Short Paper

FishCoral-PRSA Information System for Albay Gulf

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Abstract

Purpose – The demand for the development of information systems provides a critical role in project management considering the call towards project automation. The study aims to develop and implement an information system (IS) used to managed the assessment results from socio-economic assessment, aquatic ecology and habitat, water quality assessment and capture fisheries of Albay Gulf. The study utilized the features of Geographical Information System (GIS) to render the coordinates of sampling target sites for spatial referencing. The Rational Unified Process (RUP) model was used to design the overall design, implementation and evaluation of the system. The source code of the developed program was used to develop the test cases the results showed that the internal and external characteristics of the developed system satisfied the standard functional system requirements. Thus, the system offers the features of an information system and may serve as a model of future IS projects. Information systems played a critical role in project management. The purpose of the study is to develop an information system to database the participatory resource and socio-economic assessment (PRSA) of Albay gulf. The system features managed the requirements for socio-economic, aquatic ecology and habitat, water quality and capture fisheries assessment. The features of the Geographical Information System (GIS) used to render the coordinates for spatial referencing of targets of the different components. The BFAR as the funding agency shall serve as the administrator of the system and in support Bicol University can help in the pilot testing of the developed system to partner agencies and various stakeholders.

Method – The study used developmental type of research using Rational Unified Process (RUP). The system used PHP applications, bootstrap framework and other tools to design the functional requirements of the system. Black-box and White-box testing was used to analyze and validate the internal structures and functionalities of the system components including the full visibility of the logic and code structures.

Results – This study generated the features for socio-economic, aquatic ecology and habitat, water quality and capture fisheries components. Each component has its own user interface showing the assessment results, field activities and infographics.

Conclusion – The study provides effective and efficient interface for socio-economic assessment, aquatic ecology and habitat, water quality and capture fisheries assessment. The application of geographical information system generated the geospatial location for coral reefs, seaweed/seagrass, and mangrove sample target areas.

Recommendations – The implementation of the system will help Government agencies like DA and BFAR secure the information (especially in projects like this) and serve as reference for future projects.

INTRODUCTION

The Government in its efforts and pursuit to establish an electronic government in the country using development and innovations in ICT adopted a digital transformation strategy that will greatly improve the Philippine's governance capability, transparency and accountability, enhanced citizen's engagement, socio-economic development, and effective delivery of services to the people (Economic and Social Commission in the Asia and the Pacific (ESCAP), 2018).

Government projects have their purpose and strategies, IS support improvements in productivity, management effectiveness, facilitate client-centered environment, and the provision for quality of services. However, there are several concerns about the successful implementation of ICT projects as well as strategies to be adopted. Gichoya (2005) categorized ICT success and failure as either as driver, enable, barrier or inhibitors. The factors that affect successful ICT implementation involved Government support, vision and strategy while lack of government funds and poor infrastructure considered as major failure. Despite with the efforts and activities, IT projects still failed for several reasons. These factors include inadequately defining the project scope, lack of human resources, cost overruns, poor communication, failure to follow project auditing rules, and inadequate practices of project risk management (Mkoba & Marnewick, 2016). However, the development and implementation of an information system support the government in its goal towards integration and interoperability of ICT all across government agencies (Department of Information and Communications Technology, 2019; see https://dict.gov.ph).

The term information system (IS) refers to software and hardware systems that operate as a whole and supports data-intensive applications. It is concerned with the design, modelling, algorithms and hosting of hardware for a system to run smoothly (Elsevier, 2019). The benefits of which provides the user with updated information lead to better business productivity and efficiency, better decision making, better communication, and better data and better knowledge of customer needs. IS provides the building blocks to ICT infrastructure especially the implementation of the Government Information System Projects (GISP), Public Services Information System (PSIS) and Electronic Procurement System (EPS). These provide users with a range of government services and information useful to the public in a fast and convenient way (Information Technology and Electronic Commerce Council, 2000). In general, IS can

perform multiple tasks all at the same time which increases efficiency and productivity (Babaei & Beikzad, 2013).

The Participatory Resource and Socio-Economic Assessment (PRSA) is a project implemented under the Fisheries, Coastal Resources and Livelihood (FishCORAL) project of the Bureau of Fisheries and Aquatic Resource of Department of Agriculture (DA-BFAR). The project is in collaboration with various agencies covering three target assessment areas namely: Albay, Ragay and Asid (side of Bicol area) gulf covering several Municipalities of Albay, Sorsogon, Camarines Sur, and Masbate. Its implementation served as a mechanism to assess and address the alarming poverty incidence in fishing communities and provide protection and conservation of coastal resources. The project includes the socio-economic profiling, aquatic ecology, and coastal habitat assessments, water quality assessments, and capture fisheries resources assessment of the target sampling areas.

