CHAPTER 2
THEORITICAL FOUNDATION

2.1 Introduction

Agriculture could not be separated with outside farming activities commonly called on-farm activity [2]. Agriculture activity is a plantation process followed by maintenance and producing crops. In Indonesia, our farmers use common patterns based on their own experience and knowledge, even many of them already familiar with agriculture since they were born.

In this era, agriculture is not the favored sector by the young generation. The young generation is more interest to work as a factory worker, staff or employee who work in the company rather than become an individual farmer. Youth who had graduated from high school were reluctant to return to their home to become a farmer like their parents. In general, there are only elders who no longer work in a company move to the agricultural sector.

The lack of agricultural schools also makes young people to stay away from that sector. Self-sufficiency in rice (Swasembada Beras) is only based on rice data production centre [3]. This thing has to be changed as soon as possible, to make the agriculture sector popular and coveted by the next generation.

Most of the communication and information media are not used to develop the agricultural sector optimally. Television, radio, newspapers, magazine more often preach news and shows like political issues related to seizure of power, entertainment related to celebrities, and any other various shows that mentally are
not educating the young generation and of course does not benefit farmers and agriculture.

The development of ICT (Information and Communication Technology) is so fast. Competition of ICT vendors to gain market makes the price of IT software or solution gradually decreased. One of the most famous IT advance is the Internet. Internet is combined networks that are connected to one another and it works as the backbone in exchanging information between any component and client in this world. Internet has become a trend and lifestyle, so internet becomes the most effective media to disseminate information.

Revival of agriculture in a nation will not be realized without the dissemination of information technology. Dissemination of IT will make agriculture becoming more modern, competitive, and efficient in bringing added value to farmers (Prof. Kudang Boro, 2010). In this day, the agricultural sector is so far left behind compared to other sectors because the lack of IT.

2.2 Information and Communication Technology in Indonesian Agriculture

The globalization becomes a very big impact for economic sector including agricultural sector. Globalization delivers new opportunities and challenges but also new threats, people even farmer and exporter have to prepare to deal with it. Because of that, a technology that could offset globalization needs is the information technology.

Competition in the world of agriculture is growing to be more competitive because of globalization. To be able to have an integrated management system to maintain
the operation process, it needs the use of information technology tools, software and internet.

In the emerging global economy, e-commerce and e-business have increasingly become a necessary component of business strategy and a strong catalyst for economic development. The integration of information and communications technology (ICT) in business has revolutionized relationships within organizations and also between organizations or individuals. Specifically, the use of ICT in business has enhanced productivity, encouraged greater customer participation, and enabled mass customization.

The issue of implementation of ICT is becoming a priority to develop the Indonesian agribusiness and agricultural sector. In early 2000, e-agribusiness were born and introduced to the public by the Indonesian Ministry of Agriculture. Most of people in the big city use web browser and mobile phone to access the internet. The Ministry initiated short message service and web portal as media communication to provide rich information about agriculture. There are also some communication centers like telecasters and internet cafe (warnet) in some rural areas. They have to support their financing needs by themselves; there was no financial aid from the Indonesian Government to install the internet for their business. The development of ICT adoption in the rural area to manage their agriculture business depends on their communication infrastructure or environment, the role of Government and the organization itself. Internet technology has became the most sophisticated and important technology for every industry sector including
agricultural sector. With the internet, people could easily search and find all information that they need. Besides that, the e-commerce facilities enable buying and selling activities to be done in virtual world including agribusiness. All important information about agribusiness could be retrieved easily by farmers so they could improve their prosperity in the future.

Indonesian Government cooperated with Non Government Organization (Lembaga Swadaya Masyarakat) has tried to support the Small and Medium Size Enterprises with funding programs, conducting managerial training, and ensuring applicable technological adoption [4]. In order to get the best development in implementing the ICT in agricultural sector they have to make sure their equity growth, decentralized, market-price-oriented and export industry based on ICT. The role of private enterprises also became an important factor to increase the efficiency of the operational activities and the competitiveness of the crop quality.

According to the agricultural situation in Indonesia, it is clear agribusiness needs to use ICT to create a sustainable advantage in the future. Those factors that the author already mentioned above need to be cooperated very well in order to improve the agricultural industry with the help of ICT.

