Maximizing Crop Yields: A Digital Platform for Rice Pests and Diseases

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Abstract

The researchers conducted a survey from an agricultural office about how they disseminate rice information to farmers and farm owners. Farmers and farm owners were also asked about how they got that information and how effective it was for their rice plants. Data on what are the difficulties that the office personnel, farmers, and farm owners were also surveyed through floating questionnaires. From the data gatherings, it was found that there was a need to seek solutions on how the dissemination of rice information will be disseminated to the farmers and farm owners faster and easier. This study aims to develop and implement an Information Dissemination Portal as an ICT Tool for the Agricultural Office that would help farmers and farm owners to be informed and educated on how they should work on their rice plants properly. This study also aims to help the office staff and experts to give effective and helpful studies and solutions about how to protect the health of rice plants. The information to be coded in the system will not only be in the universal language but will also be available in two more dialects such as Ilocano and Tagalog for the clients to understand clearly what the experts would like to suggest on how they should protect their rice plants properly. The tool also has an announcement page where the office could disseminate the information about events to happen in the future or could display any important announcements there. This tool was also designed to have a communication feature that will let farmers and farm owners talk to rice plant experts.

Keywords: Rice Plants, Rice Pests, Rice Diseases, Rice Information, Farmers, Farm Owners, Department of Agriculture

1. Introduction

Agriculture is the backbone of the Philippine provinces' economies. Most Filipinos, specifically in rural areas, depend on agriculture for their livelihood. Rice production is essential to Filipinos as it is among the significant employment, income, and food security sources for Philippine farmers. Ma, Liang, and Lyu (2019) stated that Agriculture, especially rice cultivation, has been challenged by various problems over the past few decades, with the issue of crop failures caused by the outbreak of pests being more particularly acute. Rice pests and their diseases sometimes harvest fewer grains as expected. Experts experimented and studied these and formulated solutions to cure and prevent them, but this information should immediately be relayed to the farmers. Bachhav (2021) stated that farming productivity would benefit from the information in Agriculture. Therefore, this is the gap that this research proposal seeks to fill.

The following studies could be a solution for the existing rice problems: a weather analysis using models to predict rice pests' outbreaks (Ma et al., 2019); image processing models, and recognition methods of still images and videos used by Sethy et al. (2017) and Dengshan Li et al., (2020) that provides information of a particular rice disease upon detection; and a chatbot with automated replies basing on received images and a feature of live chatting with a specialist. However, there is no guarantee that those technologies can accurately collect data that can cause data loss in their original monitoring data; image processing tools can have a chance to give wrong predictions due to different filters and blurry effects of smartphones' camera lenses, and the automated chatbot can give the wrong prediction due to pieces of evidence of incorrect captures and what if it took the specialist too long to respond from the incorrect prediction?

With the inadequacy seen from the existing technologies today using still image processing, recognition techniques, and automated replies from a chatbot, this paper aims to develop a web-based system that could show records of correct prevention and cure to rice diseases where all farmers can access it using any unit of computing devices that can have internet access which will be ready to serve 24×7. This study targets a specific place in the Philippines, particularly in San Mateo, Isabela, so that the proposed technology will contain information in three (3) dialects: English, Tagalog, and Ilocano. This information system will respond to this problem, where still images are available to be classified by the users whether it is the same as what they visually see from their field and could immediately read the possible solutions to cure the disease and prevent it in the future.

2. Methods
Data Gathering
The researcher gathered information about how an office in a certain municipality is disseminating information to the farmers/farm owners; and how the farmers and farm owners get important information from the office through survey questionnaires. The effectiveness of the Information Dissemination Portal was also surveyed through questionnaires after the user-testing process.

