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Design and development of broiler farm dashboard: enhancing farm management decision-making and performance measurement

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The poultry sector supplies over 65% of all animal protein and employs around 12 million people, or 10% of the workforce. About 85% of the broiler sector is dominated by the partnership structure. Although the core plasma partnership is one answer to the paucity of resources (financial, technical, and human), the partnership system has resulted in several issues: the dependence of plasma farmers on their partner management firm renders their bargaining position with the leading corporation weak. On the other hand, broiler farmers had limited records regarding their farming activities and financial costs, hindering their ability to assess their overall performance thoroughly. Furthermore, most prior broiler farm studies focused only on comparing a specific treatment effect on the single farm performance. Therefore, research on measuring various farm performances is essential. In order to provide a solution for manual accounting, it is necessary to implement an information system. The study focused on constructing dashboards for farm management and performance measurement of broiler farmers. Even more, the previous dashboard development study rarely focused on broiler farms. The dashboard is expected to provide independence in bookkeeping, maximize present farming cycle profit, and measure future performance. The self-service business intelligence methodology was utilized to create and construct the dashboard. Based on the findings, five dashboards were developed, each providing an extensive overview of the history of all farming periods, red, amber, and green analysis, all farming performance, and harvest setting for maximizing profit.

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1. INTRODUCTION

Recent increases in both production and consumption of meat have been attributed to growing incomes. With an annual rise of 83 million population in the last decade, the demand for meat has grown proportionally [1]. The consumption of poultry and pig meats has increased faster than any other form of meat on the market [2]. Furthermore, chicken meat consumption has increased around the globe. Indonesia's poultry sector covers over 65% of the country's total animal protein supply and employs roughly 12 million people (10% of the total workforce) [3].

As seen in Fig. 1, Rabobank anticipates significant industrial development, although slower than in previous decades. The big businesses are

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contemplating additional expansions due to the tremendous growth in 2017 and 2018. It is worth noting that in several countries, integrated firms hold a portion of the broiler production chain [4]. It means that integrated firms own not only broiler farms but also feed facilities, slaughterhouses, processed chicken products and even the supermarket [5]. Before the production stage, the broiler must go through the farm-raising stage. In Indonesia, there are several types of broiler farms. Individual farms comprise 15% of the total, while internal business partnerships account for 45% and external business partnerships account for 40% [2]. Evidence suggests that the partnership structure accounts for around 85% of the broiler farming market. In Indonesia, core-plasma partnerships are a typical business collaboration for raising broilers.

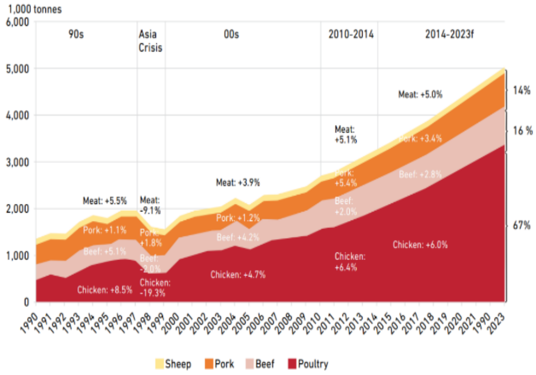

Fig. 1. Indonesia meat market [6]

In the core-plasma relationship model, livestock companies (the core) and broiler management farmers (the Plasma) work together for the benefit of both parties by providing farmer with access to processing facilities and inputs for the Day Old Chicken (DOC), feed, medications, and the selling of poultry products [2]. This partnership model integrates productive farm management with various livestock processing methods. Modernization and concentration have contributed to the growth process. Charoen Pokphand Indonesia, the Indonesian broiler chicken market leader, had 31% of the poultry feed market and 41% of the Day Old-Chicks market in 2017 [7].

Even though the core-plasma collaboration is one answer to the problem of insufficient capital, technology, and labor impeding the expansion of the broiler business, these constraints remain. However, Nurtini *et al*. [8] note that the existing partnership has led to several issues: (1) the plasma farmer has a significant dependency on the partner management company; (2) the plasma farmer's bargaining position with the leading corporation is poor; (3) the rural population does not usually accept the distribution and marketing of broiler distribution systems; and (4) small-scale farmers should be well prepared for the broiler market.

The broiler farmer situation reveals that capital procurement, input and output price fluctuation, and supporting farmer resources, including human resources, are shortfalls. The widespread reliance on manual bookkeeping processes increases the risks of information loss and mistakes [4]. In addition, one party often suffered a financial loss due to data divergence between the plasma farmer and the main corporation. Broiler farmers seldom maintain extensive records on farm activities or economic expenditures, making performance evaluations difficult [9]. The problem highlights the need for research into farm performance measurement.

