



The Insight into Layer Farm Performance under Climate Change at Malang Raya, Indonesia

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Abstract. Climate change impacted in livestock sector from up-stream, on farm production to down-stream and lead to threatened the performance layer farming and egg's consumption. Research aimed to examine the profile of the Karangsono Farm and its feasibility based on Break Even Point (BEP, Margin of Safety (MOS) and income of the Karangsono Farm in both rainy and dry seasons. This farm respondent located at Bululawang Subdistrict, Malang Regency was selected by purposive sampling method with criteria that raising around 20,000 laying hens with more than 10 years experience in operating layer farm. Data collection was carried out from April to May 2024. Survey using structured questionnaire was applied to gather primary data, whereas secondary data was provided by Karangsono Farm and related institutions. Descriptive and economic formulation techniques was applied to analyse the data involving profit, BEP and MOS. Results found that Karangsono Farm represented a sustainability layer farm from upstream (having partnership with industry for pullet, feed, and medicine), on-farm (raising the superior strain lohmann platinum chicken) to downstream (developing customer relationships). The economic performance of layer farm in dry season was better than those in rainy season in terms of MOS in dry season (21.88% vs. 21.74%) and profit (IDR 5,520 vs. IDR 4205 per KG egg) accordingly. The BEP in dry season (IDR 20,654/Kg of egg) however, appear least than those in rainy season (IDR 20,130/Kg of egg). The research implied the understanding toward the uncertain in climate impacts during rainy season and dry season which can help farmers in making informed decision to enhance productivity, reduce risks, and optimise profitability, hence layer farming can resilience to encounter the ongoing climate change.

Keywords: BEP, MOS, income, relationships, sustainability.

1 Introduction

The climate adversities become the big challenge to global animal industry, intensifying the weather, elevating temperatures and humidity and leads the decrement of livestock market. Climate change refers to the variability of atmospheric (CO₂), tropospheric (O₃), temperature, precipitation, storm surges and sea level rise, and becomes the big problems in worldwide food supply chain. External stressor, heat stress feed

can spill up the existence of the animal pathogen carriage [1]. The heat environment disturbs intensely in the animal life involving production performance (growth, the yield, volume and quality of meat, milk, egg), reproductive performance, metabolic and health status as well as the immune response [2]. The climate adversities can interfere extremely on livestock growth, production and welfare impacts [3].

In regard to layer farming, in one side, eggs become one of human diet that providing an important source of high-quality protein and micronutrients as well as healthy and nutritious with affordable price [4]. The layer farming also have contribution in family income, labour opportunity and sustainability food security. In the other side, climate change impacted in livestock sector from up-stream, on farm production to down-stream and lead to threatened the performance layer farming and eggs 'consumption. The erratic climate can increase temperature and impair climate which exposure the risk off heat stress in transporting animal, thereby make poor animal welfare and causing death [5]. The impacts of climate change from the hazards to the exposure and vulnerability in layer farming and the food availability. Poultry farming is susceptible to the risk of the extreme climate alteration for instance heat stress. Heat stress reduced feed intake and egg production and negatively affected egg quality [6]. This can also reduce the size of eggs and thickness of eggshells [7]. The heat stress condition can bring down the immune bird response toward vaccines, hence their response to infectious diseases [8]

Negative effects of heat stress reduced feed consumption, growth rate, feed digestion and efficiency, immunity, welfare, and survivability [9]. The large number in flock can engender heat stress then causes high mortality, lowest production, hence the profit of layer farm. Heat stress initially, causes feed conversion ratio and production performance that leads to decrease the production rate. Heat elevation can disrupt the acid-base balance, hence influencing several metabolic functions and the overall performance of chickens [10]. The important factors namely, FCR, feed composition and manure management respectively affect the total environment, then impacts on eggs production. Transport and energy has only minor effect on eggs production [11].