Research Paradigm

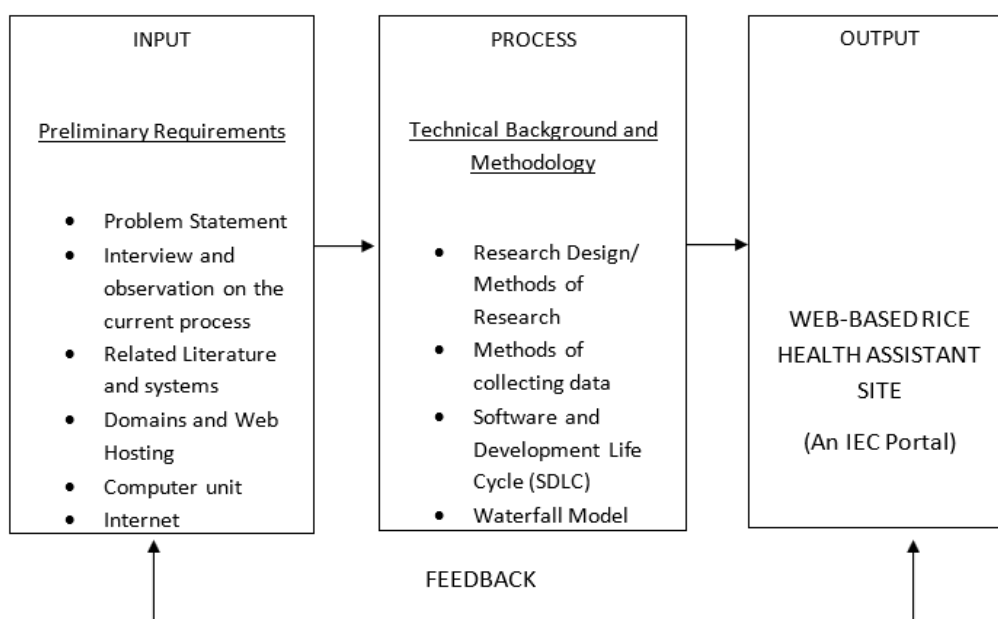**Figure 1: IPO Model of the Proposed System**

Figure 1 illustrates the Input, Process, and Output paradigm to be followed up with the proposed system. The input involves hardware, software, and knowledge requirement data to be processed using the prototyping software and methodology to develop the output web-based "Rice Health Assistant Site". Mikalse et al. (2021) stated that the COVID-19 pandemic has caused organizations to transform physical work to online mode using modern technologies. Their study emphasized the benefits an organization could get if they engage in an information system development that could be accessed online to communicate and give information to all people involved who cannot communicate physically due to some implemented protocols. The importance of information system development proves that this study would provide the farmers with' rice information without going to public facilities instead of browsing and communicating through a web-based platform. Their paper also includes a survey result reflecting the effects of using an online information system that might also result when we implement the proposed system.