Thus, the system shall enable stakeholders and partner agencies provided an updated assessment and use the information for possible decision-policy making. The system covered the Albay gulf assessment results gathered from different Cities/Municipalities of Legazpi City, Bacacay, Sto. Domingo, Rapu-Rapu, Manito, and Sorsogon (Bacon District and Prieto Diaz). These assessment results come from interviews conducted and actual field assessments along with socio-economic profiling, aquatic ecology and habitat, water quality and capture fisheries. The system shall serve as a prototype model for future project-based activities. Geographical information system (GIS) was utilized to render the target coordinates for spatial referencing for seaweed and seagrass, corals and mangrove sites. It offers a user-friendly interface, easy access to system features not limited to CRUD management, updated data entry, provide GIS mapping to target sampling areas and printing solutions for prompt report requests.

LITERATURE REVIEW

The establishment of the National Computer Centre (NCC) through Executive Order 322 in 1971 pioneered the computerization project in Government. This marks a significant year which enables the Government to venture in computerization project. Unfortunately, due to lack of political leadership, inadequate funding and delays in the implementation of various ICT projects the focus was diverted on different priority concerns. Although, there were attempts to revive ICT projects such effort was accomplished in limited success (ESCAP, 2018).

The National Information Technology Plan was developed for human capital, research development, and partnership and linkages with the private sector. With the growing demand in Business Process Output (BPO) then, the objective of e-Philippines Strategy Government Information Systems Plan of 2000 was to provide a human resource for IT services and promote ICT in education and expand to community development. To further strengthen the ICT coverage in the country, the Philippine Digital Strategy (PDS)

(Department of Information and Communications Technology, 2014) envisioned to delivers trends in technology which shall make the citizenry proactive and innovative (see http://www.gov.ph; ESCAP, 2018). For example, the Bureau of Fisheries and Aquatic Resources through their Online Information System provided the latest information of the office programs and activities, news and opportunity for users to send comments and suggestions. With the benefits and opportunities of having websites, many offices including LGU's have worked on how to computerize their respective transactions. They believed that the utilization of such electronic tool allows various stakeholders to present their perceptions on public issues and could raise the quality of governance which satisfies citizen demands. These efforts promote transparency, accountability, facilitate public participation, and enhance the basic delivery of public good and services.

In 2000, the Department of Agriculture (DA) developed an internal system funded by World Bank for monitoring the foreign-assisted projects. The system offers National Information Network Kiosk (NIN) which provided linkages to various internal and local research institutions, local government units and end-users. Also, the system facilitated the access of farmers and cooperatives to agricultural and fisheries information through the Kiosk. The Department of Budget and Management (DBM) launched the Electronic Procurement System (EPS) which provides online procurement services, virtual store and registry of supplier details. The system simplifies the procurement of products of various agencies and accreditation of suppliers online. This feature allows the office perform greater efficiency, cost reduction, and transparency guidelines. The DENR maintains a document tracking and monitoring system for incoming and outgoing documents. Other systems implemented include personnel information system, confiscation database which monitors the volume of timber confiscated and Sulu-Celebes Database which record the scientific data for coliform concentration, quantity of seagrasses, and location of fish sanctuaries (Magno & Serafica, 2001). Similarly, the DSWD has document tracking system for top management and computerized personnel information system. The Department has computer-based management information system monitor the programs and activities like Day Care Center database, Early Childhood Development Project (ECDP), community-based poverty mapping system and a request and referral information system. They are just some of many line agencies which used IT to strengthen the centralization of operations and encourage people's participation in governance.

The Philippine Digital Strategy (Department of Information and Communications Technology, 2014) was developed to further improve the identified internal weaknesses encountered in the ICT strategies. Some of the weaknesses include concentrated telecom market, limited competition, low broadband penetration, insufficient ICT training and skills, lack of high-level ICT leaders in government, lack of transparency in government and others. To address the concern, the PDS for 2011 to 2016 geared towards citizen-centered governance, improve the delivery of basic services, a system which support the fight against corruption and ensure that integration and interoperability of IT infrastructure across agencies. The strategy focuses on transparency

and efficient service, internet opportunities for All People, Investing in People, and ICT industry and Business Innovation for National Development (Serafica, 2015).

Some works of literatures integrated the features of geographical information system (GIS) to capture and display spatial patterns. Maliene et al. (2011) used GIS technologies into a single analytical model, in which diverse data are 'geo-referenced' to cartographic projections. This integration makes it easy for users to mark certain geographical locations with corresponding data needed for processing needed information. GIS has the ability to handle much larger databases and to integrate and synthesize data from a much wider range of relevant criteria than might be achieved by manual method (Wright & Bartlett, 2001).

