

# Agricultural Geographic Information System for Pangasinan

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**Abstract** – Agriculture’s importance in the sector of living takes a big part. The Agricultural Geographic Information System (AGIS) was made for Pangasinan’s agricultural sector enabling the access and analysis of data on the crops being planted or harvested depending on the factors that affect the yield. Data were gathered thru series of interviews with the persons involved and had intensive research in line with the topic. Geographical Information Systems were primarily made to be able to access, process, and present data in different fields of living. It is also a tool that could be used for crucial decision-making. The developers then used a mixed-method type of research design with the rapid application development methodology to guarantee that the evidence obtained allows the developers to effectively address the study’s objectives logically and explicitly as possible. With the phases the methodology used, it enables the developers to construct a geographical information system for the province’s agricultural sector. The features based on the requirements of the system constructed will enable the users to produce reports regarding the problems that could arise. It is then after the users accepted the system from the different tools the developers used to test the acceptability of the system.

**Keywords** – Agricultural geographic information, repaid application development.

## INTRODUCTION

Rice is a staple food in most countries. It is estimated that 40% of the world’s population use rice as a major source of food, ninety percent of the population in the following countries such as Bangladesh, Burma, Sri Lanka, Vietnam, and Kampuchea rely on rice as their major intake. In the 2017 Agricultural Sector Report of the Educational Management Information System, it was reported that the Philippines had an 8.8% contribution on the national gross domestic product (GDP) in the sector of agriculture and forestry and grew at an average of 2.6% annually according to NEDA (2011). It was also stated from the 2013 CountrySTAT of the Philippine Statistics Authority, 50% of the agricultural sector depends on crops, hence, crops play an important role in the agricultural sector of the country. Furthermore, rice production is 22% which is the highest among all crops in the country, making rice crops valuable in the agricultural sector of the country.

Pangasinan covering 160.7 thousand hectares of agricultural land, the province has 49.7% of the total farms in the region making Pangasinan the highest sharing province in terms of arable land not only in the province but also in the entire country. In support, FoodEvolution (2017) stated that the province of Pangasinan is one of the top-performing provinces in terms of rice crop productions and was awarded the National Rice Achiever’s Award.

In the succeeding section, the factors are to be considered in identifying suitable crops.

### I. Soil Type

Soil is the primary production factor and at the same time a working instrument and a working objective. Furthermore, soil organisms also affect the quality and quantity of crops that are produced in a certain season. Agriculture involves a set of soil and climate conditions to be able to have a better yield of the crop. Moreover, it is discussed that relatively constant natural conditions include climate, hydrological relations, height above sea level, exposure, and soil type [1].

### II. Climate

The Philippines has been experiencing many calamities every year and the sector of agriculture is so much affected. These natural disasters have negative economic and environmental impacts on the affected areas and the people who live in the areas [2].

Moreover, agricultural and natural resources are highly vulnerable because they are directly exposed to calamities and their unwelcome consequences. An analysis of the impacts of the typhoon, floods, and droughts on agriculture provides catastrophic consequences for living things in the vicinity.

From 2004 to 2010, the country had experienced 18 typhoons per year. It was reported to have 274 calamities for the past two decades making it the fourth disaster-prone country in the world [2]. Between 2003 and 2016, an accumulated \$3.8 Billion damages and losses were caused by natural disasters, mainly typhoons. As an

outcome, the Philippines is also experiencing floods which is also the main factor in the production of the yield of the crops. In addition, the country is also experiencing droughts in different regions.

From 2000 to 2010, the national agricultural area affected by typhoons, floods, and droughts in the Philippines has been trending upwards. A total area of 1, 461, 608 hectares were affected for the year 2006. Hence, it produced total agricultural damage of P106, 882.00 and crops wherein, rice and corn crops were highly damaged.

Climate factors affecting agriculture include temperature, sunlight, radiant energy wind, etc. It helps the crops of a geographical area grow faster and with better quality or not. The Philippines is a tropical country makes it suitable for more crops to be planted and harvested due to its climate condition and soil type.

### III. Equipment

With the agricultural land, water is essential to increase yields. In the Philippines, the National Irrigation System service has been servicing 663, 209 hectares from 1990 to 767, 006 in 2010. In addition, of the 3.126 million hectares of irrigable lands, 75% were irrigated in the wet season, and 70% in the dry season, and 2% in the 3<sup>rd</sup> season which gives an accumulated 146% of the increase in rice crops yield.