Software Design and Implementation

Figure 2: General Model of Design Process
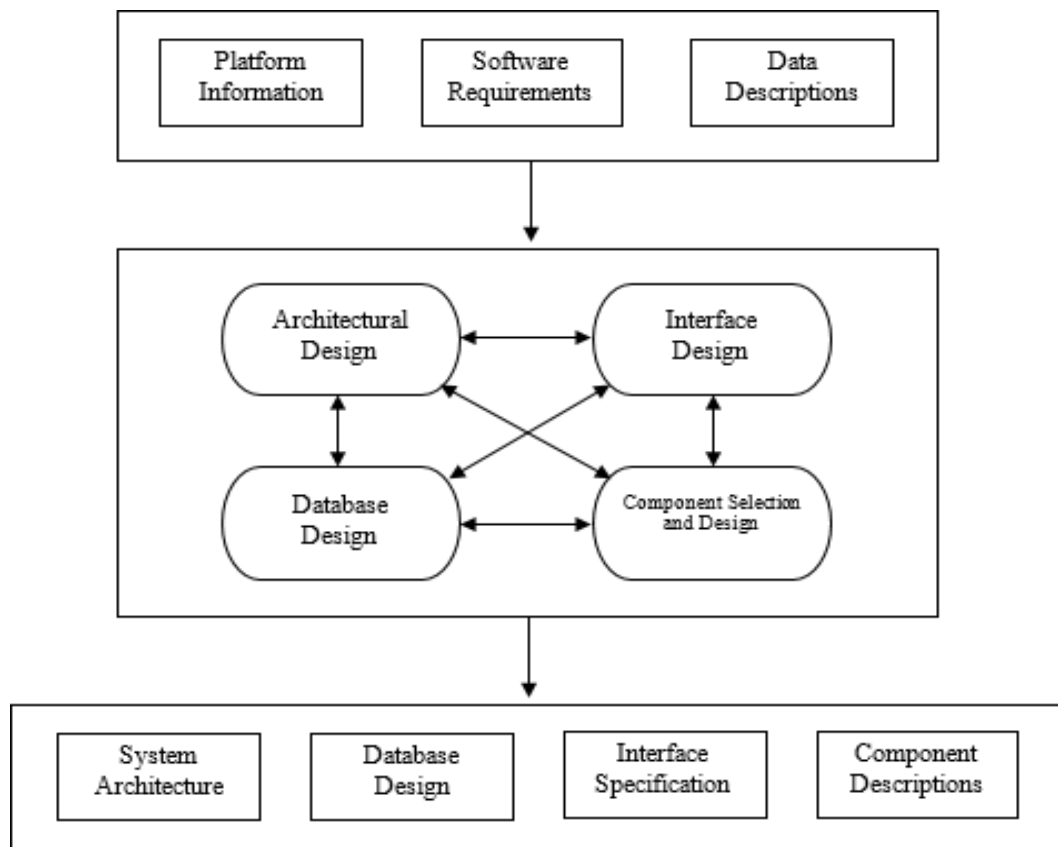
Architectural Design

In this stage, the researcher identified the overall structure of the system, subsystem, or modules, their relationship, and how they are distributed. It involves developing Database design through developing an Entity Relationship Diagram (ERD), Designing Interface and component design of farmers' portal, and back-end system using HTML, CSS, JavaScript, Bootstrap Framework, and PHP Programming.

Database Design

With the information that the researcher gathered during requirements specification, the database structure of the proposed system was designed accordingly. Using Entity Relationship Diagram, data

were critically analyzed, to understand the flow of data and the relationship of each attribute of the given database to derive the database architecture design.

Interface Design
The researcher comes up to design the system's interface with the modern User Interface. Using Adobe PhotoShop tools, the researcher initialized the interface design and integrated it into a web-based platform using HTML, CSS, JavaScript, Bootstrap Framework, and PHP Programming.

Component Selection and Design
The components selection and design depended on the interface requirements acquiring the function feature of the system.

Nyamekye et al. (2020) conducted a study focusing on collecting and classifying techniques that provide actionable agricultural information to rice farmers. They had introduced web-based information systems that present opportunities but merely for decision-making. They emphasized that farmers must acquire the information communicated in the tool like this present study wanted to achieve. According to their studies' results, one of their discussions focuses on mobile-based platforms, which reviewed most farmers or at least one family member of the farmer-owned mobile phone. With this, like here in the Philippines, it would be helpful to deploy a web-based information system regarding rice pests and diseases that contains media such as images and videos that will give actionable knowledge to the farmers.

Objectives of the Study
This study aims to attain the following objectives:
(1) To identify the materials and methods used by the office personnel of the Municipal Agricultural Office in disseminating information about rice pests and diseases.
(2) To classify the problems encountered by the personnel and farmers in this time of pandemic with regards to disseminating information in terms of:
   a. Speed
   b. Accuracy
   c. Efficiency
(3) To determine the level of acceptability of the current system.
(4) To determine the level of need for developing a web-based Rice Health Assistant Site.