Today, the Government designed a master plan that integrated ICT network and system all over the country to promote governance and digital transformation of basic services. The plan aims to achieve "One Digitized Government" which shall enhance organization and intergovernmental coordination, address personnel and capability issues in utilizing ICTs for more efficient operations, public service delivery, and support businesses to perform more effectively. According to the report, 92.99% used websites as the primary e-Government channel for providing information and services to the citizens (Department of Information and Communications Technology, 2019).

In support of the Government thrust to improve the delivery of basic services and support the integration and interoperability of ICT across government agencies, this study aims to implement an interface that allows stakeholders especially local government units (LGU) to have free access to assessment results of the three (3) gulfs.

METHODOLOGY

The study used descriptive and developmental type of research. The development of an information system follows a methodology that analyzes and presents the necessary system requirements, data and process modelling techniques, and software testing. The system development lifecycle is a methodology in system analysis and development which assist designers to analyse and identify key system requirements. For this study, the researchers used the Agile Development – Rational Unified Process (Rational, 2001) which relates to building the essential output requirements of the system (Figure 1).
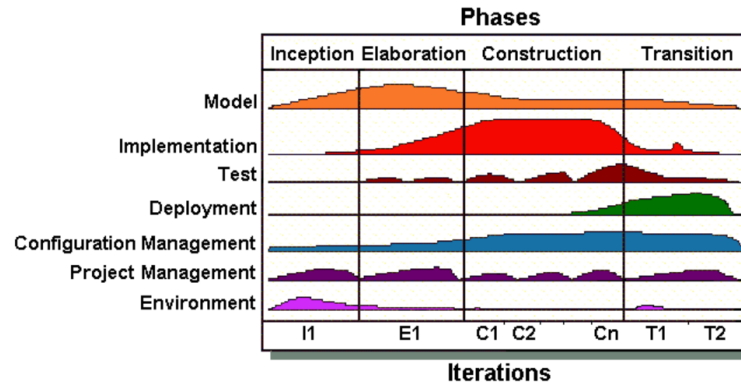
Figure 1. Rational Unified Process
source: http://www.agilemodeling.com/

This methodology involved business modelling, analysis and design, implementation, testing and deployment. It used a set of building blocks and content elements, describing what is to be produced (artefacts), deals with a lifecycle that ends with a milestone. Also, the methodology provides a specific plan for each step of the development process which ensures that high-quality in system production has satisfied the essential client requirements (Rational, 2001). An application was utilized to facilitate site validation of target coordinates for mangrove, seaweeds/seagrass, and water quality assessment.

The system architecture defines the structure of the system in terms of various subsystem components and their relationships with sub-modules and external environment (Pradhan, 2013). The PRSA environment has components for profiling, database management, report generation and individual webpage for each component (menu covering the project component results, activities and infographics). These components are linked and shared with sub-modules for data management (Figure 2).
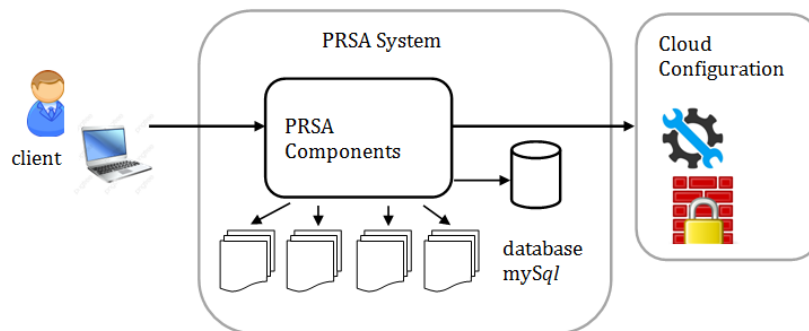
Figure 2. System Architecture

The PRSA components are linked to a cloud environment which ensures that information is remotely accessed by stakeholders. In terms of software/hardware requirements, the following technologies were used in the development of the system. These include the Apache HTTP server 2.4.17, javascript, MariaDB 10.1.13, PHP 5.6.20, HTML, CSS, Javascript technology, Bootstrap framework 3.0, GIS application (Manifold and ENVI 5.3), leaflet, OpenStreetView map and application programming interface (API).

Table 1 presents the data dictionary of managing the data of water quality database. This described the structure of the database and the relationship of the element used and other data. The system used these field parameters to store the assessment results and format the values according to field format.

