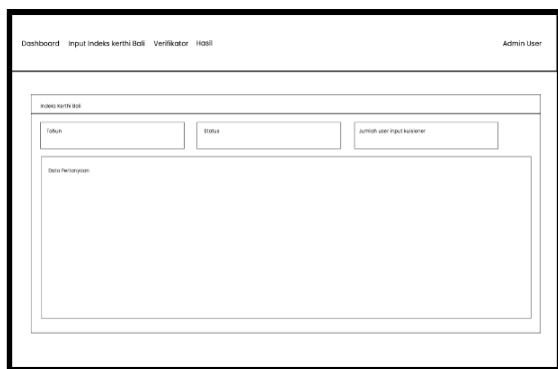


Fig. 6 Kerthi Bali Indicator Data Input Display Design

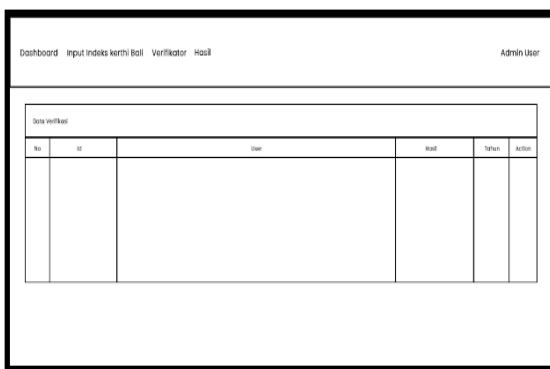


Fig. 7 Kerthi Bali Index Result Display Design

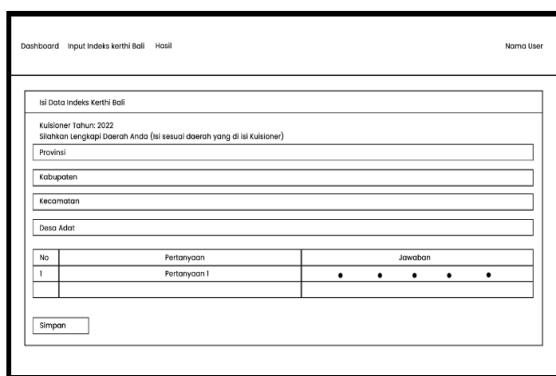


Fig. 8 Kerthi Bali Index Questionnaire Input Display Design

E. Implementation

At this stage the researcher performs an implementation of the system that will be made, by doing a coding which will later produce an assessment system for the *Kerthi Bali* Index. At this stage, coding usually uses a framework, where researchers use Laravel as the basis for the application development framework.

F. Verification

This stage is also usually called the testing stage or system testing. At this stage the results of coding the system creation which are usually still in the form of fractions will be combined at this stage and will later be tested to see whether the system created has bugs or not. If at this stage the system designed does not contain errors or bugs, then the system will then be hosted so that the system can be online and used by users.

G. Maintenance

Maintenance is the last stage of the waterfall model, namely the stages carried out in the system to carry out maintenance, so that the system is always updated, avoiding viruses, hackers and obsolete software.

RESULT

A. Research Results

This research is research on the development of a measurement system for the implementation of the *Kerthi Bali Economy*. *Kerthi Bali Economy* is an economic concept based on Sad Kerthi's philosophical values, namely an economy that is harmonious with nature and its contents and provides multiple benefits and added value directly and indirectly, both economic, environmental, social, cultural, and life added value. This concept is a new paradigm in economics that integrates and balances the order of life in order to create physical/material (scale) and non-physical/spiritual (*niskala*) welfare and happiness. In general, there are several concepts that approach the Balinese Kerthi economy, such as the green economy, and the caring economy. In the developed system where the system will be used as an indicator of data collection that will be used as a reference for the advanced Balinese kerthi economy. With the *Kerthi Bali* index assessment system and later it will be visualized into a geospatial map to make it easier for users to see the spread of the *Kerthi Bali Economy* as a whole, and later it will be able to be studied as a basis such as the *Kerthi Bali Economic* principle, namely a harmonious economy.

