CHAPTER I
INTRODUCTION

This chapter provides the background of research, problem formulation, research objectives, research scopes, assumptions, and outline of the report.

1.1. Background

Currently, the competition level in the industrial environment is increasing especially in manufacturing. This causes every company required to be able to quickly, effectively, and efficiently increase production by utilizing all existing resources so can achieve an optimal production that can provide benefits for the company. Every company is continuously enforced to pay attention to the product, such as the quality, value, and amount of production. The uncertain market needs have forced the companies to design the production plan effectively. Thus, it is necessary for the company to plan or determine the amount of production, in order to meet the market demand in the right time and in a right amount so as the profit can be increased.

Every company wants to achieve a maximum profit. The maximum profit comes from the maximum sales as well. If the amount of products supplied is less than the demand, then the company will lose in order to get the maximum profit. Otherwise, if the amount produced is more than demand, then there is a buildup in the warehouse and it will make a large cost and the company will be lose. Therefore, a proper production planning with the right amount became one strategy to obtain the maximum profit (Nadapdap, 2012).

One way for the optimization profit is by determining the optimal production planning. There are several functions in operation and production management, e.g. planning, organizing, analysis, and controlling. In determining the actions to be taken in the future, a production planning is needed (Nadapdap, 2012). Production planning should take into account of demand total, production status, and plant capacity (Carlos *et al.*, 1993). Production planning is an important thing that must conducted by a company because of production planning is a process of determining the level of manufacturing output as a whole to meet the planned level of sales and inventory needed (Gaspersz, 2005). Planning the amount of production is an important policy that must be taken by the management of the company (Septiana *et al.*, 2013). Management should be careful in determining the amount and types of products that must be produced in order to meet the demand. In addition, the determination of the amount and types of products to be produced can also affect the profits and costs to be incurred by the company. The production costs that must be incurred by the company will affect the selling price of the product, which will also affect the amount of profit to be obtained by the company. One way for the company to get the maximum profit is by minimizing the production costs. Thus, the company should develop the production estimated that will be produced optimally and with a minimal cost.

CV Multi Rejeki Selaras is a drinking water company located on Imam Bonjol street number 81 Padang Datar, Payakumbuh, West Sumatra. CV Multi Rejeki Selaras is a private company approved by notarial deed No. 1 dated on December 11, 2002. The company has also fulfilled the STANDARD MANAGEMENT ISO 9001-2015. They produce the drinking water under the brand ASRI. The company produces drinking water with various size of 220 ml, 120 ml, 330 ml, and 600 ml. Drinking water with 220 ml and 120 ml size are mostly ordered by customers.

According to Head of Production division of CV Multi Rejeki Selaras, the production amount in the company is determined by considering the trend of consumer demand from the previous period. The make to stock system is applied in order to anticipate the fluctuations in varied consumer demand. It can be seen from the shift in the amount of productions for each month according to the customer demand as shown in **Figure 1.1** and **Figure 1.2**.