A survey instrument was used to determine if the developed system has the qualities of a functional system. The software testing was used to analyze the internal and external structure, design and implementation of the system. The respondents of the system for evaluation include IT expert and potential users of the system. Table 2 shows the evaluation criteria used.

Table 1. Sample Data Dictionary for Water Quality Assessment

fieldname	Data Type	Description
Id	INTEGER(2)	reference number for WQ record
gulf_code	VARCHAR(2)	reference code for gulf (al:albay, ra:ragay, as:asid)
target_site	VARCHAR(100)	reference location of the target sampling site
Ph	DOUBLE	reference used to specify how acidic a water-based solution
temperature	DOUBLE	measurement reference for hotness and coldness of substance
dissolved_oxygen	DOUBLE	level reference of dissolved oxygen of water
conductivity	DOUBLE	measurement reference of how well a material conducts electricity
Salinity	DOUBLE	measurement reference of salt content in water
Nitrate	DOUBLE	reference for nitrate
phosphate	DOUBLE	reference for phosphorous
fecal_coliform	DOUBLE	reference of total count of bacteria

Table 2. Likert scale

Range	Description
4.1 – 5.0	Far more than the expected quality characteristics
3.1 – 4.0	More than the expected Quality Characteristic
2.1 – 3.0	Presence of the Quality Characteristic
1.1 – 2.0	Less than the expected Quality Characteristic
0.0 – 1.0	Expected Quality Characteristic is not Present

The construction of test cases allows the system to easily check on the requirement and evaluate the expected results if achieved. Software testing is a process to ultimately look for software bugs within a program or application. Since software bugs are defects in the system, this can result to poor product which can eventually lose customers once operating under business world. Nevertheless, it is imperative as nobody wants a flaw in their system to crop up (Lozancic, 2016). Thus, the survey instrument and testing method shall validate the functionalities of the system.

RESULTS AND DISCUSSIONS

The system was broken down into sub-modules. These sub-modules comprised the user management, project assessment management, and map module. The user management consists of user and administrator which are controlled by security privileges. Figure 2 shows the user login interface and error message for invalid user login attempts.
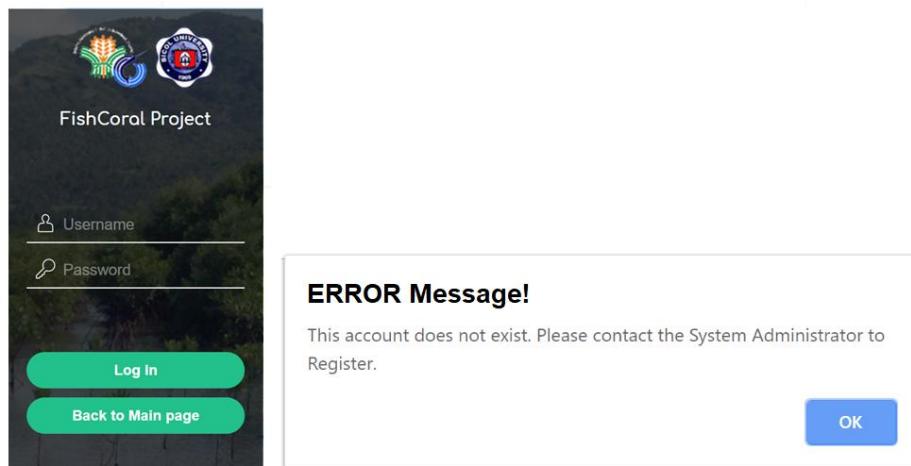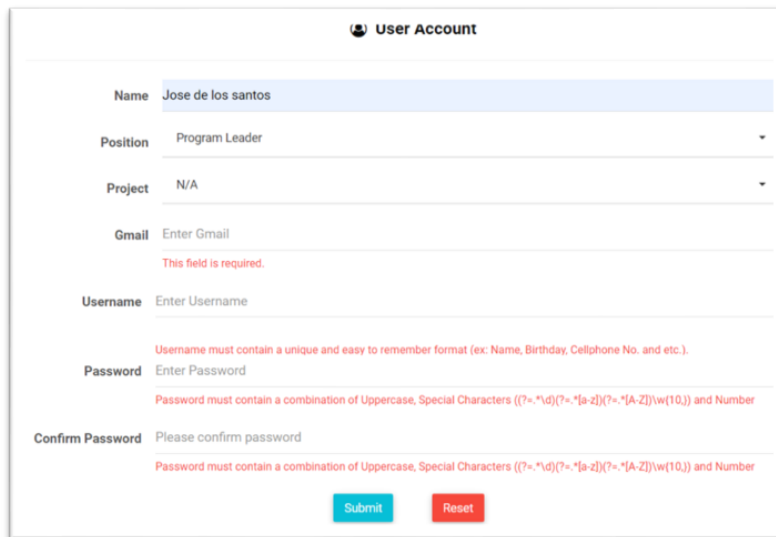