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B. Software Implementation

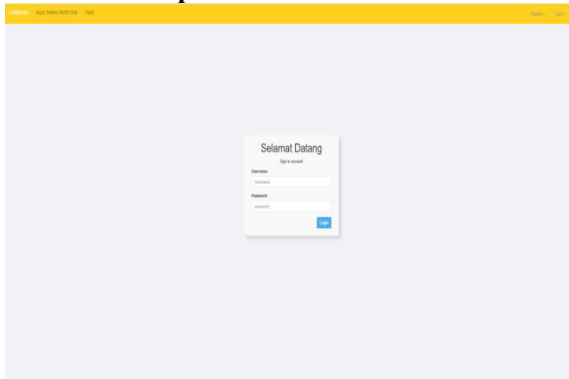


Fig. 9 Implementation of the Login Page

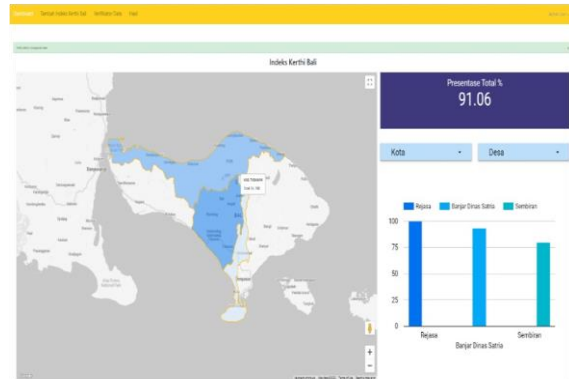


Fig. 10 Implementation of the Dashboard Page

Fig. 11 Implementation of the *Kerthi Bali* Indicator Data Input Page

Fig. 12 Implementation of the *Kerthi Bali* Index Result Page

Fig. 13 Implementation of the *Kerthi Bali* Index Questionnaire Input Page

DISCUSSIONS

The proposed application is an application that has create, read, update and delete (CRUD) operations. Based on Figure 1, there is a test case design on the main page display, with the following scenario. Based on Figure 9, a black box testing was carried out which tested the implementation of the login page, resulting in 2 test cases as shown in Table 1. Based on Figure 10, which tested the implementation of the dashboard page, resulting in 2 test cases as shown in the table 2. Based on Figure 11, which tested the implementation of the *Kerthi Bali* Indicator data input page, resulting in 2 test cases as shown in Table 3. Based on Figure 12, a Black Box Test was conducted which tested the implementation of the *Kerthi Bali* Index result page, resulting in 2 test cases as shown in Table 4. Based on Figure 12, a Black Box Test was carried out which tested the implementation of the *Kerthi Bali* Index questionnaire input page, resulting in 2 test cases as shown in Table 5.

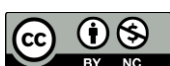
Table 1. Test Case for Implementation of the Login Page

Id	Test Description	Expected Results
TC-LG-01	Access the dashboard page by login admin. Input Username and Password Correctly	The system is able to direct the login page to the dashboard page
TC-LG-02	Give a failure display failed. Input username is wrong or wrong password.	The system is able to provide a failure login message.

Table 2. Test Case for Implementation of the Dashboard Page

Id	Test Description	Expected Results
TC-DB-01	Displays visualization of geospatial data based on the <i>Kerthi Bali</i> index data.	The system is able to display the visualization of geospatial data.

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Id	Test Description	Expected Results
TC-DB-02	Conduct data filters on geospatial data visualization based on the <i>Kerthi Bali</i> index data.	The system is able to display the visualization of geospatial data based on the filter provided by the user.

Table 3. Test Case for Implementation of the *Kerthi Bali* Indicator Data Input Page

Id	Test Description	Expected Results
TC-IN-01	On the input page of the Bali Kerti Indicator Data, displays the Data of the Bali Kerti Indicator.	The system is able to display the Data Indicator of Kerti Bali.
TC-IN-02	Create, edit, update, delete on the Kerti Bali Indicator Data Input page. The system only stores data on adjusting data types and displays warning messages if there is a mismatch.	The system is capable of CRUD on the Kerti Bali Indicator Data Input page. The system is able to store data on the right data type. The system is able to provide warning messages to improper data types.

Table 4. Test Case for Implementation of the *Kerthi Bali* Index Result Page

Id	Test Description	Expected Results
TC-IK-01	On the Kerti Bali index page, displays the Kerti Bali index data.	The system is able to display the Kerti Bali index data.
TC-IK-02	Create, edit, update, delete on the Kerti Bali Index Data Input page. The system only stores data on adjusting data types and displays warning messages if there is a mismatch.	The system is capable of CRUD on the Kerti Bali Index Data Input page. The system is able to store data on the right data type. The system is able to provide warning messages to improper data types.

Table 5. Test Case for Implementation of the *Kerthi Bali* Index Questionnaire Input Page

Id	Test Description	Expected Results
TC-QS-01	On the Kerti Bali Index Questionnaire page, displays the Kerti Bali Index Questionnaire Data.	The system is able to display the Kerti Bali Index Questionnaire Data.
TC-QS-02	Create, edit, update, delete on the Kerti Bali Index Data Input Questionnaire input page. The system only stores data on adjusting data types and displays warning messages if there is a mismatch.	The system is capable of CRUD on the Data input page of the Kerti Bali Index Questionnaire. The system is able to store data on the right data type. The system is able to provide warning messages to improper data types.

Based on the test plan that has been prepared, the following tests can be carried out. The number of pages tested was 5 pages with 2 tests each for each page so that there were 10 tests using black box testing. The results of all tests give good results, where testing of all pages has worked well as expected. Based on the test plan that has been prepared previously, the test results can be shown in table 6.

