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## Effect of Climate Change on Laying Hen Farms

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### Abstract

The purpose of this paper was to review some articles about the effect of climate change on laying hen farms. The articles were collected from some journals, books, reports of the climate change and its effect on laying hen both in developed and developing countries. The results revealed that the impact of climate change on laying hen farms was not only on laying hen productivity, but also on the economic loss.

**Keywords:** Climate change; effect; laying hen farms.

### 1. Introduction

#### 1.1. Background

In the recent decades, the impact of climate change has become the world's attention [1]. Various studies undertaken to assess the impact of climate change on various economic sectors, especially sectors that vulnerable to climate variability. Sectors which indicated sensitive to the impacts of climate change were agriculture, livestock and water resources.

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Studies about the impact of climate change on a global scale indicate that climate change could adversely affect livestock production in the world. The negative impact was mainly felt by the tropical regions located near the equator, such as Indonesia [2]. One of livestock that are particularly vulnerable to climate change was poultry especially laying hens.

Laying hens farm is growing as demand for animal products such as eggs is very high. However, like other poultry, laying hens were so sensitive to the environmental temperature. Some researchers have studied about the effect of climate on productivity, product quality and animal welfare. The selection process was to obtain higher production have increased the vulnerability of laying hens against heat stress, and difficult quest mitigation measures [3]. The decreased productivity and mortality of laying hens was caused by heat stress which was usually observed during high ambient temperature conditions, the significant economic losses for farmers of laying hens [4].

During laying hens' production cycle, efforts to reduce the decline in productivity and an increase in mortality is very important. Therefore, this paper will explain how the effects of climate change on the productivity of laying hens, which in turn have an impact on the economic loss.

## ***1.2. Description of Problem***

The problems in this paper are as follows ;

1. Does climate change can affect the productivity of laying hens?.
2. Does climate change has impact on economic losses on laying hen farm?.

## ***2.1. Laying Hen Farms***

Laying hens produce meat chicken and eggs. In Indonesia, the type of laying hens is of light and medium [5]. Business of laying hens' farm became one of the alternatives in the livestock business in Indonesia. Business of laying hens' farm is able to absorb a lot of work force, this business also has a strategic position in improving the quality of human resources in order to provide animal protein. Market of eggs is certainly lies on farm size chickens, eggs are sold in the form of granules raw eggs, egg yolks are treated, egg whites that have been processed and eggs that have been treated with various kinds of seasoning are sold in the restaurants and houses. Laying hens is very sensitive to climate change. This is due to changes in environmental temperature is quite extreme, so the chicken will be disrupted physiological conditions, which will ultimately have an impact on productivity decline, in this case the production of eggs. On the farm, internal microclimatic conditions should be tailored to the needs of livestock thermohygro-metric to be able to optimize production.

The optimum temperature that can be tolerated by laying hen between 15-20°C [6]. Several studies have shown how this affects the temperature on parameter of feed and water consumption, body weight, egg production and egg weight [7]. At a temperature about 30°C, hens still can maintain its body temperature, but when the temperature reaches about 40°C, body temperature increased dramatically [8]

### 3. Global Climate Change

Climate change is a change in the statistical distribution of weather patterns that lasts for a long period of time (ie, decades to millions of years). The most common definition of climate change is a change in the statistical properties of the climate system when considered over the long term, regardless of the cause. Climate change can refer to the change in average weather conditions, the weather or the time variation in the long-term average conditions (ie, more or fewer extreme weather events). As for the response to climate change mitigation and adaptation can be seen in Figure 1. Mitigation is the effort to reduce greenhouse gas emissions (GHG) that cause global warming, and an increase sinks that absorb greenhouse gases. While adaptation is human intervention in adjusting the natural and social systems to cope with the impacts of climate change.