Although prior researchers and professionals have extensively adopted several approaches to assessing performance, each kind of farm, including broiler farms, has its unique set of key performance indicators. Masoudi *et al*. [10] utilized mortality, body weight increase, weekly feed consumption, feed consumption ratio (FCR), income over feed and chick cost (IOFCC), and european economic factor (EEF) for poultry or index performance (IP) for broiler farm performance.

Introducing an information system is crucial for resolving the issue of manual bookkeeping. The optimal use of raw data and its integrated, real-time management may benefit from using information systems [11]. One of the most well-known information technology (IT) platforms is business intelligence (BI). For many businesses, BI seems to be a key driver of success. Studies have shown that many BI implementations fail, indicating that putting up a successful BI system is no simple task. Lack of IT specialists and heavy reliance on the IT department are two of the most common causes of a failed BI deployment.

Most Indonesian broiler farmers also lacked access to adequate information technology infrastructure [12]. Self-Service Business Intelligence is the solution given by Imhoff and White [13]. SSBI enables non-technical business users to acquire, analyze, and evaluate business and environmental data without IT aid [14]. In conclusion, the research would use Self-Service BI to facilitate the development of a dashboard for a broiler farm. This research focuses on a suggested dashboard design for farm management and performance measurement of broiler farmers.

2. RESEARCH METHODS

2.1. Object and subject

The main objective of current research is to create a dashboard that can be used to track and analyze critical indicators of a broiler farm's performance. The scope of the studies is limited to the broiler farming process periodically (approximately 35-45 days). Three farming periods worth of data from Farm A were evaluated, as well as data from Farm B for two farming periods. The research aims to provide a dashboard design for use in performance monitoring, assessing, and evaluating broiler farmers. In addition, the dashboards are built to be self-sufficient in terms of bookkeeping, to maximize the profit of the present farming cycle, and to measure future performance.

2.2. Related works

The related works section provides an overview of prior research relevant to the current study's topic. Its purpose is to utilize previous research as a point of reference for developing methodologies and addressing issues in the present research. Specifically for scoping broiler chicken performance measurement, much prior research specifically mentioned broiler performance.

The rate of depletion, food intake, body weight at harvest, FCR, and IP measures Nuryati [15] stated broiler production success. The result by Mahfudz *et al*. [16] stated that the denser the farm, the higher the amount of consumption and FCR. Broiler chickens kept at a cage density of 12 birds per square meter benefit significantly from a 1% black cumin supplement to increase their productive efficiency. Nuryati [15] analyzed broiler chickens' performances within closed and opened-house farms. Results showed that in closed farms, mortality was 13.07%, feed consumption was 2.53 kg/bird/day, harvested body weight was 1.43 kg/bird/day, FCR was 1.78, and IP was 213, whereas, in open houses, it was 7.70%, 2.24 kg/bird/day, 1.38 kg/bird/day, FCR was 1.78, and IP was 255. In contrast, broiler chicks raised in a more natural environment or open houses have better growth and productivity. Broilers' performance in both housing forms was poor, as indicated by a performance index of below 300.

In order to see how elevation affected broiler chicken productivity, Nugraini *et al*. [17] conducted the research. Body weight gain (WG) in the finishing phase, FCR in the starting and finishing phases, IP in the starting and finishing phases, and IOFCC were all shown to be significantly influenced by altitude ($P<0.05$). Based on the results of this research, it can be stated that raising broiler chickens at a medium height is more lucrative than doing so at a high or a low altitude. Sugiarto *et al.* [18] discusses the issues that influenced the commercial choices of broiler chicken producers during the COVID-19 epidemic. Most broiler farmers (75.5% in this study) were determined to keep operating during the COVID-19 epidemic, while the other 20% temporarily halted operations. The discriminant analysis found a significant discriminant function ($P<0.01$). Two categories of business choices may be distinguished by considering several independent factors. Broiler farmers' judgments on whether or not to continue operations are significantly influenced by the farmers' age, the farmers' level of farming experience, the size of their farms, and the farmers' perceptions of the effect of the COVID-19 epidemic.

Lennerholt and van Laere [19] delved through the literature to find a solution to the challenge of putting Self-Service Business Intelligence (SSBI) into practice. In this research, the author examines the literature and identifies six issues with SSBI, four associated with independent users, and one overall issue with the system's design. Silahtaroğlu and Alayoglu [20] assessed the usefulness of a BI system. As part of this study, interviews were conducted with the senior executives of organizations operating in various sectors. The research showed that, as may be expected, eight of the companies surveyed were not using any strategic management techniques. Evaluating a BI system's quality has boosted the effectiveness of management control systems. This study's results showed that BI improves performance evaluation methods' accuracy. Gaining a strategic advantage requires these skills.