Climate change disrupt the food supply, access, and consumption, food security [12]. The impacts of elevating heat environment temperature happen in the whole aspects of the food supply chain, from production, processing, transport, wholesale, retailing, into consumption and beyond local supply chains which along longer supply networks [13]. Erratic rainfall pattern engenders in the decline of humidity and leads to several impacts, emerging diseases and parasites, increasing mortality, reducing feed and water intake, causing soft eggshell, lowering quantity and quality of egg production, raising production cost [14]. The multiple levels of chicken eggs systems involves concentrate feed and related inputs, on-farm production, marketing, distribution and chicken eggs demand for consumption together, become key to ensure food and nutrition security, equitable value chains, and positive environmental outcomes. Furthermore, the climate change will impact on these pillars and even affecting on their provision of goods and services (e.g. financial instrument), human livelihoods and health, ecosystems, economies, cultures, and infrastructure in complex ways. The study therefore, addresses to investigate the profile of the layer farming and to exam-

ine the impact of the climate change especially from economic point of view in term of BEP, MOS and profit under varying weather in both rainy and dry seasons.

2 Materials and Methods

2.1 Selection of Layer farming

The study is carrying out in layer farming located at Bululawang Subdistrict, Malang Regency that selected with multistage sampling method. Respondent of this research was determined by purposive sampling method. Some consideration in selecting this farm, first, this farm has reared about 20,000 layer with HDP around 90-95%. Second, they has longest (more than 10 years) experience in running this farm. Third, this farm still exists up to now even it has bad circumstances in the Covid period time. Therefore, the layer farming of the “Karangsuko Farm” has been chosen as respondent.

Primary data collection was carried out from March to April 2024. Survey method with structured questionnaire was applied to gather primary data. Secondary data was provided by “Karangsuko Farm” which including data from May 2023 -February 2024. In regard to this research, rainy season data presented from April to May 2024, whereas dry season data reported from May to October 2023.

Data was analysed based on the research objectives. The first objective is analysed using descriptive analysis to delineate the sustainability the up-stream, on-farm and down-stream sub-systems of the layer farming. The second objective is analysed by applying descriptive with economic formulation techniques namely BEP, MOS and profit [15]. The profit of layer farming can be formulated as below:

$$\Pi = TR - TC \quad (1)$$

where:

Π = Profit (IDR/month)

TR = Total Revenue (IDR/month)

TC = Total Cost (IDR/month)

3 Results and Discussion

The climate changes can disrupt the multiple level in layer farming system from up-stream, on-farm to down-stream and exposure the financial risks. The negative impacts of erratic climate emerge in the rise production cost, mitigate the egg production and leads to reduce in obtaining profit. This results will discuss the effects of the adverse climate in the financial risk with focus on the production of eggs impacts notably in procuring MOS, BEP, and profit accordingly in both rainy and dry seasons.

3.1 MOS IN RAINY SEASON

Margin of safety (MOS) refers the safety area in layer farming to measure the decrease of sales when the change of the in production, input and output prices are happening. In the rainy season, there is the adversely effect on concentrate feed consumption since the unpredictability environment humidity. These impair the eggs production as the presence of adding cost in adapting the change in concentrate feed and related inputs to ensure food and nutrition security. The influence of the climate change on the margin of safety of layer farming during rainy season can be seen in the Figure 1.

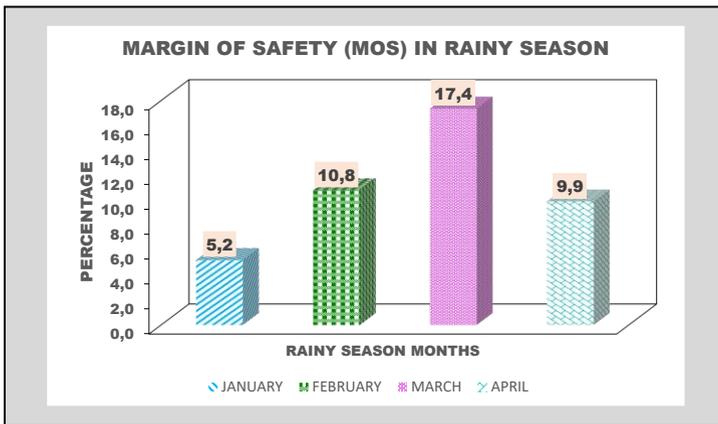


Fig. 1. Margin of Safety (MOS) in Rainy Season.