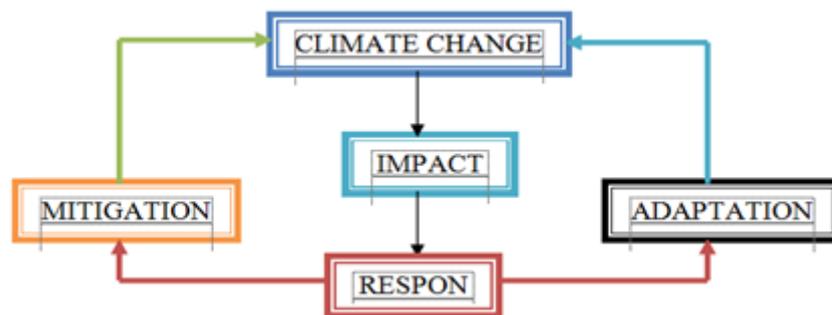


Figure 1: Response to climate change [9]

Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics and volcanic eruptions. Human activity (anthropogenic) has also been identified as a certain significant cause of climate change recently. It is often referred to as "global warming" [10]. Climate change is characterized by changes in global temperatures become warmer, and the formation of the greenhouse effect.

#### 3.1. Global Temperature Rise

The average global temperature has increased by more than 1 degree Fahrenheit over the last century 1, with an average warming of 4 degrees Fahrenheit in some areas [11]. According to scientists, this warming trend accelerated in recent years. Thermometer ten warmest years since the last record in 1860 occurred between 1995 and 2005 [12].

The World Meteorological Organization has reported that 2005 was the second warmest year on record, surpassed only by 1998, when El Niño conditions in the Pacific Ocean result in a temperature rise above the average in the whole world. In the United States, the first six months of 2006 recorded the hottest period [13]. Scientists have proved that the Earth has been warming. Human activity, mainly the burning of coal and oil, has drastically improved gas concentration in the atmosphere retain heat. Researchers predict that global temperatures will continue to rise in the years ahead, with a significant impact on sea level and weather patterns, and the consequences for human health, ecosystems, and economies.

### ***3.2. Increasing of Greenhouse Effect***

Scientists studying the rapid rise in global temperatures by the end of the twentieth century. They said that natural variability cannot explain what is happening now. According to them, the main cause is the emission of carbon dioxide and greenhouse gases from human activity, mainly the burning of fossil fuels such as coal and oil. The sources of these gases, including deforestation, agriculture and industrial processes [14].

Scientists call what has happened on Earth during the last century as the "enhanced greenhouse effect". Greenhouse effect warms the earth and its contents, without it, the Earth's surface would be around cooler average of 60 degrees Fahrenheit. Because the Earth's average temperature is around 45 degrees Fahrenheit, the natural greenhouse effect is definitely a good thing. However, the increase in the greenhouse effect means that trapped solar heat exceeds that should, causing global temperatures to rise .

## **4. Impact of Climate Change**

### ***4.1. Productivity of Laying Hens***

In understanding and predicting the effects of global climate change on natural, management, as well as its relationship with socioecology system is one of the most urgent challenges that must be faced by science today. Spatial and time variation in the distribution of climate and no climatic stress factors often produce non-linear pattern (very complex) [15].

Observations regarding direct relationship to climate change by anthropogenic factors are also a challenge [16], due the fact that the impact of climate change on organisms and ecosystems [17, 18]. However, the scientific literature shows the very real effects of changing climatic conditions for some species in terms of distribution, penology, growth patterns, productivity and reproduction [19, 20, and 21].

Indonesia indicated the impact of climate change with the shift of the seasons and changes in rainfall patterns in various regions, such as Sumatra and Java [22]. Seasonal changes in rainfall patterns are allegedly able to have an impact on the incidence of climate-related disasters such as floods and dry. Changes in dry season becomes longer can turned on causing drought, while rainfall intensity increased during the rainy season could potentially increase the incidence of flooding in various regions in Indonesia. The last four decades is reported that the frequency of droughts in Indonesia increased [23]. This will obviously have an impact on the livestock sector in Indonesia; in this case one of them affects the productivity of laying hens.

Productivity of laying hens can also be influenced by environmental pressures as a result of climate change (such as heat stress), which may be one of the most common challenges in production systems worldwide. Decreased feed intake is the most harmful effects of heat stress at the beginning of laying hens production, which leads to a decrease in body weight, feed efficiency, production and quality of eggs [24, 25]. However, in addition to the reduction in feed intake, the impact of heat stress also leads to a decrease in feed digestibility, and decreased plasma protein and calcium levels [26].