Vajirakachorn and Chongwatpol [21] investigated the potential of using a business intelligence framework to control and process data into insight for festival tourism. The research used a solution that included database administration, analytics, and data visualization to gain an understanding of the site visitors' records. Radenkovic *et al*. [22] examined the intelligent grid's analytic components and how they may be used in BI research. This research shows that monitoring performance and handling the market can be done more effectively with business intelligence.

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Immawan *et al*. [23] used the specific, measurable, actionable, relevant and time (SMART) method, the analytical hierarchy process (AHP), and the objective matrix scoring system to evaluate the performance of small and medium enterprises. The study has published 31 key performance indicators due to the study efforts. The right improvement solution for a small or medium-sized business may be evaluated using a dashboard displaying the most important aspects.

Burhanuddin [24] has the closest similarity to the current research, which inducted the use of an information system for core-company in order to control the provision of animal feed, determine the effectiveness of daily feed through the indication of FCR, determine the harvest performance of farmers based on IP calculation. However, Burhanuddin [24] mainly support the core company by reducing operational cost for Technical Support (TS) and simplifying the company for controlling their plasmas. It increases the possibility that plasma's bargaining power will weaken over the core company, and plasma will become more dependent on the core company.

The prior broiler farm studies mostly highlighted the special condition or treatment effect on single or some farm performances, for instance, the effect of altitude to FCR, the effect of density on mortality, et cetera. Furthermore, the prior dashboard development studies rarely focused on broiler farms. It referred to all of the previous studies mentioned above. Therefore, the current study would combine the farm performance and dashboard development study.

The suggested dashboard model provides complete assistance to broiler farmers. It enables them to transform their raw data into an easily understandable and visually appealing format, facilitating the tracking of farm performance indicators mentioned earlier. By acquiring the necessary skills to create and utilize a dashboard, broiler farmers can evaluate their future performance independently. As the dashboard provides valuable information on different farm performance indicators, it assists farm decision-makers in monitoring and assessing the overall progress and performance of the farm. Moreover, since the farm performance relies on daily operational activities, the suggested dashboard can be classified as strategic and operational, catering to different aspects of farm management.

The research would use Self-Service BI to facilitate the development of several dashboard for broiler farm. This research focuses on a suggested dashboard design for farm management and performance measurement of broiler farmers. Furthermore, various farm performance indicators employ red, amber, and green analyses. Green signifies the target, yellow indicates approaching the target, and red signifies a failure to meet the target (far from the target).

2.3. Data collection

The information collected as primary data comes directly from the operations or activities carried out in the field. Primary data collection is conducted and aims to provide a broad picture of the research objective. Primary data are collected by physically assessing the daily conditions of the farm and conducting interviews to determine how the dashboard should be designed for the farm owner. In addition, reports that were utilized and classified as primary data had a significant connection to the determined farm performance indicators. Secondary data was collected from past studies of organizational records, books, papers, articles, interviews, and focus group discussions with broiler farm owners and employees. Secondary data were used throughout this investigation to provide research support and further strengthen qualitative definitions.

Interviews and a focus group were conducted with Grogol Broiler farm owners, farm workers and technical support from the core company to gather the necessary information. Additionally, data was gathered on-site at Grogol Broiler Farm A and Farm B using a combination of in-person interviews and direct observation, as well as secondary data gleaned through article publications and other sources. Daily farm recap information is required for the research.

The farm records the farming operations daily on three recording papers which provide information about daily mortality, defect chicken, mortality, cumulative mortality, used feed, and cumulative feed used. Three recording papers each provide daily farming information on the first floor, second floor and a total of both. Unfortunately, the recordings are moved to trash after the farming period.

2.4. Data processing

Once the data collection phase is complete, the data processing phase will provide a broad picture of how to establish a BI system and design the development of various dashboards.

2.4.1. *Farm performance criteria*

Technical factors, such as the weight of the chickens, the weight of the harvested chicken, and the mortality rate, are often used to evaluate the efficiency of a chicken farm—other factors include FCR [25]. Broiler genetics are continuously improved to enhance desirable traits and performance characteristics through selective breeding and genetic selection programs (Table 1). Improvement of broiler production performance focuses on enhancing the feed efficiency of broilers. Producers can reduce feed costs and optimize resource utilization by selecting birds with improved FCR, which means they convert feed into body weight more efficiently. Furthermore, Table 1 indicates that broiler growth rates and increased body weight are improved. By selectively breeding broilers with higher growth potential, producers can achieve faster growth rates, resulting in larger and heavier birds at market age.