The fluctuation and intend to decline trend of the MOS of layer farming happens in the rainy seasons. MOS starts from 5.2% in January, then increase up to 17.4% in March and drops into 9.9% in April. The worst MOS is about 5.20% which exists in January. It means that the layer farming remains in the safety area when the egg's price decrease into 5.2 % (IDR 22.193). On the other hand, the decline beyond 5.2% of egg price will exposure the loss of layer farming. The best (17.4%) MOS occurs in March, this can interpret that the layer farm stays in safety position regarding financial performance when the egg's price dropped into 17.4% (IDR). On the contrary, the decline of egg price more than 17.4% will make this farm more vulnerable to loss. The unusual temperature in rainy season can exposure diseases that reduce feed consumption, therefore this impacts on laying hens weight loss, feed efficiency [16] and eggs production and quality [17]. The climate change can exposure diseases that reduce feed consumption, therefore this impacts on laying hens weight loss.

3.2 MOS IN DRY SEASON

In the dry season, there is the adversely effect on concentrate feed consumption since the uncertain environment humidity. These impair the eggs production as the exist-

ence of adding cost in adapting the change in concentrate feed and related inputs to ensure food and nutrition security. The impact of the climate change on the margin of safety of layer farming during rainy season can be seen in the Figure 2.

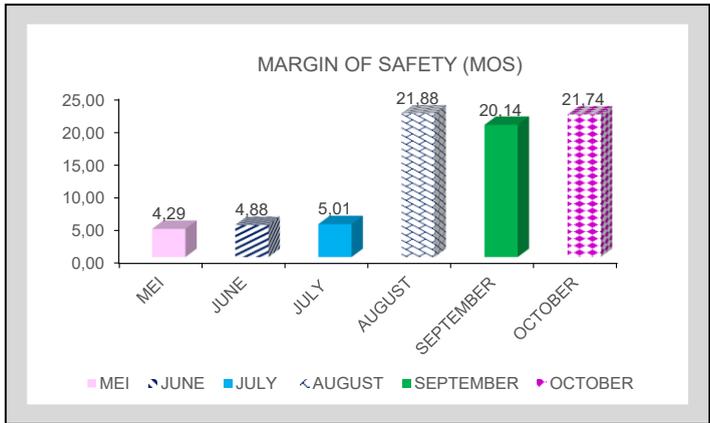


Fig. 2. Margin of Safety (MOS) in Dry Season.

MOS in the dry months exhibit the fluctuation and intend incline trend, it displays 4,29% in May and increase into 21.74% in October. The worst (4.29%) MOS presents in May, it means that the egg’s price is going down into 4.29 %, the egg’s price still in the safety area. If the egg’s price fall more than 4.29% will experience the loss. The best (21.88%) MOS displays in August. This means that the farm still have financial in safety when the decline of price into 21.88%). On the contrary, the decline of egg price more than 17.4% will make this farm more vulnerable to loss. The unusual temperature in rainy season can exposure diseases that reduce feed consumption, therefore this impacts on laying hens weight loss, feed efficiency [16] and eggs production and quality [17]. The climate change can exposure diseases that reduce feed consumption, therefore this impacts on laying hens weight loss.

3.3 BEP IN RAINY SEASON

The climatic adversities during rainy season disturb the physiological homeostasis of chickens, precipitate notable declines in production efficacy. The impact of the temperature–humidity index, with a focus on the production costs egg. The impact of the climate change on the Break Even Point (BEP) of layer farming during rainy season exhibit the comparison between Market Price and BEP price (Figure 3).

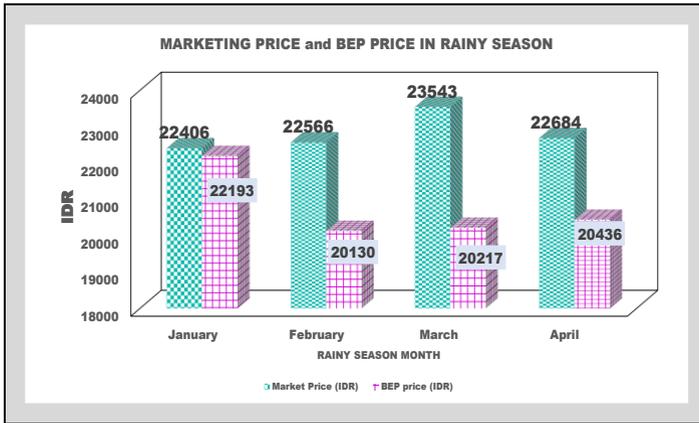


Fig. 3. Market price and BEP price in rainy season.

