Proceedings of International Conference
on Technological Challenges for Better World 2019

BIYAYA: A Web-Based Agricultural Management System

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Keywords: farmer, entrepreneur, clustering, production, information

Abstract. This developmental project is designed and developed to be used by small-holder farmers and farmer cooperatives and associations as a new information documentation and management tool in order to implement Agro-Entrepreneurship and be linked to the institutional markets. This data management platform will assist the farmers and their leaders in handling and managing farmer and product information which will allow them to keep track pertinent data connected with the clustering approach. Provisions for the Production Module and Financial Module are also included in order to allow farmers to maintain a documented and scientific means of managing farming data. This will allow the farmers access to a well-managed information management tool which can help them better manage their produce as well as access to possible improvements of their farming process. Access to generated reports on farming data will also allow the farmers to become more efficient in the farming process. With the development of this management platform, farmers as well as with leaders and groups will be able to reinforce traditional farming methods into a more systematical means of farm documentation methods.

1. Introduction

Agriculture plays an important role in the country's economy. This is measured as the value added contribution of the agricultural sector as a percent of GDP. According to the World Bank data from 1960 to 2016, the average value for the Philippines during the period was 21.36 percent with a minimum of 9.65 percent in 2016 and a maximum of 31.06 percent in 1974. This shows a sad truth that the percent of GDP (value added) contributed from the agriculture sector continues to decrease. Although people still think of the Philippines as an agricultural economy, strictly speaking, and based on the data, this is not the case [1].

As of today, technology is one of the tools which can be given to the farmer in order to be competitive. As mentioned by Peter Drucker, "Innovation is the specific instrument of entrepreneurship. The act that endows resources with a new capacity to create wealth". Innovation is one of the twelve pillars of the Global Competitiveness Index (GCI) which requires an environment that is conducive to innovative activity and supported by both the public and the private sectors [2]. Innovative economies must design and develop cutting-edge products and processes to maintain a competitive edge and move toward even higher value-added activities. Apparently, the innovative countries were also the world's most competitive economies.

Currently, the Philippines' GCI ranking is down by 10 notches from 47th among 140 economies in 2015 to 57th among 138 economies. This ends a decade of rank improvement from 73rd in 2005 to 47th in 2015 [3]. With this, the government and the private sector are also providing ways and means in introducing technology and innovation into the agricultural sector. According to an article in Sunstar Philippines, "The Food and Agriculture Organization of the United Nations (FAO) and the International Telecommunication Union (ITU) are giving its support to the government in formulating a national e-agriculture strategy, believing that ICT platforms have the potential to significantly enhance and accelerate the flow of information across a complex network of agriculture stakeholders and throughout the value chain [4].

The term "BIYAYA", a Tagalog word which means "favor, grace or gift" [12] was coined to be the title of the information system as farming products and produce are considered to be "gifts from God" or "something given like a present" to the farmers. BIYAYA, as part of the innovation for the agricultural sector, is envisioned to rationalize resources and holistically address ICT opportunities and challenges for the agricultural sector in a more efficient manner while generating new revenue streams, improving livelihoods and contributing to the achievement of broader national plans.

2. Objectives

The intention of this project is to attain the following:

1. An information management platform that will provide an organized means of documentation of farmer and product information as well as process specification documentation that will help the farmer easier management of information.

2. Production and product price forecasting modules that will allow the farmer to document and manage farming processes and become more cost-effective in terms of production and pricing and;

3. Allow the farmer to have a broader perspective on Agro-Entrepreneurship via report generation modules which will allow them to have a deeper understanding of the business process.

3. Literature References

3.1 Entrepreneurship Concepts

In the journal "Entrepreneurship and entrepreneur: A Review of Literature Concepts", it was mentioned that "The field of entrepreneurship is still a relative one that is less explored, and many opinions in regard to defining the concepts of entrepreneurship and entrepreneurs remain the same" [5]. Entrepreneurship is also said to be defined as multidimensional term that is extremely difficult to define [6]. Entrepreneurship is, thus, the product of a combination of three elements, the context in which the opportunity arises or is created, a set of personal abilities necessary to identify and use that opportunity, and the capacity to materialize the opportunity, by transforming it into results [7].