Table 1. Broiler production performance development since 1975

Year	Harvested age (day)	FCR	Harvested weight (kg)
1975	56	2.1	1.71
1980	53	2.05	1.78
1985	49	2	1.9
1990	48	2	1.98
1995	47	1.95	2.12
2000	46	1.95	2.28
2005	44	1.9	2.38
2008	42	1.76	2.63
2013	42	1.71	2.71

In most cases, a company's core businesses provide performance requirements for broiler production. These recommendations are then utilized as a reference for acceptable farming hens. Data from the United States and Brazil are usually used as indicators of the capacity of the worldwide broiler production market. It is because both countries can compete in the global broiler production market. The changes in production performance reported by poultry associations in the United States may be seen in Table 1. The United States is the leading producer of broiler chickens across the globe.

Optimizing broiler performance depends on factors like DOC strain, feed, and management. Farm management significantly determines the management factor itself. The farm is crucial to the success of a broiler farming business that engages in intensive breeding.

Daily body weight gain is determined by subtracting body weight at the moment of weighing from body weight on the previous day. The increment in daily body weight of broilers is not constant but grows until it achieves its maximum growth rate, after which it declines [16]. According to Reece and Lott [25], that body weight gain is a more accessible measure to give a clear picture of growth. The growth of broilers is very fast and starts from hatching until the age of 7 weeks, after which the growth rate will decrease.

Based on Li *et al.* [26], variations in sex, feed intake, habitat, seeds, and feed to gain quality influence body weight. The rate at which chickens increase body weight is determined by genetics (strain), gender, environment, management, and the quality and amount of the feed they eat. In contrast to when they are under stress, the process of weight gain in broiler chickens may function well when kept in a comfortable environment. Due to the elevated temperature on the farm, the chicken will experience stress if it cannot expel excess heat [27].

Mortality is a measure of the number of deaths (generally or as a result of a particular cause) in a large population on a large scale [14]. At the same time, defective chicken means chickens are in an unhealthy condition and have physical disabilities or diseases in their bodies. Defect chickens are required to be removed from the farm because the disease they are suffering from allows it to affect the health condition of the normal chickens on the farm. Therefore, the defective chickens accumulated mortality due to the similarity that the chickens had been removed from the farm.

The depletion rate is affected by various variables, including body mass, country, chicken breed, climate, ambient cleanliness, equipment and cage sanitation, and illness [28]. North and Bell [28] also concluded that broiler raising was adequate if the total depletion rate was less than 5%. If an event is found to have an excessively high depletion percentage, a possible cause must be sought [29].

The relationship between the amount of food consumed and the amount of weight gained over a certain period constitutes the Feed Conversion Ratio [29]. FCR is a metric used to evaluate livestock efficiency; More feed is required for the same quantity of growth if the FCR is high. FCR

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indicates how efficiently chickens utilize feed to grow and develop; a lower FCR value indicates efficiencies. A high feed conversion number implies poor feed efficiency, whereas a low feed conversion value shows chickens consume little feed [30].

The IP was developed To assess whether a broiler farm is successful. This index was created in Europe under the name EEF to evaluate the economics of a broiler farm. This indicator covered average body weight over a certain age, FCR, and the percentage of chickens alive during farming [31]. A higher performance index value suggests efficient and effective broiler raising. According to Cardinal *et al.* [32], the performance index can be categorized as follows: (1) IP ≤ 299 indicates poor performance; (2) 300 ≤ IP ≤ 325 indicates the fair performance; (3) 326 ≤ IP ≤ 350 indicates satisfactory performance; (4) 351 ≤ IP ≤ 400 indicates very satisfactory performance; and (5) 400 ≤ IP indicates excellent performance.

IOFCC indicated gross income computed by deducting the income from the sale of chickens from the total expenditures paid throughout the farming cycle for feed and day old chicks [15]. However, most Indonesian broiler farmers know IOFCC as rekapitulasi hasil panen peternak (RHPP). The only difference between RHPP over IOFCC is that RHPP considered the chemicals (drugs and vitamins) given by the core company as additional expenditures.