BEP price shows the decline trend from IDR 22,193 in January into IDR 20,436 in April. On the contrary, the fluctuation market price and to decline happens in the range January to April of the rainy months. The best BEP price occurs in February approximately IDR 20,130 which means that layer farming can reach efficient production cost in producing one Kg of eggs. The recent market price of eggs even appears the highest one, thereby the margin price highest one about 14.04%. This invention contrast with [8] that the large number in flock can engender heat stress then causes high mortality, and feed conversion ratio. This is because the layer farming can eliminate and adapt with the adverse effect of heat stress in hens nutritional, for instance using the good quality of feed concentrate and improving the good layer farm practice. Adaptation toward floods in rainy season became the crucial factors to address uncertain climate [18], whereas mitigation can diminish greenhouse gas emission which it became critical issue both economically and environmentally [19, 20].

3.4 BEP IN RAINY SEASON

Break even point measures the production cost that required to produce the chicken eggs. The climatic adversities during dry season disturb the physiological homeostasis of chickens, precipitate notable declines in production efficacy. The impact of the temperature–humidity index, with a focus on the production costs egg. The impact of the climate change on the Break Even Point (BEP) of layer farming during dry season exhibit the comparison between Market Price and BEP price (Figure 4).

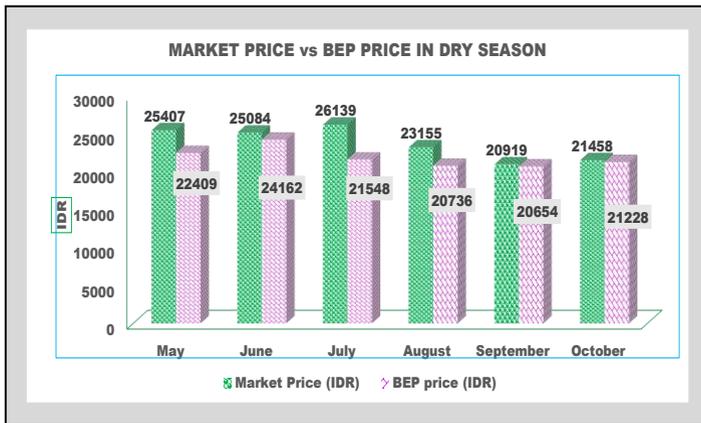


Fig. 4. Market price and BEP price in dry season.

Figure 4 indicates the less fluctuation in BEP price during dry season months. The best one of BEP price (IDR 20,654) occurs in September, whereas the worst (IDR 24,162) comes from the month of July. The market price trend has the similar slightly fluctuation trend in which the highest market price (IDR 26,139) exists in July, while the lowest (IDR 20,654) happen in September. The best BEP price occurs in September approximately IDR 20,654 which means that layer farming can reach efficient production cost in producing one Kg of eggs. The layer farmer can use the efficient expenditure (IDR 20,654) in producing one Kg of eggs. This discover reinforces with The findings confirm with [7] that a hot environment reduces productivity, impacts fertility, and increases susceptibility to disease. It can also impairs production (i.e, egg yield, weight, and quality) and reproductive [8] that the large number in flock can engender heat stress then causes high mortality, and feed conversion ratio. This is because the layer farming can eliminate and adapt with the adverse effect of heat stress in hens nutritional, for instance using the good feed concentrate quality and improve the good layer farming practice. The market price margin of eggs however, delineates the highest (21,37%) on July in comparison with 1.28% those on July September due to the uncontrollable the eggs market price. This circumstances explain that the market price is determined by eggs' demand and supply rather than best BEP only.