Figure 2. User login screen with Error Message displayed on invalid login attempt

User accounts are generated and managed by administrator who controls the access and monitors the activities of the user when logged-in. This shall serve as a control mechanism to avoid duplication of entries. User shall be directed to contact or approach the administrator for generation of an account. On login, the user shall be prompted to input the valid username and password and the system generates an invalid error message on incorrect login attempt. A user who has granted access shall have exclusive privilege over the information and could perform data management. This served as a control mechanism to prevent other users from manipulating the information which may corrupt the data from improper usage (Figure 3).

Figure 3. Interface showing the valid and required user entries for user account module

The project assessment management module comprised of assessment results, field action and activities, and presentation of infographics and factsheets. The features include socio-economic, aquatic ecology and habitat assessment, water quality, and capture fisheries assessment which has distinct interface and functionalities. Figure 4 shows a sample interface for aquatic ecology and habitat assessment. This interface has functionalities which showed the description of the project component, actual results gathered from different areas cities/municipalities along with corals, seaweeds/seagrass, and mangrove.

Figure 4. Aquatic ecology and habitat assessment interface

Additionally, the project management module has its feature showing pictures of the project team members. Using a light gallery plugin for jQuery, the images are fully responsive to dynamic transitions. The project management module is the user assessment sub-module which provides support to users in managing the assessment

results. The user shall be allowed to perform CRUD management, view other component information and generate reports. The interface showing the user assessment sub-module was presented in Figure 5. The overall function of the module is to assist project leaders and administrators effectively managed the assessment results.

Figure 5. Interface to store and manage fish species assessment results

A customized feature for socio-cultural, economic and institutional policy, aquatic ecology and habitat, water quality and capture fisheries were designed to attain the objectives. Each component has its distinct features catering to the activities of the project. The management and control of assessment results are exclusive to registered users. However, information about other components shall be available for viewing only. Information shall be inputted and recorded per project component. The information displayed in the component results reflects the actual information stored in the database. The details are stored according to the summary results per Province, Municipality, and Barangay. Information shall be temporarily saved every after entry and shall be automatically saved to the master database after actual form submission. Thus, in the event of any unwarranted system occurrences, users could limit the effort in repeating their input and directly modify the saved record. This feature shall be true to all components to maximize the efforts in reducing the time for checking user entries.

Figure 6 shows the admin module for seagrass and seaweeds species which allows the user to perform updates on existing information. Sometimes, we lose track of what we are doing and in many situations, we tend to go back where we started the process. The purpose of the update module is to keep track of the information and store the accurate details.

Figure 6. Admin module for Seagrass and Seaweeds Species

It shall be observed that records on-display represents those species collected or found within Albay gulf only. Similarly, records for water quality are arranged based on the date the records were submitted. Still, the records can be displayed in ascending or descending order (Figure 7). The parameters recorded for water quality assessment results include pH, dissolved oxygen, temperature, conductivity, salinity, color, nitrate, phosphate, total suspended solids, and fecal coliform.

Figure 7. Interface showing the water quality existing records

For capture fisheries and resource assessment, the system managed to record the details for catch and effort which includes gear inventory, catch rate and production. To enhance the process of recording, the researchers devised an approach which simplified the process. In the selection option, the gulf name shall be selected first which triggered

the province, municipality, and barangay option to be in the automatic state. That is, this shall display the appropriate options managed by the program. The results from capture fisheries resource assessment include the fishing gear used per month and calculated catch rate. Thus, the user could navigate and provide options for the type of fishing gears used. The selections for fishing gears are in their local name (i.e. Baklad, Ispat, Kati (tina-tina), etc) (see Fig. 8). Entries should be in number values and negative values are also accepted. The system also recognizes NULL and zero entries for each parameter.

Figure 8. An interface showing the capture fisheries resource assessment with adding feature

Report Generation

Report generation is an integral component of an information system. This improved the quality of providing accurate records, reduce errors, and minimize costs. The system makes use of the available tool to generate the reports in format with extension .xls, .pdf, .csv and direct printing. In Figure 9, a generated sample report for water quality was produced in Excel format.