The selected metrics of farm performance include daily gain, average harvested body weight, depletion rate, FCR, IP, and IOFCC. The following formulae are used in broiler farming's daily summary in order to compute key performance indicators for each farm:

Daily body weight gain = Weight current day - Body weight yesterday (1)

Average harvested body weight = Total weight harvested / Total chickens harvested (2)

$$Depletion=\frac{Total\ mortality + Total\ defect}{Total\ population}*100\ \% \quad (3)$$

$$FCR = \frac{Total\ weight\ of\ feed\ intake}{Total\ weight\ of\ chickens} \quad (4)$$

$$IP=\frac{(Average\ Body\ Weight * \%\ chickens\ alive)}{(FCR * Age\ of\ harvest)}*100\% \quad (5)$$

IOFCC or RHPP =Total sales of harvested chickens – (Feed expenditure + DOC expenditure + chemicals expenditure) (6)

2.4.2. *Dashboard development*

The first step, dashboard development, must analyze system requirements. A system requirement analysis aims to establish the features and capabilities the resulting system must have, including the system's functional needs. All metrics for farm performance would be subjected to a systematic study of system requirements. The issue statement and study objectives pointed to the necessity for developing performance assessments utilizing Self-Service BI to create the suggested dashboard for providing farm performance criteria.

It proposed that farm management based on farm performance utilizing self-service business intelligence has to be developed based on the issue formulation and research purpose. There are three distinct sorts of farm performance proposed dashboard: all farming periods performance history, red, amber, and green analysis single period with daily farming operations performance and decision support for determining the appropriate harvest time. In order to develop information systems from each analysis, researchers must first identify system specifications, which include the system's functional needs.

After a thorough review of the system requirement has been completed, the following step is to design the system graphically in purpose so the broiler farmer may have access to actionable business knowledge and streamline their decision-making processes. In Sherman [33], the author outlined a six-stage procedure for creating an SSBI dashboard. The six stages are scope and planning, analysis and define, architectural design, construction testing and refining, implementation, and rolling out. The research has only covered the design phase of dashboard creation, skipping beyond implementation and deployment.

Furthermore, the writer captured the farmer or user perception of the dashboard:

1. Simplified farm data visualization
   Dashboards present data visually appealing and concisely, making it easier for users to interpret complex information and identify trends, patterns, and outliers.
2. Farm real-time monitoring
   Dashboards often provide real-time or near real-time data updates, allowing users to stay informed about the latest information and make timely decisions based on the most current data available.
3. Farm performance tracking

Dashboards enable users to track farm performance indicators and progress towards goals or targets. It helps assess performance, identify improvement areas, and make data-driven decisions.

4. Customization and personalization
   Dashboards often provide options for customization, allowing users to tailor the displayed information based on their specific needs and preferences. This flexibility enhances user experience and relevance.
5. Improved decision making
   By providing clear and accessible data, dashboards empower users to make informed decisions, identify opportunities, and address challenges more effectively.

After determining farm performance requirements, the researcher develops the business intelligence system's scope. Its scope and plan limit system design and development. The scope is reviewed and discussed with relevant parties at Grogol Broiler before the researcher decides the extent of the system design for business intelligence. The defined system scope is farming period history, farm performances, and harvest setting. After defining the research parameters and developing a strategy for the business intelligence system, the researcher collaborated with Grogol Broiler to conduct the validation. Validation ensures that the study object is a good fit for scoping the proposed business intelligence system's scope and development strategy.

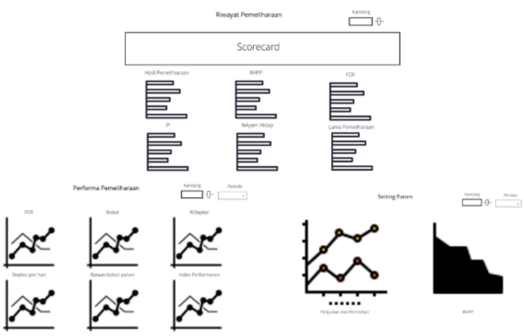

Fig. 2. Validated dashboard initial design

This verification is conducted together with Grogol Broiler's owner. This discussion aims to combine the research design findings with the needs of the BI infrastructure. Fig.2 displays validated prototypes of three distinct dashboards.

Scope and plan limit system design and development. Analyze and plan specific farm performance data utilized to develop the BI system that required broiler farmer data must be processed. Once building a dashboard, the researcher only retrieved information already available inside the farm. New information, once processed, can serve as a warehouse database for the Grogol Broiler BI system. The farm data is exported to Excel, and once it is cleaned up to fit the specifications, the data is imported to Tableau. After processing, the current data may serve as a broiler farmer's warehouse database.

The researcher then employs a preliminary data warehouse generated in the analysis and defines the phase. For Tableau to function, the input data must be compatible with the system specifically for its connectivity and format. Because Tableau only supports a small subset of data types (Excel, SQL, and Python), the first step is to convert the farm data to Excel. The paper-based farm summary data will be entered into an electronic spreadsheet. The ETL (Extraction, Transformation, and Load) will be used to cleanse data that is already in Excel format (remove information that is irrelevant to the study purpose) and then split the data into sections (transformation). This process aims to create a warehouse database that works properly with the software.