3.5 PROFIT IN RAINY SEASON

The impacts of climate change from the hazards to the exposure and vulnerability in layer farming and the food availability. Poultry farming is susceptible to the risk of the extreme climate alteration for instance heat stress. The uncertain weather during rainy season causes the profit fluctuation. This wet season increase the environment humidity, then reducing in the chicken egg production. The effect of wet environment on the profit of layer farming during rainy season demonstrate in Figure 5.

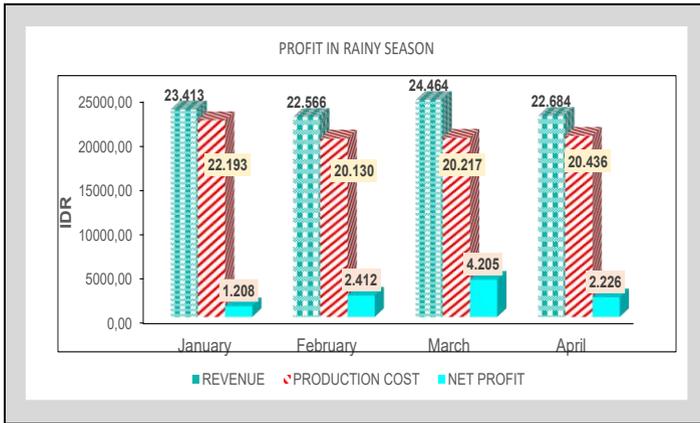


Fig. 5. Profit of layer farming in rainy season.

Profit of the layer farming in rainy season fluctuates and tend to decline, initially IDR 1, 298/Kg eggs in January, then incline to IDR 4,205/Kg of eggs on March, finally sharply drops into IDR 2,226/Kg Eggs in April. The layer farming can achieve maximum profit about IDR 4,205/Kg eggs in March. This is supported by the highest revenue (IDR 24,464/Kg of eggs) and the efficient of layer production cost (IDR 20,217/Kg of eggs). The highest revenue occurs in March about IDR 24,464/Kg eggs due to the highest HDP (85.13%), the efficient of FCR (2.27), the large normal eggs (98.24%), less cracked egg (1.76%), and the good market price margin (16.28 %). The layer farm in the wet season can make the efficient production costs notable in March (80.71%), FCR (2.27%), Vitamin cost (1.63%), labour cost (3.43%), hence the greatest income, respectively.

The least profit in January relates to little revenue about IDR 23,143/Kg of egg and inefficient in the expenses. Heat stress during rainy season firstly has influenced feed consumption ratio to increase about 2.17 and this can stimulate the high feed cost (79.25%). Secondly, the market price margin became smallest (0.96%) and resulted on the small revenue thereby the profit will shrink into IDR 1.208. The rainy season often increased humidity, inclined disease risks and reduced feed quality that may affect egg production and feed conversion efficiency led to higher costs and lower farm income. The stress on hens during wet season also lowered egg quality which may decrease in egg price and even a reduction in demand, especially for buyers who concerned about product quality. This can further squeeze profit margins. The findings agree with [2] that heat stress in wet season can increase the production cost, disrupt extremely in layer chicken performance, therefore profit will go down, accordingly.

3.6 PROFIT IN DRY SEASON

The climate changes can disrupt the multistage system process on layer production from up-stream, on-farm to down-stream and exposure the financial risks. The negative impact emerge in the increase production cost, mitigate their production and will impact on profit. The impact of heat environment on the profit of layer farming during dry season is delineates in Figure 6. Trend profit of layer farming in dry season fluctuates and intend to decrease sharply in September and October. Likewise, profit fluctuates and reduce trend, previously IDR 4,093 in May, then incline to IDR 5,520 in July, finally sharp drops into IDR 227 in October.