3. Results and Discussion

Table 1: Mean and Descriptive Interpretation of the Respondents on the Materials and Methods used by the Farmers in Seeking Information about Rice

Materials and Methods	Mean	Descriptive Interpretation
Books	4.04	Agree
Internet Surfing	4.54	Strongly Agree
Fliers	4.86	Strongly Agree
Magazines	2.91	Fairly Agree
Attending Forums	4.63	Strongly Agree

Attending Seminars	4.91	Strongly Agree
Attending Symposiums	3.08	Fairly Agree
Attending Trainings	4.86	Strongly Agree
Grand Mean	**4.22**	**Agree**

Table 1 presents the mean and descriptive interpretation of the respondents on the materials used by the farmers in seeking information about rice. This shows how they agree on the materials used to like books with a mean of 4.04; use of the internet with a mean of 4.54; fliers with a mean of 4.86; and magazines with a mean of 2.91 with a grand mean of 4.09. It also shows how they agree on the methods used like attending forums with a mean of 4.63; attending seminars with a mean of 4.91; attending symposiums with a mean of a 3.08 and attending training with a mean of 4.86; with a grand mean of 4.22 or descriptive interpretation: Agree.

Mikalse et al. (2021) stated that the COVID-19 pandemic has caused organizations to transform physical work to online mode using modern technologies. Their study emphasized the benefits an organization could get if they engage in an information system development that could be accessed online to communicate and give information to all people involved who cannot communicate physically due to some implemented protocols. The importance of information system development proves that this study would provide the farmers rice information without going to public facilities instead of browsing and communicating through a web-based platform. Their paper also includes a survey result reflecting the effects of using an online information system that might also result when we implement the proposed system.

Table 2: Mean and Descriptive Interpretation of the Respondents on the Materials and Methods used by the Office Personnel of MAO in Disseminating Information about Rice's Pests and Diseases

Materials and Methods	Mean	Descriptive Interpretation
Books	4.75	Strongly Agree
Internet Surfing	4.75	Strongly Agree
Fliers	5.00	Strongly Agree
Magazines	4.50	Strongly Agree
Conducting Forums	4.50	Strongly Agree
Conducting Seminars	5.00	Strongly Agree
Conducting Symposiums	4.50	Strongly Agree
Conducting Trainings	5.00	Strongly Agree
Grand Mean	**4.75**	**Agree**

Table 2 presents the mean and descriptive interpretation of the respondents on the materials methods used by the office personnel of MAO in seeking information about rice pests and diseases. This shows how they agree on the materials used like books with a mean of 4.75; internet with a mean of 4.75; fliers with a mean of 5.00; and magazines mean of 4.50. It also shows how they agree on the methods used

like conducting forums with a mean of 4.50; conducting seminars with a mean of 5.00; conducting symposiums with a mean of a 4.50, and conducting training with a mean of 5.00; with a grand mean of 4.75 or descriptive interpretation: Strongly Agree.

The study by Armstrong et al. (2012) proves how ICT tools can make farmers more informed about their rice crops easier, faster, and more accurate. They have illustrated how vital information is to the farmers, especially those in rural areas, as these farmers depend on what knowledge they are gaining from specialists. They also emphasized that farmers firmly believed information from government agencies, and whatever was given is firmly applied. This study also paved the way to introduce how important it is to make information on any platform in the form of a local language so all those farmers who are indifferent education level could clearly understand the data and apply all of it correctly. And this study also proves that, like Rice Health Assistant Site, it would be beneficial for the farmers and farm owners to gain knowledge from trusted agencies in the way of a platform that they could get information the fastest way.

Table 3: Mean and Descriptive Interpretation of the Respondents on the Problems Encountered by the Farmers on the Manual Method used in Terms of Transacting at MAO

Problems Encountered	Mean	Descriptive Interpretation
Farmers		
Time consumed in going to the municipal for asking questions	4.92	Strongly Agree
Delay Appointments	3.86	Agree
Transportation	4.97	Strongly Agree
Office Personnel		
Insufficiency of References	4.75	Strongly Agree
Time consumed in scanning books, magazines, and other web references	4.75	Strongly Agree
Grand Mean	**4.65**	**Strongly Agree**

Table 3 presents the mean and descriptive interpretation of the respondents on the problems encountered by the farmers and office personnel on the existing method in terms of transacting at MAO. This shows how they agree on the problems encountered like a time-consuming in going to the municipal for asking questions with a mean of 4.92; delay appointments with a mean of 3.86; and transportation with a mean of 4.97; with a grand mean of 4.58; insufficiency of references (book, magazines, etc.) with a mean of 4.75; and Time-consuming in scanning books, magazines, and other web references with a mean of 4.65; with a grand mean of 4.75 or descriptive interpretation: Strongly Agree.

