I. INTRODUCTION

1.1 Background

The main purpose of livestock productions is to provide humanity with products such as meat, eggs and milk. Milk consumption increases every year due to increasing awareness of the public health. According to data from Directorate General of Livestock Services (Ditjenak) the consumption of milk in Indonesia in 2011 was about 1.76 million ton. It perhaps increases continuously in coming years.

Increase of milk consumption does not match to national milk production. The current population of dairy cattle in 2010 was about 597 thousand heads, which still very low to produce sufficient milk for fulfilling market demand. The increase rate of national milk production from 2010 to 2011 was just 9.94%. This unfavorable circumstance causes dependency on milk import, which reaches 30-60% of total required milk (Ditjenak 2010).

The amount of milk to be imported is influenced by various factors. The first factor is the low productivity of dairy cattle. Sudono (2000) stated that the milk production from dairy cattle in Indonesia was only 10-11 liters/day, while in industrial countries such as America and Europe this reaches 20-40 liters/day. Most of the dairy farms in Indonesia are conventional. The dairy farms are classified based on the size of the dairy population, consisting of industrial scale (>100 heads), middle scale (30-100 heads), small scale (10-30 heads) and traditional scale (1-9 heads). In Indonesia the highest amount of milk is contributed by the traditional scale which reaches about 90% of the total milk productions (Yusdja 2005).

The government enhances of milk production by means of improvement the dairy cattle population and dairy farming management, which is the sole source of milk production. This effort was also exerted to support the White Revitalization’s program aimed at enhancing the quality of life and well-being of the Indonesians. Refinement of the structure management system, strengthening of the cooperative system and the improvement of the feed sector were carried out to develop the dairy sector in Indonesia.
Dairy cattle are highly dependent on forage, which influences the milk production and quality. It is important to secure the forage supply in order to sustain the production of dairy cattle. Feed is consumed by dairy cattle to provide in the requirements concerning maintenance and productivity. Feed can be divided into concentrate and forage. Feed is the highest cost in dairy farming, reaching 70% of total cost production. Based on this calculation the sustainability of forage availability is the main issue in this sector.

Forage sustainability should be observed by ecology, economy and social aspects. It is avowed by Devandra (1994) that sustainability of animal production is the result of applying or introducing strategies which do not strain natural resources. The main problems of providing forage in Indonesia are as follow (1) unpredictable production due to the weather, (2) the low quality of forage itself, (3) higher land conversion, (4) limitation of land area for planting forage. Good management systems will result in increasing forage consumption which will eventually lead to increasing farmer’s income. This is due to the fact that the cost per kg dry matter (DM) spent by farmers is lower compared to that of concentrate (Johnson et al. 2008).

The sustainability of forage supply is needed in dairy farming. It is assumed if a dairy cow requires 25 kg of fresh forage (moisture 87%) which equals to 4 kg DM and the size of the population reaches 445,000 heads. Based on this calculation then the amount of forage needed per day will be 11.125 ton which adds up to 4,060,625 ton needed per year (Lestari 2006). This large demand for forage forms a huge challenge for dairy farmers.

Java Island is the center of dairy cattle in Indonesia, due to the suitable environmental conditions. West Java is one of the central provinces of dairy cattle. Almost 50% of the total milk production in West Java is derived from dairy farms situated in the sub-district Lembang (West Java). The problem in forage supply is limitation of forage production area. It is noticed that West Java is the most densely populated area which has 3,710,061.32 ha with a population of 42,19 billion.

The model needs to be built on the system working of providing forage sustainability in Lembang. This model is expected to describe how the system is
able to provide forage by considering ecological, economic, and social aspects. The model is built using the dynamic model that showed the time function due to the input changes for every variable observed. As Hartisari (2007) stated, a dynamic model has the strength to predict the probability of a situation which might occur in the future. System dynamics is a problem evaluation approach based on the premise that the structure of a system, that is, the way essential system components are connected, generates its behavior (Richardson and Pugh 1989). System dynamic also provides an alternative view point in order to clarify the structure of the system, reveal the links with external environment, and determine the way the organization on operates to reach the defined goal. This analysis is essential for practical purposes. It supports the everyday work of managers to determine (1) the cause-effect relationships between the types of actives in the system, (2) ensuring its contacts with the external and internal environments, (3) the application of certain approaches, methods and techniques for management (Harizanova et al. 2009).

1.2 Objectives

The common objective of this research is to build a simulation model of sustainable forage supply for dairy farming in Lembang. The specific objectives of this research are:

1. To identify forage and dairy farming condition in Lembang and seek for related factors of forage supply considering the ecology, economy and social aspect.

2. To simulate the model to estimate the supply of forage.

3. To formulate the policy of decision making from the model simulation built to support management systems of dairy farms.

1.3 The Significance of Study

The main importance of this study is to provide a model that will be able to describe forage sustainability in dairy farming. The specific importances of this study are:
1. Developing the science and knowledge of modeling in sustainability of dairy farming.
2. Gathering information on how the system provides forage sustainability.
3. Recommendation of policy and management systems for refinement of forage sustainability.

1.4 Conceptual Framework

A system may be designed as a dynamic, complex, integrated whole, consisting of self-regulating pattern of inter-dependant elements organized to achieve the pre-determined or specified objectives. The system approach to instruction signifies a process and a technique by means of which an instructional system is developed, implemented, controlled, and evaluated or improved. Sustainability of animal production should be supported by forage sustainability. The dairy cow has a very high demand for forage. Costs related to feed make up the largest part of the total production costs. The issue of forage supply is complicated by the limited amount of arable land. This situation causes a lack of forage which in turn leads to an increase of costs related to feed. Eventually, this condition causes the farmers to sell their cattle. Consequently both the size of the cattle population and the milk production decrease. A model which simulates the supply of forage, taking into account the independent relationship between ecology, economy and social aspects as the mainstay of the ideology of sustainability, is urgently needed. The model that will be built is also expected to aid in estimating and predicting forage sustainability. This model will also be useful in creating forage management systems. The conceptual framework of this research is illustrated in Figure 1.
Figure 1. Research framework

It can be seen from the figure 1, the research framework that showing how to make a model simulation for forage sustainability by considering the ecology, economy and social aspects.