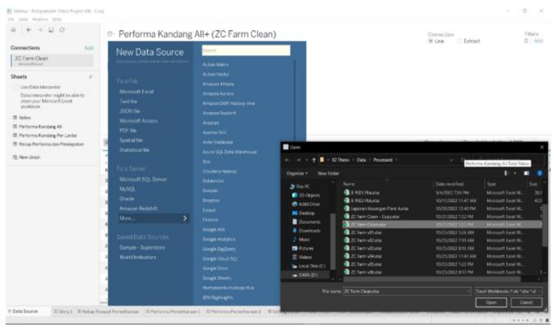

Fig. 3. Data importing process

After ETL, the warehouse database is in a usable state to be loaded into Tableau (Fig. 3). By using the Extract-Transform-Load (ETL) technique and then loading the data into Tableau, It is possible to create a dashboard to examine the data warehouse. The built-test-refine phase yielded a dashboard for measuring broiler farmer performance and a report detailing the most critical aspects of various farm performance metrics.

3. RESULTS AND DISCUSSION

After obtaining farm performance indicators, five dashboards were developed as part of the

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research to support managerial decisions on farms.

3.1. History of all cycle dashboard

The farm's farming activities were depicted in a general history of all cycle dashboards. Because of the available filter, users may choose the farms that best suit their needs. Multiple choices exist for the kind of farm specified to choose. Fig. 4, for instance may show users which farm, among all farms, has the greatest RHPP value during the last five periods.

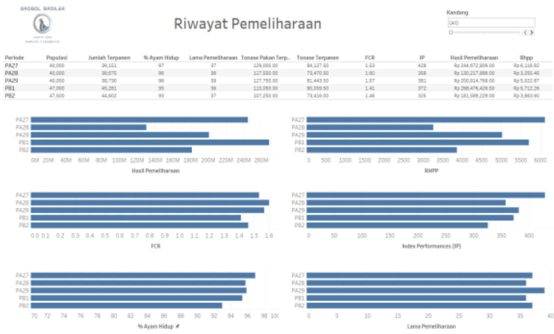

Fig. 4. History of all cycle dashboard

3.2. Red, amber, and green analysis dashboard

Fig. 5 presents the red, amber, and green analysis dashboard. Most traffic-light systems will incorporate repeated-measures data. Many of these measurements occur daily, aggregated weekly or monthly values along with rolling averages are often then calculated to describe trends in the data and facilitate analysis [34]. However, when group data are pooled without accounting for the dependency of repeated observations on the same individuals, relationships between variables of interest can be overstated [35].

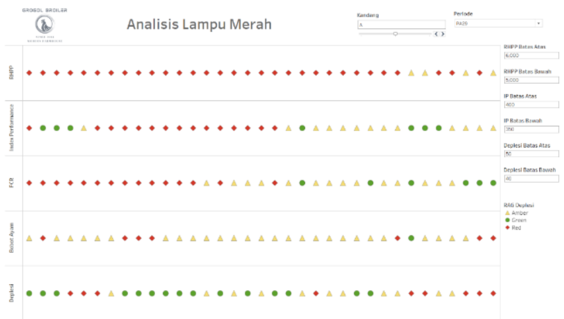

Fig. 5. Red amber green analysis dashboard

Users have the ability to set the farm and time frame. Furthermore, users able to set individual preferences of lower and upper limit for several farm performances indicators namely RHPP, index performances, and daily depletion. The set of measures added in Tableau in order to categorize the provided performances indicator into three criteria: color of green signifying on the target, yellow indicating approaching target, and red signifying failure to meet the target (far from target). The goal of the dashboard can aid the user for decision support with simpler visual information.

3.3. Farm performance I dashboard

A farm performance I dashboard aims to visualize FCR and body weight throughout a farming period (Fig. 6). Two different representations of the data and two different filters are provided to facilitate analysis and interactive presentation. In order to evaluate daily performance, a reference standard for FCR and body weight provided.