2.3 Agriculture and Agribusiness Software System

In many developed countries especially in Europe and America, they have implemented a variety of software used to manage and develop their agricultural system. The author has reviewed and takes some software offered by foreign vendors to become one of the foundation theories.
2.3.1 SST Software: The Leader in Agriculture Information Management

SST software provides an IT solution in data management and process so the user can use all of the information or data to make decisions. They made a very useful software tools to manage the agricultural data called FarmRite. FarmRite offers many solutions as below [5]:

a. Variable Rate Recommendations
   - Place and Track FarmRite Orders
   - Receive Nutrient Recs in an Average of 5 Minutes
• Export Variable Rate Recommendations To Controllers

b. Record Keeping & Reporting

• Keep Your Farm Data Organized
• Record Data for Every Operation

• Assigning Operation Data To A Field
• Create and Print Detailed Reports

2.3.2 Farm Works Software

Farm Works was established in 1980 to serve the farmers and agribusinesses with their software products. Farm Works offer features and solutions for the office part [6]:

a. Desktop Solutions

Flexible integrated agricultural solutions for the office computer. These office solutions include field records, farm accounting, herd management, mapping, and analysis. Those features are:
• Field records

• Accounting

• Analysis

b. Connected Farm

A revolutionary new solution for managing precision agriculture data between the field and farm office
c. Livestock Solutions

Herd management solutions for the office and pasture

d. Other software

Farming game, teacher resources, and Lexicon Yield Tools

2.3.3 FarmERP

FarmERP Online is a multi-user, internet based solution being used by agribusiness companies, contract farming companies and exporters [7]. This software helps the agribusinesses to manage their farming data. It has also reporting tools to support the decision making activity. It also can be accessed anytime and anywhere as long as because it is an internet-based software solution. There are many useful features that FarmERP has [7]:

a. FarmERP Online for Contract Farming Agencies

Records data like Farmer details, crops, stock, record keeping, procurement, inputs given etc.
b. FarmERP Online : Centralized Farm Management

![Diagram of FarmERP Online]

- Unique FIN (Farmer Identification Number) for every farmer grower.
- Secured login for admin and field level staff.
- Field level staff can collect data from various places and upload it.
- Top management can access and analyze the data over website.
- Authorities can allot the work and set targets for field staff.
- Partial data can be viewed by clients if allowed by admin. (e.g. Traceability related info)
- Agriculture inputs offered by company to the farmers can be recorded.
- Information like land and crop details, cultivation practices of each individual grower can be stored for future reference.
- Estimated production quantity and procured quantity for every grower can be compared.
• Data search based on crop, variety, estimated harvest, region date etc. is possible

d. Advantages of FarmERP Online

• It is internet based multi user solution, hence it is highly scalable.

• Useful in macro level crop planning, scheduling, procurement and supply.

• Improves operational efficiency & staff performance levels.

• Covers complete life-cycle from production to procurement and marketing.

• Increases management efficiency and saves operational costs.

• Maintains history of practices adopted and daily operations.

• Strong reports module which simplifies Quality certification related documentation.

• Simple scheduling of your daily activities to optimize the resources.

• Strong reports module which helps in decision making based on analysis of real time data.

• Can be integrated with existing offline and online software systems.

• It can be customized as per your business requirements.

e. FarmERP Online : Reports

• Representative work report

• Farmer member report

• Crop detail report
2.3.4 eSagu: Data Warehouse Enabled Personalized Agricultural Advisory System

According to Reddy, Ramaraju, and Reddy (2007) they stated that in eSagu, instead of an agricultural expert visiting the farm, the farm situation is brought to him/her in the form of both digital photographs and text. The agricultural expert delivers the expert advice based on digital photographs and other information [8]. Two options exist for sending the photographs. The first method is the farmers themselves can send the photographs of his/her own farms.

The other method is, instead of farmers, educated and experienced farmers of the village can be brought-in as mediators (we call them as coordinators) who will capture and send the photographs of a group of farms. In developing countries like India, the majority of farmers is either illiterate or has a low level of education. It is difficult for them to send the crop situation to agricultural experts. So they preferred to have the second option; i.e., assigning the work of capturing and sending the photographs by the coordinators.
2.4 Database Management System

DBMS is software that is designed to maintain and utilize the data collection and the need for this system is increasing.

The entity-relationship data model allows the designer to describe the data contained in the enterprise in terms of objects and their relationships and this model is widely used as a basis for designing a database.

ER model plays an important role in designing a database. It can generate something that very useful to allow designer to change the description of the client or database user needs to become more detailed, accurate and clear description that can be used in the DBMS.

Six steps of database design process [9]:

Figure 2.1 The parts of eSagu system. Here, ‘C’ indicates coordinator. A double arrow indicates information flow.
1. Requirement Analysis

In this stage, designers must understand what data will be placed in the database and applications above it. Anything that about user needs with the database has to be understood well. In addition, analysis of the current system and the need of changing, analyzing documents in the current application which would be replaced or used in the database.

2. Conceptual Database Design

Information that already gathered in the requirement analysis stage is used to develop high-level description data which are stored in the database and also the constraints that exist. In general, this stage uses the ER model.