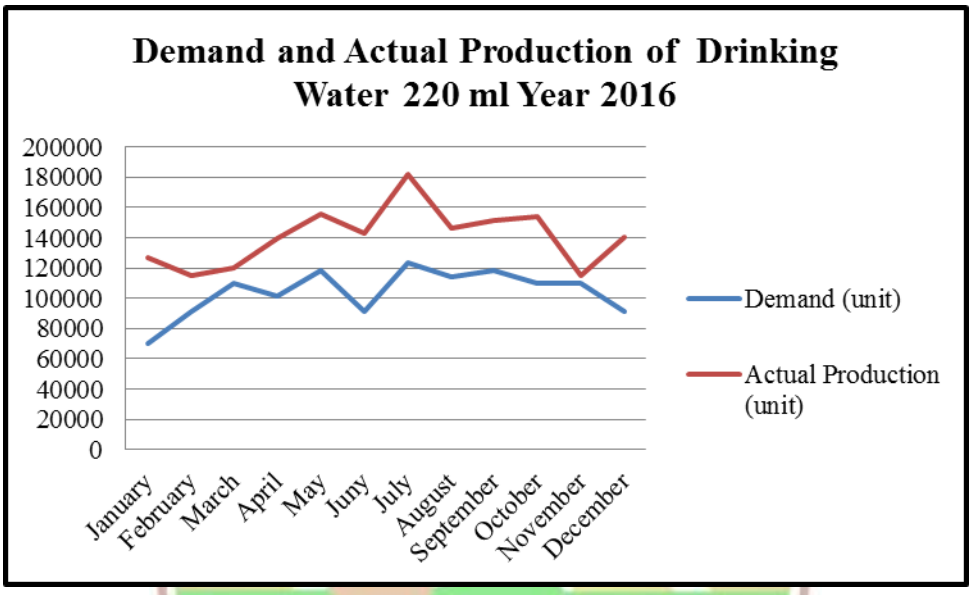

Figure 1.1 Demand and Actual Production of Drinking Water 220 ml

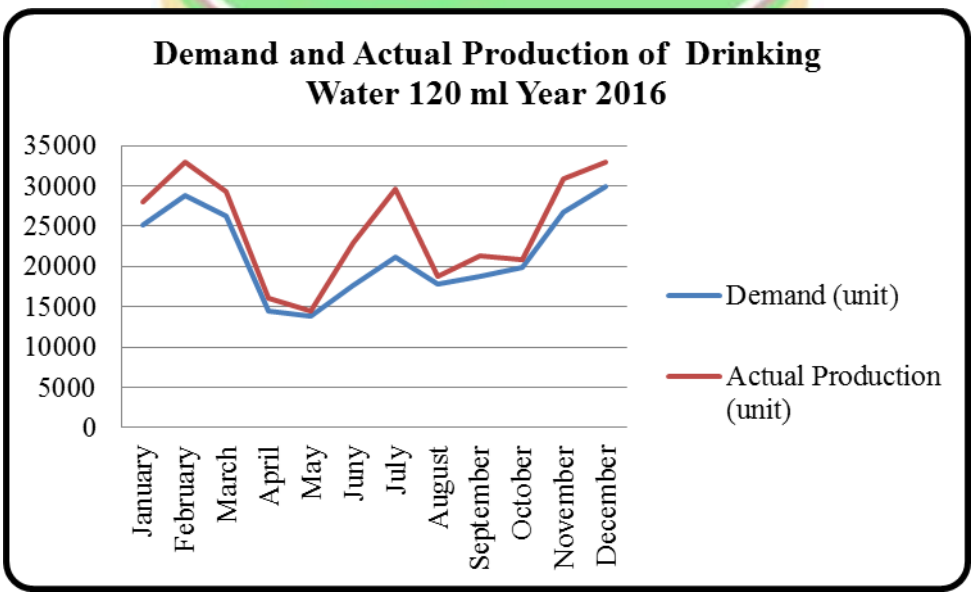

Figure 1.2 Demand and Actual Production of Drinking Water 120 ml

Figure 1.1 and **Figure 1.2** depict the trend between the amount of the demand and the production. This leads to overproduction and the accumulation of products in the warehouse, causing additional storage costs, increasing the likelihood of decreased product quality, and the occurrence of blocked capital turnover so as minimizing the profits. The company has no certainty in determining how much quantity of products must be produced to achieve the optimal conditions. The existence of limited resources owned by CV Multi Rejeki Selaras such as limited production capacity, working hours, and the fluctuating demand, making the company has not found the right method for production plans. Therefore, it should be develop or design production plan to optimize the use of the capacity of each work station, raw material, and fluctuating the demand, so as the profit can be increased.

In order to optimize the production planning with a series of imprecise goals, including the amount of items produced, the amount of inventory, and the amount of labor in each period with the minimum production target constraints to be achieved, the limited number of available labor, and the maximum or minimum inventory allowed, it needed an optimization method that is using fuzzy logic (Ciptomulyono and Prasetya, 2011). The theory of fuzzy was first introduced by Lotfi A. Zadeh in 1965 and has been widely used in research (Yulianto *et al.*, 2008).

According to Aliev *et al.* (Fatrias and Shimizu, 2012), one of the main characteristics of production is characterized by an imprecision and incomplete of data making the information is vaguenes related to decision. Stochastic models are usually solve that problem based on the representation of existing uncertainty using probability concepts, but consequently, there are limited the information captured. In the other hand, the estimation of the probability distribution is difficult to used in a fuzzy environment because of the imprecision of the data. This is why fuzzy logic is used as useful tool to solve this problem effectively.

The fuzzy set theory provides a mathematical framework model which vague concepts can be studied. The development of fuzzy set theory is in progress, using to explore the ability of fuzzy set theory to become a useful tool for mathematical analysis of real problem. The new applications to various scientific fields such as machinery study, military study, medical study, decision theory, military science, sociology study, economics study, psychology, management science, expert systems, control theory, statistics, and many studies have demonstrated that fuzzy set theory not only be a theory in found of applications, but a useful tool for the expressions of a professional judgment (Herath, 2015).

The reason why the fuzzy logic is used in production planning because of in determining the number of products to be produced, the company only makes subjective decisions that lead to ambiguity and vagueness. This happens because there is no strict limitation on the information (Nadapdap, 2012). The existence of limited resources owned by CV Multi Rejeki Selaras such as limited production capacity of working hours, availability of raw material, and the fluctuating demand and also there is no historical data such as demand at the previous time, make the company needs a professional judgment to making a decision. Even conventional concepts such as Material Resources Planning can fail to present complex system properties when insufficient and inaccurate information exists. Thus the mathematical model will be more difficult if there is subjectivity in the system. This is where the concept of fuzzy logic is needed in solving the problem of the subjective information that is often encountered in everyday life. Although the information obtained is uncertain, the method used is mathematically exact (Hua Fang, 2000).