Aside from watering technology in agriculture, machinery is also important in terms of the yields of the crops. The use of machines nowadays can make the farmer cultivate more than 2 acres of land with less labor [3].

With the factors listed that affect the production of the yield of crops like rice, it is just a critical role for the government to be able to have good decision-making for the province's supply in terms of a specified crop like the rice, corn, and watermelon. The developers then wanted to help the provincial government of Pangasinan, the Philippine Statistics Authority – Pangasinan Branch, the farmers, and the future developers in line with this kind of topic. The developers then came up with a system entitled "Agricultural Geographic Information System (AGIS) for Pangasinan", a system mainly to total the hectares harvested or planted, the production in metric tons, and the total yield of the crop selected.

## MATERIALS AND METHODS

To ensure that the evidence obtained enables the developers to effectively address the study's objectives logically and unambiguously as possible, the developers used the mixed-method type of research design together with the rapid application development (RAD) methodology.

The following are the phases of the RAD Methodology:

**Requirement Planning.** Interviews from the clients and probable users of the system would be essential to be able to gather data and plan for the requirements. The developers gathered data through series of interviews with the Provincial Rice Research Officer together with the High Crops and Vegetables Provincial Officer, and have some analysis on the manuscripts available in line with a topic for gathering the requirements of the system. The objectives of the Requirements Planning stage are to establish a general understanding of the business problems that surround its development and eventual operation, to become familiar with existing systems, and identify the business processes that will be supported by the proposed application [11]. After, the developers conducted intensive research on what should be the requirements need by the Department of Agriculture based on the data gathered during the interviews. Upon having the final requirements done, the next phase will take place.

**User Design.** The User Design stage should be able to produce a model for the detailed system area, an outlined system design, and an implementation plan. This phase should be able to analyze in detail the business data associated with the proposed system area, develop the system structure in terms of the automated and manual functions that will comprise the system, proposed screen layouts for the most important automated functions, select the appropriate construction approach for the system and be able to prepare a work plan defining the steps necessary for the transition of the system, the effort required to perform these steps, and a schedule by which these steps can be completed. The developers made a model system of the AGIS and then developed an outline model with the requirement planned during the first phase. Then, the plan for the implementation was made while refining the system design. Upon finalizing the design of the system, the developers then started to construct the system.

**Construction.** The design of the proposed system, initially described in the user design stage, is completed in the construction stage, and application software to implement that design is developed and tested. Activities to prepare for the transition of the system to production status are also performed [11]. Automated functions on the software were implemented and tested. The developers populated the data needed in the system that will test the inputs and will verify the operational capacity of the system.

**Implementation.** The system that was developed in the construction phase becomes operational in this phase.

The developers at this phase prepare existing data for the new system and train the users to operate the new system. The developers also would provide support to resolve any problems that could arise when the system is operational. It is also in this phase that the conversion of the existing data sources to the information necessary to the system.

## RESULTS AND DISCUSSION

### A. Data Needed for the System

To identify the data needed for the system, the Agricultural Geographic Information System (AGIS), the developers conducted research and interview with the concerned persons of the study. Articles from online resources of IRRI and PhilRice had been reviewed and studied. The developers also conducted series of interviews with Ma'am Rita A. Prieto the provincial rice research officer of the province of Pangasinan. Ma'am Prieto is the one in-charge in gathering data from the municipal agriculturist and making annual reports with regards to the production of crops especially rice of the province.

As an individual entity, the developers should have a separate record of when the crop having been planted is in its harvesting period. In the harvesting period, to be able to know the production of the crop in a specific weir, you should be able to know the hectares covered by the crop being harvested and the production of the weir in terms of metric tons to be able to know the yielded production of the crop in the weir.

Given the total yield, the provincial government can be able to decide terms of the crop production, e.g. export, import.

### B. Functional and Non-functional Requirements

The functional requirement describes the core functionality of the system. This section includes the data and functional process requirements. Moreover, functional requirements essentially specify something the system should do [9]. Generally, the Department of Agriculture – Pangasinan Provincial office is the source of the specified and derived requirements.

The developers consider the following as the functional requirements of the AGIS for Pangasinan:

- Adding Weir (polygons) on the maps – The system should be able to draw weir (polygons) on a certain map provided in the system, for it will be the main portion where information will be added.
- Adding Information to the weir (polygon) of the farm - data needed in such weir must be provided by the user.
- Adding Farmer's Information - system could also add information to the farmers that are in charge on

lots of the farm. Here, contact number forms are provided to have faster communication with the farmers.