Table 6. Respondents Assessment Results

Id	Expected Results	Test Result	Conclusion
TC-LG-01	The system is able to direct the login page to the dashboard page	The system successfully directs the login page to the dashboard page	Appropriate
TC-LG-02	The system is able to provide a failure	The system successfully gave a failure	Appropriate

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Id	Expected Results	Test Result	Conclusion
	login message.	login message.	
TC-DB-01	The system is able to display the visualization of geospatial data.	The system successfully displays the visualization of geospatial data.	Appropriate
TC-DB-02	The system is able to display the visualization of geospatial data based on the filter provided by the user.	The system successfully displays the visualization of geospatial data based on the filter provided by the user.	Appropriate
TC-IN-01	The system is able to display the Data Indicator of Kerti Bali.	The system succeeded in displaying the Kerti Bali indicator data.	Appropriate
TC-IN-02	The system is capable of CRUD on the Kerti Bali Indicator Data Input page. The system is able to store data on the right data type. The system is able to provide warning messages to improper data types.	The system successfully made a crud on the input page of the Bali Kerti Indicator Data. The system successfully stores data in the right data type. The system managed to give a warning message to the wrong data type.	Appropriate
TC-IK-01	The system is able to display the Kerti Bali index data.	The system succeeded in displaying the Kerti Bali index data.	Appropriate
TC-IK-02	The system is capable of CRUD on the Kerti Bali Index Data Input page. The system is able to store data on the right data type. The system is able to provide warning messages to improper data types.	The system successfully made a crud on the Kerti Bali Index Data Input page. The system successfully stores data in the right data type. The system managed to give a warning message to the wrong data type.	Appropriate
TC-QS-01	The system is able to display the Kerti Bali Index Questionnaire Data.	The system succeeded in displaying the Kerti Bali Index Questionnaire Data.	Appropriate
TC-QS-02	The system is capable of CRUD on the Data input page of the Kerti Bali Index Questionnaire. The system is able to store data on the right data type. The system is able to provide warning messages to improper data types.	The system successfully made a crud on the input page of the Kerti Bali Index Questionnaire. The system successfully stores data in the right data type. The system managed to give a warning message to the wrong data type.	Appropriate

Although the *Kerthi Bali Economy* has a strong dimension for spiritual activity, this concept can still be measured through the principles contained in it. This principle will be applied through an action so that measurements and observations can be made on the action. In the implementation of the *Kerthi Bali Economy*, a geospatial-based visualization system was developed. Geospatial data or data referenced by coordinates on the earth's surface is important data to determine the condition of an area. Studying the characteristics of a region requires spatial knowledge in order to plan a more comprehensive solution to regional problems. Geospatial data can be visualized in the form of maps, maps help in knowing the relationship between data, namely between the attributes of objects or phenomena located on the earth's surface. Regional profile data is a collection of various kinds of data such as physical, social, economic, and cultural profiles that can reflect the conditions of a region.

The application of the *Kerthi Bali Economy* is visualized geospatially with data in the form of the *Kerthi Bali* index. The *Kerthi Bali* index is the result of calculating the application of each *Kerthi Bali Economic* principle. This system can be used by traditional villages and stakeholder policy makers. Every government policy, especially economic policy, must pay attention to the economic principles of *Kerthi Bali* and its implications for nature, culture and humans. The *Kerthi Bali* Index provides information on the application of Balinese kerthi economic principles in all traditional villages in Bali. This index assessment is calculated and can be visualized up to the sub-district level. The output of the system will display with different colors the results of the calculation of the high and low implementation of the Balinese Kerthi economy. The existence of this information will be able to become a reference for sustainable and harmonious economic policies towards nature. Balinese culture and people.

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CONCLUSION

Kerthi Bali's economy is an economic concept that is harmonious and integrated into natural, cultural and human activities. The difference with the green economy and the caring economy is in the recognition of non-material concepts (scales). *Kerthi Bali's* economy is very strong with local wisdom and spiritual values. *Kerthi Bali's* economy does not only refer to physical activity, but also non-physical activities in maintaining prosperity, happiness, harmony and also Taksu. There are 11 economic principles of *Kerthi Bali* that are harmonious with nature, culture and people. This principle can be seen and measured through people's actions in their economic activities. The application of the principle will be able to create balance and maintain Taksu. In the implementation of the Balinese kerthi economy, it can be done through observing the application of its principles. Measurement can use the index, which is a method of measuring the performance of a group of data. The measurement results are able to produce the *Kerthi Bali* Index. The measurement results of the *Kerthi Bali* Index are displayed through visualization of geospatial data, namely data that references coordinates on the earth's surface which is important data to determine the condition of an area. Visualization of the *Kerthi Bali* Index has been able to be displayed at the sub-district level. This system can be used by traditional villages and stakeholders to be used as the basis for making development policies.

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