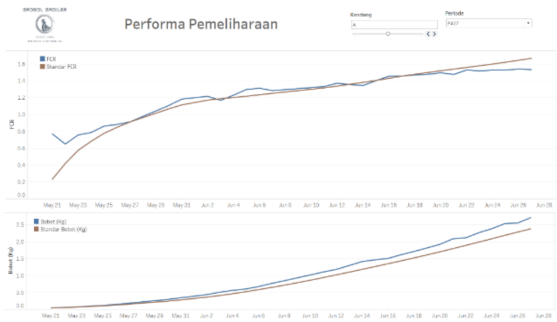

Fig. 6. Farm performance I dashboard

3.4. Farm performance II dashboard

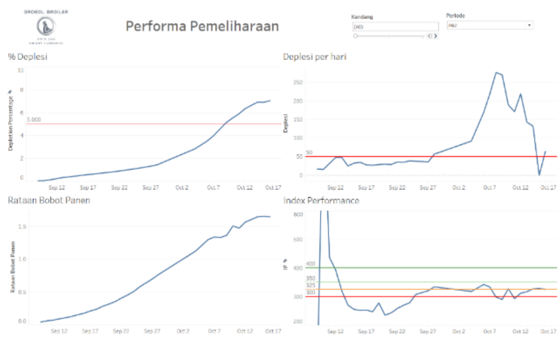

Fig. 7. Farm performance II dashboard

Fig. 7 presents the farm performance II dashboard with the same purpose as the farm performance I dashboard to visualize various performances, namely depletion percentage, depletion, harvested body weight, and Index Performance throughout a farming period. The dashboard included four different representations of data and two filters to facilitate user interactive display and readability. Furthermore, the standard for depletion percentage, daily depletion, and Index Performances are provided.

3.5. Harvest setting dashboard

Fig. 8 showed the final dashboard is the harvest setting dashboard. Users can set the farm and time frame. The set of measures provided in Tableau in order to make the system able to self-forecast the amount of profit generated in the current situation (total depletion, total feed intake, total weight generated). The gross profit gain line chart aims to provide an insight perspective of daily expenses and total income.

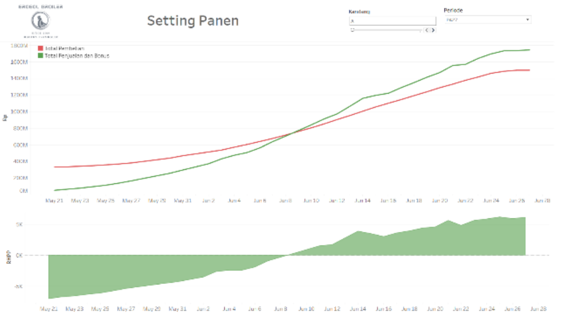

Fig. 8. Harvest setting dashboard

3.6. Dashboard story

The research's primary objective is to address a pressing issue in the business. Lack of resources to back up decision-making, especially in farm management, can be identified as a central problem on farms. Multiple performance criteria for evaluating performances are also included. Therefore, the report model on the business intelligence dashboard may prove helpful in finding a solution. The story is created to facilitate easy transitions between the dashboards.

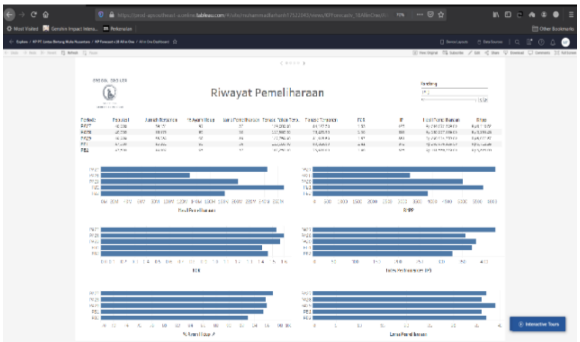

Fig. 9. Dashboard story

After designing and developing the four Tableau dashboards and a story that integrates each, the results were uploaded to the Tableau Online site for distribution to the business and core firm. Fig. 9 is a dashboard representation of the story from Tableau Online

Daily summary paper data may be processed and analyzed on the farm to provide helpful insight for farm management using the idea of a dashboard based on business intelligence. Daily operations farm data gathered through business intelligence. Making this decision would be less complicated because of the emphasis on data-based for use in farm management and performance evaluation.

3.7. Prior BI application research

Business Intelligence (BI) system development in business is the subject of Olszak and Ziemba [36], with a particular emphasis on system goals and functions. It proposes a two-stage process of business intelligence ‘creation’ and ‘consumption’. The research devotes considerable space to outlining the goals and activities accomplished throughout BI development and deployment. Specifically on BI deployment for the farm business sector, below are some brief reviews of prior BI applications for farm business.

Schuetz *et al.* [37] report the results of an academic-industrial collaboration aimed at creating a semantic data warehouse that may be used in precision dairy farming. Following an action research methodology, this study builds upon previous work by creating a loading stage, outlining an analysis perspective, introducing semantic online analytical processing patterns, and establishing analysis rules to automate periodic analyses. An essential part of making analysis usable by regular people was performed by semantic technology.

In order to streamline the outsourcing process, Cretan *et al.* [38] suggests a collaborative negotiating system to support the manager during the negotiation. It helps keep track of all the negotiations going on, simplifies it to numerous bilateral negotiations at once, and helps ensure all the different parties can communicate with one another. It uses an ontology to handle the complications of semantic interoperability, uses a lattice-based technique to automate the selection of trustworthy partners, and handles duplicate proposals by letting subject-matter experts set a satisfaction level for each SME.