3.2 Farmers as Entrepreneurs

Can small-scale farmers become entrepreneurs? Yes. Small-scale farmers all over the world have shown a remarkable ability to adapt. They look for better ways to organize their farms. According to Kahan, "they try new crops and cultivars, better animals, and alternative technologies to increase productivity, diversify production, and reduce risk – and to increase profits and farmers have become more market-oriented and have learned to take calculated risks to open or create new markets for their products. Many small-scale farmers have many of the qualities of an entrepreneur" [8]. Being entrepreneurs, farmers also form what we call as "Clusters" or "Group Entrepreneurship". Entrepreneurship can also occur among groups of farmers who want to form a business together [9].

3.3 Information Systems as tools of Entrepreneurs

In the Philippines, there are in existence, several information systems which are designed for the agricultural sector. The PhilRice Soil Information System: A Tool for Effective Crop Management System, was presented and described in detail in the article "National R and D Highlights – Information Systems Division" [10]. In the same article, another system was presented and this was the "Corporate Data Management and Information Systems Solutions (CORE) which is a practical and smart information system that helps in strategic planning, management, operational control and transactional processing [10].

3.4 Synthesis

The clustering approach had been in effect for quite some time right now though there is still the need to interconnect and build communication networks in order to address common challenges and pursue opportunities. The reviewed literature propounds that the cluster development can act as an important tool in the development of agriculture and can further be reinforced with the tools of technology such as the use of information management systems.

4. Methodology

The method used in this research is based on the "Parallel Development Methodology". The methodology, which is a variant of the Waterfall development methodology was chosen as it has the advantages of identifying requirements long before programming begins and limiting changes to the requirements as the project proceeds, as shown in Fig. 1.

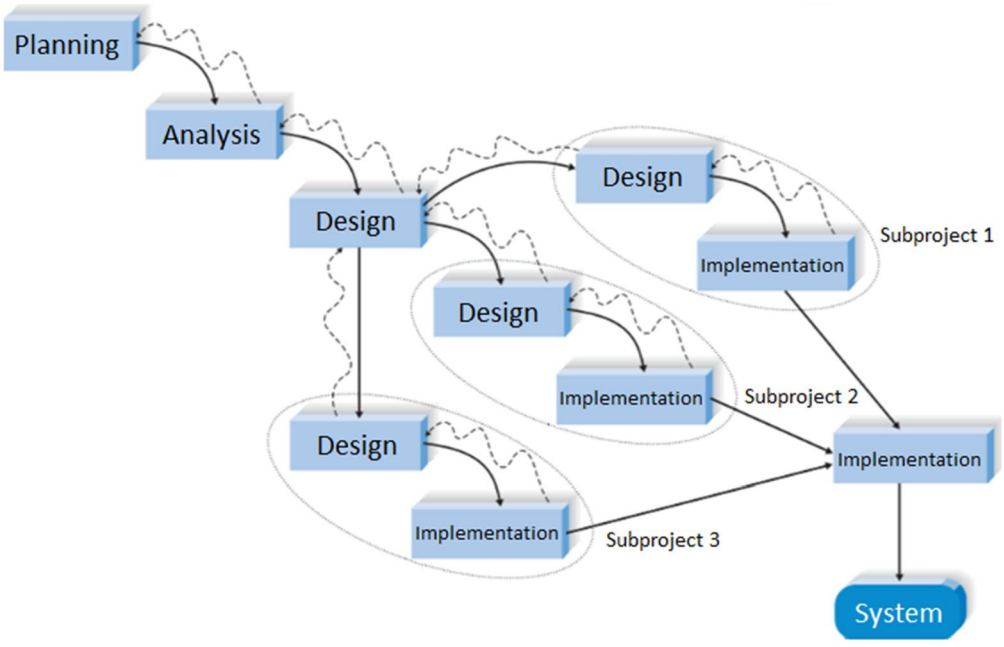

Fig. 1. Parallel Development Methodology

Parallel development reduces the time required to deliver a system, so changes in the business environment are less likely to produce the need for rework. The approach still suffers from problems

caused by voluminous deliverables. It also adds a new problem: If the subprojects are not completely independent, design decisions in one subproject may affect another, and at the project end, integrating the subprojects may be quite challenging [11].