Gulf	Location	pH	Temperature	Dissolved Oxygen	Total Suspended Solid (TSS)
Albay gulf	Opening Puro River	8.12	28.25	6.37	22.62
Albay gulf	Opening Yawa River San Roque	8.09	28.27	6.25	23.2
Albay gulf	Open Water,Buhatan	8.12	28.15	6.28	23.45
Albay gulf	Open Water Cawit, Manito	8.14	28.3	6.59	23.44
Albay gulf	Center (Open Water) Poliqui Bay	8.13	28.36	6.68	23.46
Albay gulf	Open Water Cawayan, Manito	8.13	28.55	6.46	23.34
Albay gulf	Open Water Poliqui Bay Banquerohan Area	8.11	28.36	6.55	23.36
Albay gulf	Misibis Bay Midway Bacacay - Rapuranu	8.15	27.91	6.29	23.68

Figure 9. Sample report generated in Excel format (.xls)

The values therein are the actual summary reports taken from the water quality report. In Figure 10 shows the ready to print water quality report. The report was

arranged based on the date the entries were inputted in the system and user preference. However, printing by preference shall be made before printing.

Figure 10. Ready to print water quality report

An on-screen display report is another option that the system has provided. This feature is very common yet it gives prompt and direct output to the user. Figure 11 shows the sample on-screen report generated for coral (live form). The major category percentage cover for Albay gulf was presented. The total percentage comes from the actual values of hard coral, dead coral, soft coral, other organisms, algae, substrate, and TWB.

Figure 11. Sample report generated for Coral (live form)

Along with other project components, this interface represents the main description which takes the overall appearance of the process. Simply means, selecting the

accordion button would display the details of the target sampling site. In Figure 12 shows an example where details of mangrove assessment accomplished in Buyo, Legazpi City was presented. This gives the user a clear description of the mangrove species found, number of stands, density, relative density, and others. Also, the general comment was provided which gives the user updated information and opportunity for updates. A similar report interface was presented in Figure 13 for capture fisheries resource assessment.

MANGROVE ASSESSMENT
⚲ ALBAY GULF   ◉ RAGAY GULF   ▲ ASID GULF

Albay , Legaspi City

Buyo

[Copy] [CSV] [Excel] [PDF] [Print]   Search:

Mangrove Species	No. Stand	Density	Relative Density	Frequency	Relative Frequency	Basal Area	Relative Dominace	Important Values
Rhizophora apiculata	28	5600	100	1	100	2.68	100	300
TOTAL	28	5600	100	1	100	2.68	100	300

Showing 1 to 2 of 2 entries

Previous [1] Next

No. OF PLOTS : 2
PLOT AREA : 25
TOTAL AREA SAMPLED: 50
HA. : 0.005

GENERAL COMMENTS : Fringing, refo. Area purely R. apiculata, the landward side dominated by Nypa, deep mud soil extended up to 100 meters, inability to trap mud soil,lack of Avicennia and Sonneratia spp., condition is good.

[✎ Update Informtaion]

Figure 12. Sample interface displaying the summary count, RD, RF,BA,RDom and IV

CATCH RATE - CAPTURE FISHERIES RESOURCE ASSESSMENT

⚲ ALBAY GULF

Albay , Legaspi City

Bgy. 50 ? Padang (Bgy. 60)

Show 10 ▾ entries   Search:

Fishing Gear	Category	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov
Pana	Hand Instruments	11	9.5	8	6.5	5	4.5	3	2.5	3.5	5	7
Panagun-has	Hand Instruments	1.5	2.5	4	7	8.5	13	10	7.5	6	3	2

Figure 13. Sample interface displaying catch rate of fishing gear per month in Albay gulf

Other information includes catch and fish landing statistics, catch per unit effort (CPUE) of fishing gears and fisheries production disaggregated to dominant species by Municipality and by fishing gears. Likewise, boat inventory is also included as part of the gear inventory which displays the types of fishing vessels used, gross tonnage, and horsepower per Municipality.

In Figure 14 shows the graph generated for water quality assessment. The parameters displayed include the color (TCU), Dissolved Oxygen (mg/L), Fecal coliform (MPN/100 ml), Nitrate as NO_3-N (mg/L), pH (range), Phosphate (mg/L), temperature (^oC) and Total Suspended Solids (TSS, mg/L). The data are collected in fifteen (15) sampling stations of Albay Gulf with the use of geographic information system (GIS) map tool.
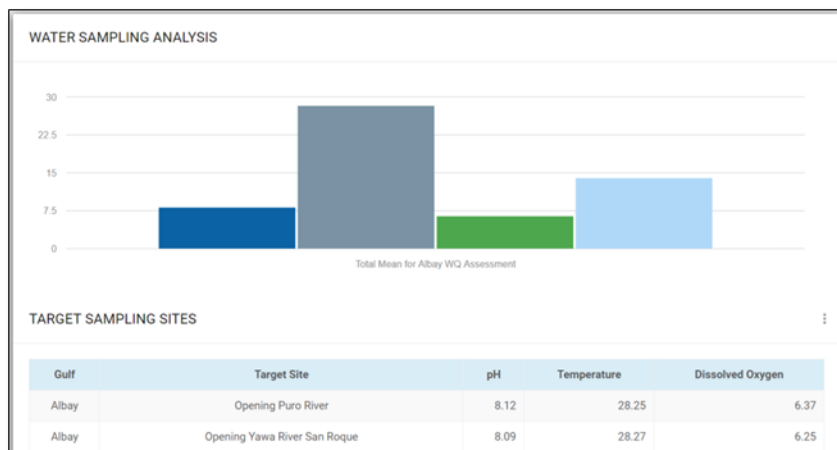
Figure 14. Graph showing water quality assessment in Albay gulf