3. Logical Database Design

Designer must choose the DBMS to implement a database design, and change the conceptual database design into a database schema in the DBMS data model that has been chosen. If the designer uses a relational DBMS, then the next task is to transform the ER model into a relational database schema.

4. Schema Refinement

The fourth stage, designer needs to analyze the relations of the data in the relational database schema so he or she can identify problems and solve them.

5. Physical Database Design

In the fifth stage, the designer should consider the average workload that must be supported by the database and then make sure that the database design can meet the needs of the desired performance. This phase also contains about building indexes.
on tables and grouping tables or redesigns some parts of database schema generated from the previous stages.

6. Security Design
In this phase, designers identify the differences between users and their role in accessing the database (e.g., buyer, admin, and staff). In every role played by the user, designer should be able to identify which parts of database that can be accessed and which parts that are not accessible and ensure that the user can only access the their necessary parts.

2.5 Data Flow Diagram (DFD)
Satzinger, Jackson, and Burd (2004) stated data flow diagram (DFD) is a graphical system model that shows all of the main requirements for an information system in one diagram: inputs and outputs, processes, and data storage. All components of the system that are collaborated to each other and working together could be seen in the DFD. It is very easy to be learned and understandable, everyone could interpret the DFD easily [10].

There are only five symbols in this type of DFD:
Step-by-step instructions are followed that transform inputs into outputs (a computer or person or both doing the work).

Data flowing from place to place, such as an input or output to a process.

The source or destination of data outside the system.

Data at rest, being stored for later use. Usually corresponds to a data entity on an entity relationship diagram.

Communication back and forth between an external agent and a process as the process is executing (e.g., credit card verification).

Figure 2.2 DFD Symbols
2.6 System Flowchart

Flowchart is a graphic depiction of the steps and the sequence of procedures of a program. Flowchart help analysts and programmers to solve the problem into segments that are smaller and it helps in analyzing alternatives in the operation. Flowchart usually facilitates the settlement of a problem, especially problems that need to be studied and evaluated.

System flowchart is the form of computer programs, data store, database, and any manual operations activity that are inside the system [10]. System flowchart is the form of graphic to show all the process includes manual and automated operation and also the flowing of the data. System flowchart and DFD have a similar graphical form but they have different focus or purpose. The system flowcharts focuses on the implementation of physical objects such as executable programs, files, and documents (citation).
2.7 Structure Chart

This chart is used so the author could see the top-down decomposition of the functions to be performed by each program in the new system. Each program in the system flowchart has functions. The author can develop the structure chart by looking the system flowchart and DFD.
Figure 2.4 Structure chart symbols

Figure 2.4c describes how data passed between modules. The arrow with open circle represents data being passed into and out of the modules called data couples. The arrow with darkened circle is called control couple flag. A flag is purely internal information that is used between modules to indicate some result. Figure 2.4d illustrates a lower-level module that is broken out on the structure chart but that in all probability will be subsumed into the calling module for programming. This documentation technique primarily ensures that the function performed by the module is highlighted. Figure 2.4e and f show two alternatives for program calls. In
2.4e it show the notation used to indicate iteration through several modules. In 2.4f it shows conditional calling of low-level modules – that is, the program calls modules only when certain conditions exist.

2.8 **PHP and JavaScript**

The HTML website designed to present static information (only display contents of which is remain constant until the webmaster make changes) so the file containing only the HTML code does not support the creation of applications that could access the database. Therefore, further thoughts and ideas emerged from various parties to create an intermediary that allows the application to produce information that are dynamic and could interact with the database. Finally, other programming languages that can be worked as the intermediary are born such as PHP, ASP, and JSP [11].
Figure 2.5 Browsing PHP Web Application Mechanism

[11]Figure 2.5 shows the scheme that allows an application to interact with databases using PHP. Once the web server finds the requested user file (file.php), the file is submitted to the PHP engine to be processed. When PHP detects any interaction with the database, then PHP will make a request on the database server and the result from the database server would be processed further. After all the contents are processed, then result (in the form of an HTML code) submitted to the web server. Furthermore, the web server sends HTML code to the user.
PHP is free software; this software can be found and downloaded on the internet through the [www.php.net](http://www.php.net) site. However, keep in mind, PHP is sometimes packaged in a bundle of software, for example WAMP5. Another interesting thing is PHP to be multiform. This means that PHP can run on multiple operating systems, like Windows, Linux, and UNIX [11].

### 2.9 Web Database

Web database is a software solution in the form of database that is designed so it can be accessed via the internet. Everybody who has the authorization to access the database can update, add, or view the database anywhere and anytime in the world. The database usually used to store very large amount of data then it can be easily accessed and viewed in the web-based interface using scripting languages [12].