- Analyzing the data inputs - The system must be able to automatically add the data inputs of the weir (polygons) and be able to come up with the totals needed for the decision-making of the department. Data gathered will be presented in graphs for more comprehensive decision-making.

The non-functional requirements are restrictions on the types of solutions that will meet the functional requirements. It is also for the system concerns with how well the system performs. In addition, non-functional requirements cover all the remaining requirements which are not covered by the functional requirements. And the following are the non-functional requirements of the system:

- Usability - The AGIS is easy to use for the levels of its users for it provides a browser-based system.
- Security - The way to access the authentication is secured enough for normal users who cannot see the login button but must be able to click certain keyboard strokes to be able to show the authentication page. Here, the security of the system would be better for the normal users who will not have the capability to access the embedded system for it will be hidden from the website itself.
- Accessibility - The AGIS is available and can be accessible every time. The system will be uploaded to the web and as long as the server is working, the system can be accessed by the users of the system.
- Flexibility - The AGIS is flexible for future integration and enhancement. Moreover, it uses the material design in the system's interface to have a clearer and user-friendly interface.
- Reliability and accuracy - The AGIS is reliable in performing its task and perform accurate computation on the totals accordingly. The capability to automatically compute the yield of a certain crop, gives the system its reliability for it will reduce the human-related errors in terms of computation that produce the accuracy and reliability of the system.
- User-friendly - AGIS uses the material design in making the system for it is now the trend and can be understood clearly by the users for it is simpler and clearer. Having the clear and clean user interface, it will allow, the users to understand more the context of the system.

C. Features of the system

The following represents the figures of the system:

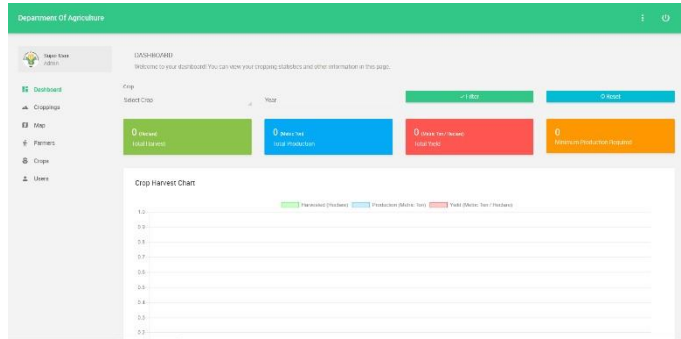


Figure 2. Dashboard

Figure 2 shows the dashboard of the system where graphs will be used to represent the data analyzed and processed from the inputs of the system.

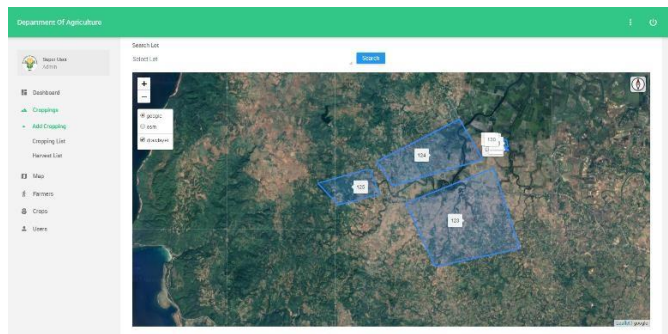


Figure 3. Maps Tab

Figure 3 represents the capability of the system to draw polygons where the information will be added.

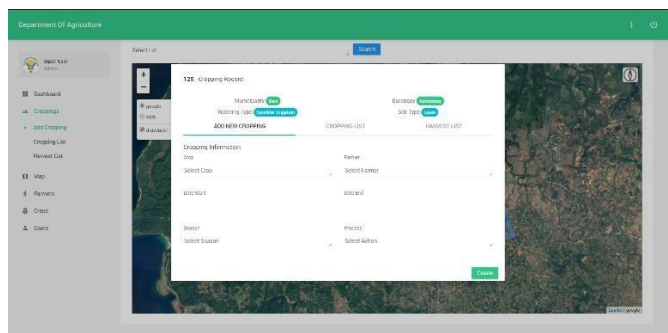


Figure 4. Add Cropping Tab

Figure 4 shows the forms that will be fill-out by the users of the system that can produce records for the polygons and will be used for decision-making purposes.