Below is the Block Diagram of the project:

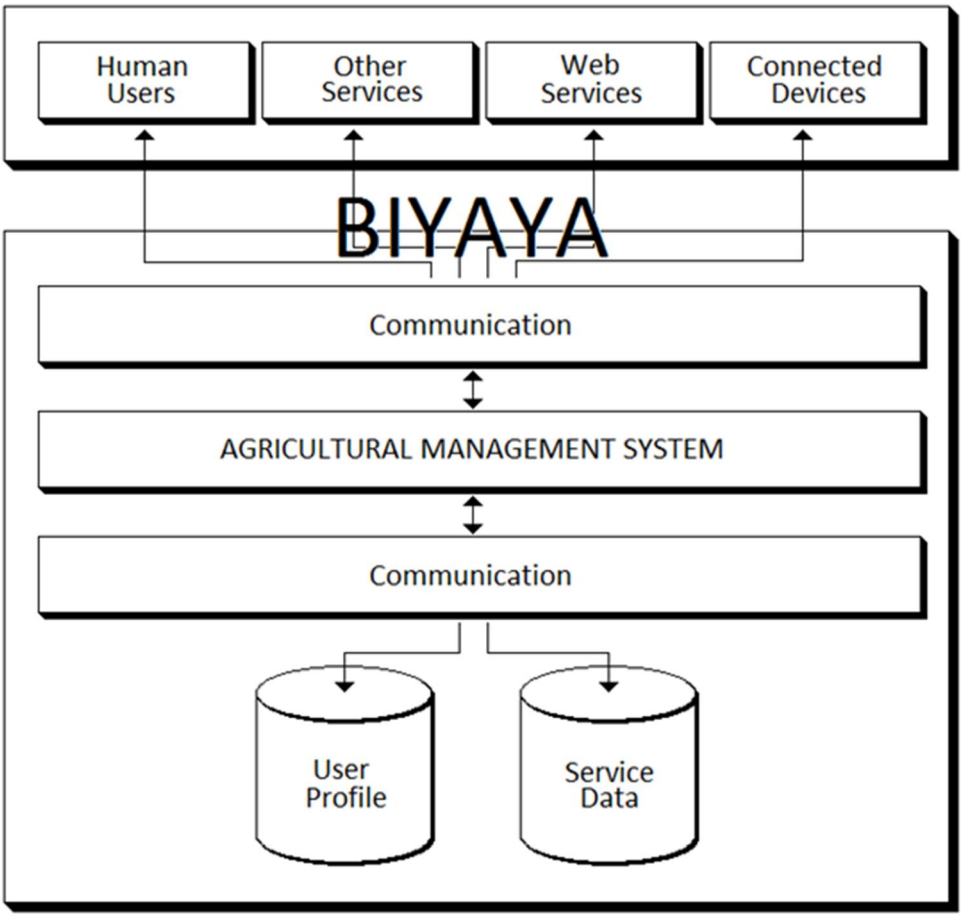

Fig. 2. Overview of the Agricultural Management System

5. Survey Results and Findings

System evaluation data were obtained from self-administered questionnaires from the subject cooperative, composed of 60 members but was completed by only 40 participants (n=40), listing a 66.67% response rate. This includes farmer leaders and farmer members who in turn, form two (2) clusters for their cooperative.

Table 1 shows the summary results of the post evaluation of the system upon demonstration of such to the farmer leaders and farmer members of the cooperative. The questionnaire focused on the overall features of the system and specific functionalities aimed at automating the documentation farmer data.

Table 1
Results of the System Evaluation Questionnaire

	1 - Highest						7 - Lowest
Survey Questions	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Overall-all System Features	10	15	15	0	0	0	0
Farmer Data	0	30	10	0	0	0	0
Data Gathering Process for Farmer Data	0	25	5	10	0	0	0
Product Details	0	25	0	15	0	0	0
Cluster Details	25	15	0	0	0	0	0
Supply Plan Module	30	10	0	0	0	0	0
Production Module	5	25	10	0	0	0	0
Ease of Use of Production Module	25	15	0	0	0	0	0
Production Financial Plan Module	25	15	0	0	0	0	0
Reports	0	15	15	7	3	0	0
Overall System Usage	25	15	0	0	0	0	0
Relevance to Farming Processes	25	15	0	0	0	0	0

Table 2 shows the Likert Rating Scale verbal interpretation of the post evaluation results. A rating of one (1) was provided if a farmer strongly agree that a specific feature highly conforms to their needs as opposed to the lowest rating of seven (7) which means that the farmer strongly disagrees to the said feature.