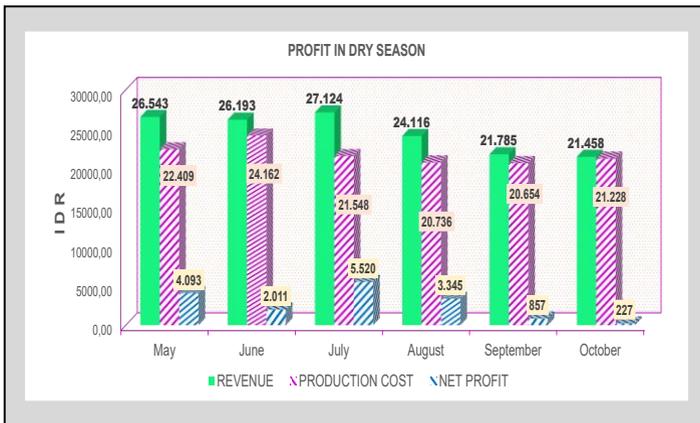


Fig. 6. Profit of layer farming in dry season.

The profit Per Kg of egg is previously IDR 4,093 in May, then incline to IDR 5,520 in July, and drops deeply into IDR 857 in September and IDR 227 in October. The best profit in July relates to revenue about IDR 27,124/Kg of egg. Good HDP (82.52%), the number of the normal eggs 98.23%, cracked eggs 1.77% and the more margin between market price and BEP price (21.31%) relates to good revenue. The efficient expenditure involves FCR (2,41), 1,53% vitamin, 3.32% employment, hence the farm can obtain the greatest profit in the dry season. The minimum profit of the layer farming is about IDR 227/Kg of eggs, however, it appears in the month of October. There is little differences layer farming revenue (IDR 21,458/Kg of eggs) and the production cost (IDR 21,228/Kg of eggs). The invention confirms that heat stress in dry season mitigates egg quality (e.g. thin and breakable eggshell) and alleviates egg weight with small size, hence dropping production. The adverse effect of heat stress on laying hens was on weight loss, feed efficiency, eggs production [16], lowering egg quality [6], reduce the size of eggs and thickness of eggshells [7] and unable to meet the maximum egg production, hence the egg market will go down [8].

4 Conclusion

Study on layer farming performance under climate change, specifically during the rainy and dry seasons, provides valuable insights into the operational challenges and opportunities faced by poultry farmers. The rainy season often leads to increased humidity, which may affect egg production and feed conversion efficiency, while the dry season tends to exacerbate water scarcity and heat stress, impacting the health of the hens and ultimately, productivity. Farmer showed variability adaption and different management strategy depending on rainy season or dry season to mitigate the adverse effects of climate change. This study provided a comprehensive understanding toward the uncertain in climate impacts during rainy season and dry season and help farmers make informed decision to enhance productivity, reduce risks, and optimise profitability which can address layer farming resilience to encounter the ongoing erratic climate. The study therefore, presented the following conclusions:

1. Layer farm represented a sustainability layer farm from upstream (having partnership with industry for pullet, feed, and medicine), on-farm (raising the superior strain lohmann platinum chicken) to downstream (developing customer relationships).
2. The layer farming has ability to adapt and mitigate toward the unfavourable impacts of climate change in maintaining the long-term economic sustainability.
3. In the rainy season, the layer farming can obtain the best economic performance including MOS (21.74%) displays in April, the best BEP price occurs in February approximately IDR 20,130/Kg of egg with the highest margin price highest 14,04% and the maximum profit about IDR 4,205/Kg eggs in March.
4. In the dry season, the layer farming can achieve the excellent economic performance involving MOS (21.88%) in August, the best BEP price occurs in September approximately IDR 20,654/Kg egg, the market price margin in (21.37%) on July and the best profit The best profit (IDR 5,520/Kg egg) in July.

5 Research Limitation

1. The study conducted in a limited geographic area, which means the findings may not be applicable to all regions with varying climates or layer farming practices.
2. Every region may have diverse types of climate change impacts (e.g., increased rainfall, prolonged droughts), hence it might lead to difficulty to generalise the research findings across the different area.
3. The fluctuation price of inputs (e.g., feed, vaccines) and outputs (e.g., eggs) might not be fully captured in the study, especially when considering only the direct climate-related variables climatic conditions.

6 Future Research

The future research need to elaborate the import The future research need to elaborate the importance of understanding the dynamics between climate change and layer farming performance involving:

1. Research regarding the strategy adaption towards the erratic climate to ensure the resilience layer farming.
2. Developing research in the economic modelling and policy support to sustain layer farming in the face of the ongoing climate change.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

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