The current condition of BI, although BI may assist agricultural businesses in improving their production potential and decision-making

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operations. Tyrychtr *et al.* [39] examine the present situation of the BI on small farms in the Czech Republic. The results reveal that the use of BI, expert, and analytical systems in agricultural operations is unaffected by production type, farm size, number of staff, or amount of financial incentives.

Oláh and Popp [40] argued that profits and environmental impact would decrease due to precision agricultural techniques. It improves prospective earnings by 20% to 50% and boosts yields, revenues, and profits above what is expected. Many farmers avoid adopting cutting-edge technologies because of their high cost, limited availability, and limited practical use. Farmers must acquire the skills to increase their production precision by utilizing new information.

3.8. Research limitations and benefits

To prevent fruitless debate, the researcher sets parameters for the study. The scope and limitations of the research are as follows:

1. The research was conducted on two farms within three farming periods for Farm A and two farming periods for Farm B
2. The research focused on performance measurement for farms with a minimum of 40000 broilers capacity.
3. The research was conducted on a broiler farm with a core-plasma partnership model.
4. The research would employ just-defined reports strongly connected to the farm performance indicators identified.
5. The dashboard created from this research is a prototype and has not been implemented yet.

To that end, this study was undertaken, hoping that its findings would be helpful to everyone concerned. As a result, the study might hope for the following advantages:

1. Broiler farmers can ascertain farm performance indicators specified as an output from the research.
2. The raw data collected by a broiler farmer can be transformed into a format that is aesthetically pleasing, easy to understand, and handle.
3. By examining identified key farm performance, the business may determine the appropriate actions and solutions to the results to maximize profit and prevent any excessive losses.
4. The farmer's core company can easily monitor the current performance of many of its farmer partners.

4. CONCLUSION

The following findings are drawn from the research, all consistent with the objective. General history of all cycles, red, amber, green analysis, farm performance I, farm performance II, and harvest setting are four dashboards whose designs are suggested and assembled in a Tableau story. Utilizing a Self-Service Business Intelligence approach, the dashboard may aid farm managerial decisions. The dashboards may be accessed from any internet-connected device, including smartphones. The daily paper-based recap data findings may be converted into useful information for assessing and enhancing the farm's productivity.

The general history of the all-cycle dashboard offers a comprehensive and overarching perspective of the history of all farming cycles included within its details. The farm can conduct direct assessments of the various farm performance indicators, such as FCR, body weight, depletion, harvested body weight, index performance, RHPP, gross revenue, et cetera. The business can compare the performance result against the stated standard to monitor the quality of the performance result. The harvest setting dashboard identifies the proper time to harvest and brings together the total expenditure and income acquired.

For example, the dashboard indicated that if farmers' revenue or RHPP value is low, then a low RHPP value can be caused by several factors, including high feed costs, low production efficiency, high chick costs, and low market prices for chicken products. Feed costs are a significant factor in IOFCC, accounting for 70% of total production costs. Actors that can contribute to high feed costs include fluctuations in the price of feed ingredients, transportation costs, and import/export tariffs. If feed prices are high or feed conversion efficiency is low, the IOFCC value can be negatively impacted. Low production efficiency can also impact IOFCC, resulting in lower weight gain and lower marketable chicken products and reduced revenue. FCR is the feed required to produce one kilogram of live weight. A high FCR means more feed is required to produce the same amount of meat, which increases production costs and reduces IOFCC. Factors contributing to low feed conversion efficiency include poor quality feed, poor management practices, disease outbreaks, and environmental stressors. High chick costs can also contribute to a low IOFCC value, especially if chick mortality is high. Factors contributing to high chick costs include breed selection, quality of breeding stock, and hatchery practice. Low market prices for chicken products can result in a lower revenue stream, making achieving a positive IOFCC value more challenging.

As is the case with any study's findings, careful analysis is required before any conclusions can be drawn from the study's findings. Microsoft Excel is used for most data extraction, transformation, and load procedures. As a direct result, the ETL process will consume significant time. Second, the business's internal data are the only ones used as the source of the information. Third, the numerous performance analyses create the basis for the choices that will help improve farm management.

The researcher proposed a future study comparing the dashboard design within the same Self-Service BI framework on multiple applications such as Tableau. One example of such an application is Microsoft Power BI. The future researcher may add more coverage, such as feed safety stock and auto order system, to enhance the analysis and performance assessment, ultimately resulting in more comprehensive coverage of decision-making.

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