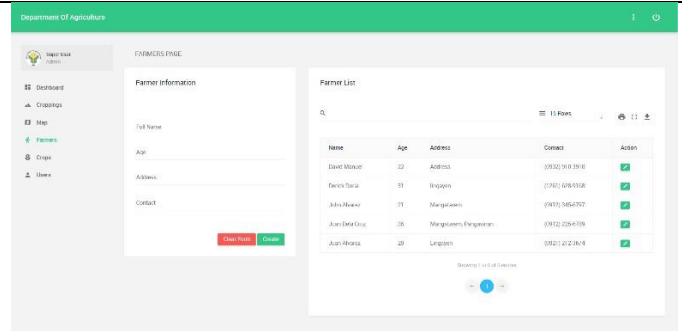


Figure 5. Farmers' Tab

Figure 5 shows the forms where information about the farmers will be input, beside it is the table that shows the list of farmers.

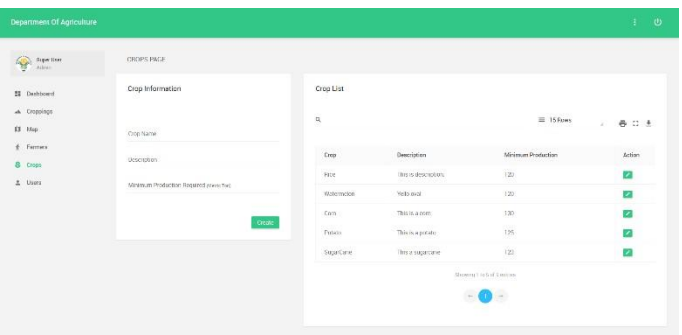


Figure 6. Crops' Tab

Figure 6 shows the form where crops and some of it needed data are inputted for the polygons information.

D. Acceptability of the system

The usability of a system refers to the users' evaluation of the system in the perception of usability, design, navigation, user-friendliness, and information went in the criteria for evaluation. The usability of the system was evaluated by the users through testing. Usability refers to how the user accomplishes their work easily. Usability is a process or set of techniques used during a design and development project. Usability tests describe the overall behavior of the system.

Table 1. Overall Acceptability Test

Acceptability Test	Mean	Description
Usability	4.10	A
Design	4.01	A
Navigation	4.10	A
User-Friendliness	4.15	A
Information	4.42	SA
Weighted Mean	4.16	A

SA – strongly agree; A- agree; N-Neutral; DA-Disagree; SD-strongly disagree

Table 1 shows the summary of the evaluated test of the system according to usability, design, navigation, and

information, and user-friendliness of the system. The study shows that the usability of the system was agreed with a rate of 4.1. In terms of the web design, the respondent rated with an average of 4.01. The respondent rated the navigation of the system to 4.1. The content information of the system was rated with an average of 4.42. The user-friendliness of the system was received with a rating of 4.15. Through this acceptability test, developers find out that the stakeholders agree that the features of the system comply with their requirements, and that is presented by the average weighted mean of 4.16.

The major features of the AGIS for Pangasinan covers the (1) capability to add information in the maps provided and be able to (2) have a report with regards to the information being input by the municipal administrator for decision-making purposes. In addition, the system could also (3) store data for farmers and be able to identify what portion of the farm, the farmers are taking good care of.

#### CONCLUSION AND RECOMMENDATIONS

After the study has been accomplished and completed, the following conclusions were observed by the developers:

One of the main reasons why slow services were delivered to the farmers by the government is the lack of access to information about what is going on in the main farming area. The developers also can conclude that technology is used in the government in terms of basic stuff but not in terms of having a system that could make the work smoother.

The study can be used by the officers-in-charge in filling the problem in terms of data access thru the use of the trend of the mobile web application. The system can provide the information needed to come up with some critical decisions concerning the agricultural industry for data directly from the weir can be provided by the system.

Thru the functional and non-functional requirements provided by the system, the developers can conclude that the AGIS can be able to perform the task with regards to agricultural matters of the province. Given its capability to identify and analyze the data inputs by the users, it will be able to come up with a decision that could be beneficial to the provincial government in the agricultural industry.

And based on the developer's acceptability test that was done with the target users of the system, the AGIS for Pangasinan is said to be accepted and approved for implementation.

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