Zuoliang et al. (2014) have studied farmers' net income effects when agricultural information is well disseminated to farmers of farm owners. Based on the information they have gathered, giving helpful information to farmers could increase their net income as they would know strategies for managing their crops. Having no or not enough knowledge on how farm owners would lead their farmers to manage the field and crops might also lead them to have a poor or less income. Their study also showed that giving agricultural information through less effective mediums such as integrated information in books or

journals would make the dissemination of information to farmers slower or, worst, never. This study emphasized the importance of giving accurate information to farmers so they would have a great strategy to have a higher income. This study supports this present research goal to disseminate rice information through a widely used platform.

Table 4: Mean and Descriptive Interpretation of the Respondents on the Benefits of the Farmers and Office Personnel on the Rice Health Assistant Site

Benefits of the Study	Mean	Descriptive Interpretation
Farmers		
The farmers and the office personnel can easily access the system	4.98	Strongly Agree
The system is easy to use	4.95	Strongly Agree
The system generates accurate information	4.74	Strongly Agree
The system saves time and effort	4.99	Strongly Agree
Office Personnel		
The system provides comprehensive searching of information than the manual process	4.96	Strongly Agree
Searching of information can be done anytime	4.77	Strongly Agree
Boost the skills in using the new trend of technology	4.78	Strongly Agree
Motivates users to know more about rice	4.98	Strongly Agree
Grand Mean	**4.90**	**Strongly Agree**

Table 4 presents the mean and descriptive interpretation of the respondents on the problems encountered with the existing method in terms of searching rice's pest and disease information. This shows how they agree on the benefits of the system like the farmers and office personnel can easily access the system with a mean of 4.98; the system is easy to use with a mean of 4.95; the system generates accurate information with a mean of 4.74; the system saves time and effort with a mean of 4.99; the system provides comprehensive searching of information than the manual process with a mean of 4.96; searching of information can be done mean of 4.77; boost the skills in using the new trend of any time with technology with a mean of 4.78, and motivates users to know more about rice with an interpretation: Strongly Agree, mean of 4.98; with a grand mean of 4.90 or descriptive interpretation: Strongly Agree.

A study by Yu et al. (2015) about developing a technological system for farmers to learn about crop information has a significant impact on the present study for it is truly believed that today's generation is influenced by technology, whatever status a farmer has, age, gender, and even life status, each farmer or at least one of their family members owns a smartphone or laptop. As one of the purposes of the Rice Health Assistant Site, it is beneficial for the farmers to develop a system that could give them real-time, direct, efficient, and professional guidance and support on effective strategies to manage their rice plants.

4. Summary

Based on the data gathered, most of the farmers get information about rice health through the flyers given by the agricultural personnel and via attending seminars that are conducted by the office. Transportation concerns, insufficient references, and time-consuming scanning were the problems most experienced difficulties by farmers and employees. With this, the implementation of the IEC portal made the respondents agree that it would be easier for them to use it in terms of the dissemination of rice information. Farmers also realized that using it would save them time and effort in seeking information on how to protect their rice plants.

5. Conclusion

With the results from data gatherings, designing and implementing of IEC Portal as an ICT Tool for municipalities' Department of Agriculture Office could deliver the work of disseminating rice information to the farmers and farm owners faster and easier.

Not only that the information in this ICT Tool will be published in a universal language but will also be in different dialects that the municipality people are traditionally used to.

The Portal provides educational information that the farmers will be helped on how they should manage their rice plants effectively. And it also has a communication feature where farmers, farm owners, and experts can exchange information timely.

6. Recommendations

It is highly recommended for this study that the portal should be hosted on a trusted domain and should implement security features to avoid such information destruction risks.

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