Geographical Information System (GIS)

The use of GIS applications had been used as a standard tool for environmental assessment and analysis. In the system, the GIS application supports to facilitate map rendering and generated the coordinates of target sampling sites for corals, seaweed (sw)/seagrass (sg), mangrove, and water quality. Figure 15 shows the location of some sample target sites in Albay gulf using Openstreetview map generated by leaflet API. The balloon marker indicates the covered areas in Albay gulf.

Figure 15. Generated GIS map with some sample target sites

To facilitate the generation of coordinates for corals, sw/sg, water quality, and mangrove, the researchers used some GIS applications such manifold, NV, and ArcGIS to produce the map (Figure 16).

Figure 16. Map showing the corals, seaweed/seagrass and mangrove sample target sites for Albay gulf

The generated image map produced by satellite reveals the coordinates and existence of mangrove (green color), corals (orange) and sw/sg (yellow) in Albay gulf. These served as a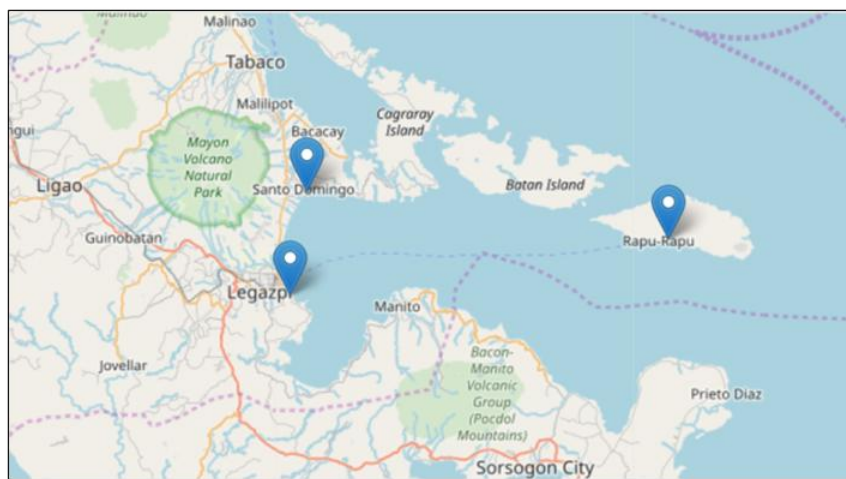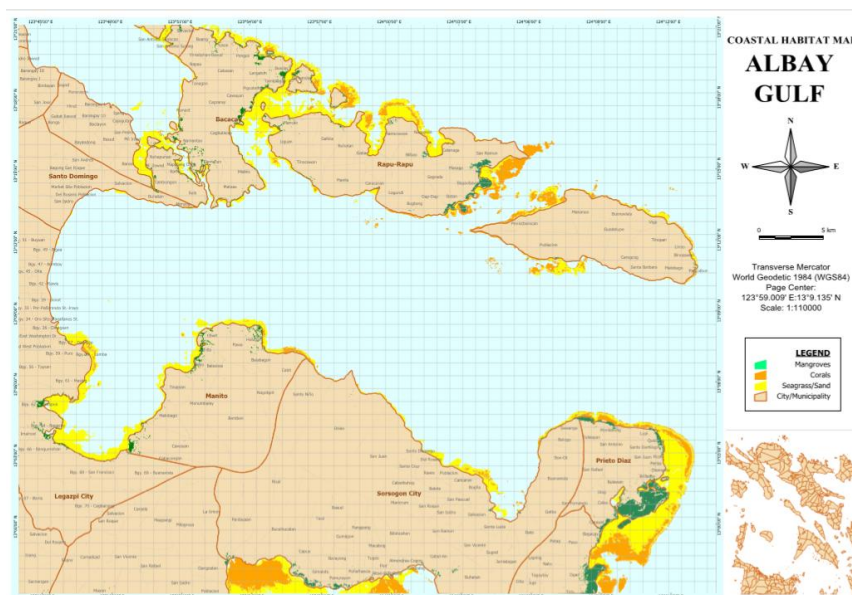 baseline to identify the approximate location of the sample target sites. Project teams shall be guided and be able to come up with the best strategy to accomplish the objectives. This shall improve the planning strategy and predict possible precautionary measures before field actions.