According to Pendharkar (1997), the production scheduling problem is characterized by the scheduling of duration period. It can be distinguished as long-term and short-term production scheduling problem. Long-term production scheduling is concerned with investment planning and is on annual basis. The short-term production scheduling, however, includes making decisions such as

determining production requirements, equipment availability, inventory requirements, and quality consideration. Previous applications in short-term production scheduling ranged from simulation studies (Pana, 1965), linear and integer programming studies (Kim, 1967) to dynamic programming (Lizotte, 1982). Linear programming and integer programming have received greater attention among the operations research techniques as applied to production scheduling.

One of the fuzzy methods that can solve the problem of production planning optimization is Fuzzy Linear Programming (FLP) method. According to Saati *et al.* (2015), the theory of fuzzy mathematical programming was first proposed by Tanaka *et al.* (1974) based on the fuzzy decision framework of Bellman and Zadeh (1970). The first formulation of Fuzzy Linear Programming is proposed by Zimmermann in 1976. He proposed a linier programming problems with a fuzzy goal and fuzzy constraints (Herath *et, al*., 2015). The fuzzy set theory has been widely used in linear programming. The main objective of Fuzzy Linear Programming (FLP) is to find the best solution possible with imprecise, vagueness, uncertain or incomplete information. There are many vary sources of imprecision in the Fuzzy Linear Programming. For example, sometimes constraint satisfaction limits are vague and other times coefficient variables are not known precisely. The fundamental of Fuzzy Linear Programming is to construct an optimization model that can be produce the optimal solution with subjective professional judgments.

Application of Fuzzy Linear Programming concept is expected to be able to give solution on how many products must be produced so that it will be able to get the optimal condition, which can give maximal profit for the company. This is conducted by analyzing on what aspects which affect the production planning, e.g. the production capacity of each workstation, the availability of working time, the availability of raw materials, the cost of goods sold and the amount of demand. The production capacity of each work station is needed to find out the number of machines, available working time, utility and efficiency factors. The availability

of working time is needed to determine the rate of production and the relationship between the time of production and the amount of products. The total of previous demand is required to forecast the future demand due to the amount of demand that changes as needed, so that the company must be able to predict how many products should be able to be produced in the future.

1.2. Problem Formulation

Based on the above background, problem formulation of this research is how to design the optimal production in CV Multi Rejeki Selaras in order to maximize the company's profit?

1.3. Research Objective

The objective of this research is to design an optimal production planning in order to maximize the company's profit.

1.4. Research Scopes

The scopes of the problem in this research are:

1. The research is focused on the production of drinking water of 220 ml and 120 ml.
2. Product demand data used is the data from January to December 2016.

1.5. Assumptions

The assumptions used in this research are:

1. The production process undertaken by the company does not change during the research.
2. The water requirement (after ozonization process) for each batch in drinking water production is sufficient to produce for each type of drinking water product.
3. No change of selling price, the price of raw materials and other production costs during the research.
4. Machinery and equipment used in the production process are in good condition (not damaged).

1.6. Outline of Report

This final project report consists of six chapters as follows:

CHAPTER I INTRODUCTION

This chapter contains background, problem formulation, research objective, research scopes, assumptions, and outline of the report.

CHAPTER II LITERATURE REVIEW

This chapter contains the theories used to solve the research problems consist of production planning and control, aggregate planning method, the capacity of work stations, forecasting, linear programming, fuzzy logic including fuzzy set, fuzzy number, mathematical modelling, types of membership function, Fuzzy Linear Programming, Multi-objective Fuzzy Linear Programming and application of fuzzy.

CHAPTER III RESEARCH METHODOLOGY

This chapter contains the research methodology consists of preliminary study, literature study, problem identification, problem formulation, identification of research variables, data collections, data processing, discussions, conclusions, and provide suggestions for the future research.

CHAPTER IV DESIGNING MATHEMATICAL MODEL OF FUZZY LINEAR PROGRAMMING

This chapter contains the data collections and the design of mathematical models using fuzzy linear programming.

CHAPTER V IMPLEMENTATION MODEL OF FUZZY LINEAR PROGRAMMING AND DISCUSSIONS

This chapter contains data processing and implementation of mathematical model using Fuzzy Linear Programming. After getting the mathematical modeling, next step is the implementation of the model using Fuzzy Linear Programming method. Then, the results are discussed.

CHAPTER VI CONCLUSIONS

This chapter contains conclusions from the research results and suggestions for the further research.