In a recent study [25], periods of heat stress for 12 days led to a decrease in daily feed intake as much as 28.58 g / head, and a 28.8% drop in egg production. Reference [27] reported a 31.6% reduction in feed conversion, egg production by 36.4%, and 3.41% by weight of the egg laying hens experiencing heat stress. Another study also found that heat stress causes a decrease in the production performance, as well as reducing the thickness of the egg shell, and an increase in damage to eggs [28]. In addition, heat stress has been shown to cause a significant reduction of the weight of the eggs (-3.24%), egg shell thickness (-1.2%), egg shell weight (-9.93%), and the percentage of eggshell (-0.66%) [29]. This report was supported by research of [30] who also observed a decrease in egg production, egg weight and egg shell thickness in laying hens experiencing heat stress.

Another study conducted [8] reported that the laying hens is at a temperature of 30°C for a long time, will respond by reducing feed intake resulting in a decrease in egg production. When the temperature rose from 30°C to 38°C, the hens will produce eggs with thin eggshell due to a decline in calcium and bicarbonate in the blood of a chicken. At a temperature of 41°C higher risk of death, whereas at a temperature of 47°C has caused the death. Management guidelines laying hens breeding companies [31, 32, 33] determining an acceptable mortality rate between 0.8 and 1.5% per week. However, these figures are sometimes continues to increase.

In addition, the optimal relative humidity in various types of farms was between 60-70%. Climate change, especially when there is an increase in environmental temperature, with humidity above 70% can inhibit the process of spending the body heat and increases the potential multiplication of bacteria, parasites and fungi. In the case of humidity below 60%, the amount of dust in the air increases as well as cases of respiratory disease in chickens [34].

#### ***4.2. Economic Loss on Laying Hen Farms***

Global economic loss due to climate change will reach US \$ 4.3 trillion [35]. More pronounced economic losses to low-income countries (decades ago, the losses reached US \$ 100 billion per year) (Global Reinsurance Company Munich Re). Reference [36] explained that the harm caused by climate change to reach US \$ 9 trillion. The World Bank estimates that 40% of the development budget was derived from loans and foreign aid 'very sensitive' to the risk of climate change.

Economic losses due to climate change, directly or indirectly, in Indonesia in 2010 may reach 2.5%, four times the loss in GDP (Gross Domestic Product) global average as a result of climate change [37]. In fact, when the chance of disaster due to climate change is taken into account, the economic losses could reach 7% of GDP [37, 38].

On a hot climate, periods of high temperatures also have a negative effect on the health and performance of domestic livestock. Poultry farms are no exception and the effects of stress caused by the increase in temperature can result in enormous economic losses from increased mortality and decreased productivity [4]. Reference [5] suggested that in the laying hens farm, there are two sides to each other shows, namely; technical and non-technical side. The technical side includes all activities to raise chickens with all devices. While the non-technical side involves economics and management. Laying hens farm that relies only on the technical side

alone, sooner or later will be bankrupt. Farms were also only concerned with the non-technical side will experience many difficulties in raising chickens.

Furthermore, [5] explained that, there are three elements that must be considered laying hens breeders to the success of a company, namely;

1. Elements of production, farmers must know the balance between food production and disease prevention.
2. Unsure management, to control, and control the all the activities like livestock in an integrated and synchronized for the maximum benefit.
3. Elements of marketing, to gain an advantage.

Reference [4] stated that economic loss can be evaluated from: 1) a decrease in performance (feed intake, growth, and eggs production), 2) an increase in mortality, and 3) a decrease in reproduction. Research carried out [40] in the various regions in the United States reported that without the application of heat reduction method (minimum intensity), total livestock losses average \$ 2.4 billion/year. Intensity of heat optimal reduction reduces the total annual loss to \$ 1.7 billion. The average annual loss on chicken farms around \$ 128 million. In all US states, Texas, California, Oklahoma, Nebraska, and North Carolina accounted for \$ 728 million annual loss, or 43% of the total national loss.

## **5. Conclusion**

Based on the discussion, it can be concluded that ;

1. Effect of climate change on laying hens was on weight loss, feed efficiency, eggs production and quality.
2. Global climate change has an impact on the economic loss on laying hen farms.

## **6. Recommendation**

It is better for laying hen breeder not suffer from economic loss from climate change through knowing the balance between food production and disease prevention, good management practices and marketing. To prevent global climate, it is better to reduce the use of green houses. People should adapt with the climate change.

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