System Evaluation

Majority of the respondents are 25 years old below and they are all single. The respondents are IT experts, IT graduates and computer users who are considered a potential user of the system. The 50% of the respondents are male and the other 50% are female.

The features of the system were evaluated based on a set of criteria. As a result, the developed system has delivered the expected deliverables or executed *more than the expected quality characteristics (4.09)* of a system. Table 2 shows the evaluation results of the developed system. Majority of the criteria have achieved far more than the expected quality characteristics of a system. The reliability, usability, efficiency and portability have an average mean of 4.13, 4.13, 4.25, and 4.15, respectively (shown in Table 3). This means that the developed system have satisfied the quality standard of a system.

Table 3. Evaluation Results of the Developed system

Criteria	Mean
Functionality	4.00
Reliability	4.13
Usability	4.13
Efficiency	4.25
Maintainability	3.93
Portability	4.15
Overall Mean	**4.09**

The study used software testing method to analyze and validate the internal structures and functionalities of the system components including the full visibility of the logic and code structures. An IT expert in the field who is not a member of the project evaluated the system based on presented test cases. There were recommendations presented during the stakeholder's meeting which was incorporated in the fine tuning of the system. Some of the recommendations include security of the information and the system in general, makes the interface easy and readable, procedure to access the system, in case of updates how these data will be updated, and the rest concerning the administrative function.

In white box testing, the branching and statement testing was used to validate the internal requirement of the system. Table 4 showed the results of branch testing after evaluating the test cases. The design of test cases was specific procedures of the system.

Table 4. Results of Branch Testing with Test Cases

Test ID	Description	Actual Results
1	if not isset(var) display alert else register the variable as session	PASSED
2	read gulf	
	if no Municipality or Barangay is active assign given area, if area is active then call a mysql query of said area then display the result	PASSED
3	execute sql query	
	count the number of records per area	
	do the loop	
	assign the field variables to different parameters	PASSED
	do the computation then divide the results by records count	
	prepare the chart tables	
	display the chart with values	

The system used applicable local and global variables necessary to determine the scope of the variables (Table 5). These variables together with other parameters were used as a reference to execute the procedure. The identified test cases represent the

majority of the processes involved in storing data entries, error message alert, SQL queries, collecting data values and transform these values into graphical representation.

Table 5. Results of Statement Testing with Test Cases

Test ID	Description	Actual Results
1	Assignment of labels as variables are related to project (*ie. gulf, temperature, transect, etc.*)	PASSED
2	Statement syntax and delimiters was appropriately applied	PASSED
3	Top-down coding approach was properly used	PASSED

In Black Box testing, results showed that the features of the developed system was effective and attained the expected outputs (Table 6). This can be seen from the fact that upon testing, the user was able to manipulate the system and generated the expected results of each component.

Table 6. Results of Black box testing

Test ID	Description	Actual Results
1	The system provided information for acceptable values	PASSED
2	Values are accepted based on given entry label and in case of unfilled entries an error message displayed	PASSED
3	Only authorized user can add information, but did not limit to view the information of other project components	PASSED
4	When user clicked the Save or Submit button the system responded and prompted an alert message	PASSED
5	Printing of reports are included and available when needed	PASSED

Furthermore, the results have accomplished the provision of user acceptability, interactivity, error messages and attained the expected output.

CONCLUSIONS AND RECOMMENDATIONS

To provide efficiency in handling complex types of data, it is necessary to develop and adopt an information system (IS). The socio-economic, aquatic ecology, water quality, and capture fishery components have successfully designed the interface and tested the test cases. System access was successfully validated and provided security procedures for user requests. The results and findings are encouraging. Thus, there should be a more comprehensive data gathering tool that should be introduced to capture a wider range of parameters that affects coastal habitats in different season, use data mining to analyze the reports of socio-economic trends and other components depending on given or acquired data sets, and develop a real-time collection of data through system integrated hardware devices.

IMPLICATIONS

The mission of the Government is to bring its services closer to the people such as free access to information and support government agencies. In support, the developed system can help Local Government Units, stakeholders and the community relative to socio-economic resources, aquatic ecology and habitat, water quality, and capture fisheries resources of Albay Gulf. The information will serve as basis in crafting LGUs respective coastal resource management plan.

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