Table 2
Survey Sheet Scale Interpretation

Survey Score	Verbal Interpretation
1	**Strongly Agree**
2	**Agree**
3	**Agree Somewhat**
4	**Neither Agree or Disagree**
5	**Disagree Somewhat**
6	**Disagree**
7	**Strongly Disagree**

The overall features of the system reflects acceptance from the farmer leaders as twenty-five percent (25%) of the total respondents gave it a rating of 1, indicating farmer approval based on the Likert Scale verbal interpretation with the other respondents rating the system either with 2 or 3 (thirty-seven point five percent or 37.5%). The Farmer Information module also was received highly by the respondents as seventy-five percent (75%) rated it with a 2 while the remaining respondents (twenty-five percent or 25%) rated it with 3, indicating that the farmers are agreeing with the module implementation, as based on the Likert Scale verbal interpretation. As for the product details, sixty-two point five percent (62.5%) gave the module a highest rating of 2 while the other respondents (thirty-seven point five percent or 37.5%) gave it with a median rating of 4 indicating a satisfactory rating or the farmer somewhat agreeing the feature based on the Likert Scale verbal interpretation. This may due to the fact that the module contained limited product details and may had contributed to its satisfactory rating. The Production Module also reflects general acceptance from the respondents as it was provided with a highest of rating of 1 and a lowest rating of 3 (twelve point five percent or 12.5% at 1; sixty-two point five percent or 62.5% at 2 and twenty-five percent or 25% at 3). The use of the Production Module was also perceived with high satisfaction as it was rated with a high of 1 (62.5% of the total respondents) and lowest of 2 (37.5% of the total respondents). The same number of respondents reflected the same view on Financial Plan Module.

The Report Module received mixed results as the respondents rated the module with a high of 2 and a lowest rating of 5. This may be due to the fact that the use of reports may be unfamiliar to the farmers as it is a new tool offered to the farmers by an information system. Fifteen respondents or thirty-seven point five percent (37.5%) rated the module either as 2 or 3. Seven (7) respondents or seventeen point five percent (17.5%) rated the system with 4 and the remaining three (3) respondents or seven point five percent (7.5%) of the total respondents rated the module with a 5.

Overall, the implementation of the agricultural information management system is highly satisfactory to the farmers as the system was rated as 1 and 2 for its usage and relevance in the farming process. Twenty five (25) respondents representing sixty-two point five percent (62.5%) of the respondents rated it at 1 for its usability and the other fifteen (15) respondents representing the remaining thirty-seven point five percent (37.5%) rated it with 2.

6. Conclusion

Based on the evaluation results from the farmer leaders and the small-holder farmers on their test of the system:

1. The farmer leaders and small holder farmers agree that having an information management system that allows them to document current farming data and processes making them more organized;

2. Farmer leaders and their members strongly agree that they are able to improve their current practices and methods due to the availability of present and historical data and allows them to forecast production and product pricing;

3. Through the generated reports, the farmer is able to see the bigger picture of the farming process, allowing the farmers to effectively manage the farming process from the planting process up to the production of their produce.

7. Recommendations

Based on the foregoing findings of the study, the following are recommended for further study and improvements:

1. The information that will be used by the system is mainly based on farmers' current knowledge and traditional practices which are not generally based on scientific application. In the future, studies on the individual and cognitive processes of farmers, their acquisition of knowledge about farming and its methodologies, structure and management, will be a rich ground for further research
2. Since production processes are based on the clustering approach, some farmers may not be able to provide a single generic production process for their products. In the future, an analysis of the production processes in rural settings can also be made, wherein the best practices of individual farmers can be consolidated.

Acknowledgements

This study was completed with the help of the following: my Capstone Project Instructor and Adviser, Dr. Brandon Sibbaluca and Ms. Renia Matira respectively, for their valuable inputs into this study; KAMMMPI, for providing me with valuable farmer data and to the FEP Program of Jollibee Groups Foundation and STI Foundation for opening and nurturing my mind to the farming industry.

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