

# Information System Development of Cattle Weight Recording and Forecasting Using Website-Based Linear Regression

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## Abstract

Cattle plays an important role in meeting food demand in Indonesia, especially in the livestock sector, where cattle farms must be prepared to provide beef supply to various regions in Indonesia. On the other hand, in East Kalimantan, the demand for beef is also increasing along with the growth of population and economic activity. The role of technology is also quite important in meeting the need for beef. One of them is the use of website information system technology as a recording and reporting application. One of the distributors also involved in cattle farming in East Kalimantan is PT XYZ, which was newly established in 2020. The need for technology includes recording system, reporting system and cattle weight forecasting system. The purpose of this study is to design a web-based application that helps PT XYZ to record, report and predict cattle weight. The application development used Laravel framework to predict the increase in cattle weight using linear regression method. While the methodology used to develop the application was Waterfall method which included the phases of requirement analysis, application design, software development, testing and implementation. The application testing results showed that the application complied with the design that has been implemented and all the functions on the application page worked properly. The cattle weight recording and forecasting information system generated various reports, such as monthly cattle weight progress, monthly cattle sales reports, cattle weight growth forecast analysis, and cattle sales profit reports.

**Keywords :** Information System; Laravel; Forecasting Application; Linier Regression

## 1. Introduction

Cattles have been one of the basic needs pursued by people in Indonesia since customaries and cultures in some regions need cattle as sacrificial animals or are required on other holidays in Indonesia. East Kalimantan has an increasing need of beef in line with the population growth and economic activity development. Based on the BPS-Statistic Indonesia, cattle production of East Kalimantan in 2021-2022 increased 2% per year (BPS-Statistic Indonesia, 2019).

In the implementation for meeting needs of beef, surely it is not separated of the technology role. One of the technologies frequently used in farming is website. It is helpful to optimize of the cattle farming management, starting from monitoring the cattle growth until cattle marketing. By utilizing website technology, farmers can effectively and efficiently access information and manage livestock. With accurate and prompt information through technology of website, they can take appropriate action and handle the problem easier. The system will make the farmers easier to digitize the aspect of recording (Primada *et al.*, 2021).

Besides the utilization of website technology, the forecasting of cattle weight is quite crucial also, the

farmers can predict the future cattle weight and optimize the cattle sale thereby the livestock management impact can increase the production efficiency of cattle sales. Also, forecasting is used by decision makers for planning the company development (Sumari *et al.*, 2020).

The research conducted by Primada M. M. (2021), reveals about management information system design of a dairy farm in Batu city. This research sets up a system of web-based with the *framework Codeigniter*. The system is expected to make the livestock activities easier with digitalization on several aspects (Primada *et al.*, 2021).

The study written by Sulisty G. B. (2020) shows regarding a design of information system on an online-based cattle farm management. The purpose of this study is for designing an information system which will be applied later as an online cattle trade means which can be accessed anywhere (Sulisty & Saputri Dua, 2020).

This research is conducted in East Kalimantan, precisely at cattle farm of PT XYZ, located in Kutai Kertanegara. PT XYZ is chosen as the location of this research since there is a problem of cattle weight recording which is still conventional and there is no program or application to do forecasting of cattle weight thereby an application is needed for

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supporting the process of recording and forecasting cattle weight. Thus, this research proposes an information system development of recording and forecasting cattle weight by using a method of website-based linear regression. This research aims to design an application for recording cattle weight monthly and for forecasting cattle weight gain estimation by using an equation of simple linear regression. The simple linear regression is chosen as an approach to do forecasting since this method is simple, easy to understand, and easy to apply in program code.

## 2. Theoretical Framework

### 2.1. Laravel

Laravel is one of a number of available open source PHP framework. This framework was firstly developed in 2011 by Taylor Otwell, an American developer. After released, Laravel started to attract the developer's attention around the world. Since then, Laravel has been one of the most popular globally programming frameworks, even surpassing many previous frameworks popularity in the world of programming (Abdulloh, 2017). The researcher chooses for utilizing the Laravel framework that aims to accelerate the process of application development and to reduce attention of technical issues which may arise during the process of application making (Utama & Nuryana, 2020), (Aipina & Witriyono, 2022) (Herdiansah *et al.*, 2021), (Purnama Sari & Wijanarko, 2020).

### 2.2. Linear Regression

Regression analysis means a statistical technique that aims to improve and understand the relationship of response variable (or result) and one or more variables predictor variable or regression. The main outcome of a regression analysis frequently results a mathematical model which allows us for forecasting regarding the response variable value in the future by inserting the predictor variable value as an input (Montgomery *et al.*, 2015). Linear Regression is applied in this application as a method for determining the equation used to do forecasting on cattle weight gain.

A linear regression can be drawn in equation (1) as the following:

$$y = \beta_0 + \beta_1 x + \varepsilon \quad (1)$$

Description:

$y$  = response variable

$\beta_0$  = unknown parameter

$\beta_1$  = unknown parameter

$x$  = predictor variable

$\varepsilon$  = random error

Based on (Suyono, 2015) statement, if the random error assumption is linear with zero, then the linear regression can be written in equation (2) as below:

$$y = \beta_0 + \beta_1 x \quad (2)$$

Description:

$y$  = dependent variable

$\beta_0$  = unknown parameter

$\beta_1$  = unknown parameter

$x$  = independent variable

The value of  $\beta_0$  and  $\beta_1$  can be drawn in equations of (3) and (4) as follows:

$$\beta_0 = \frac{\sum_{i=1}^n x_i^2 \sum_{i=1}^n y_i - \sum_{i=1}^n x_i \sum_{i=1}^n x_i y_i}{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2} \quad (3)$$

$$\beta_1 = \frac{n \sum_{i=1}^n x_i y_i - \sum_{i=1}^n x_i \sum_{i=1}^n y_i}{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2} \quad (4)$$

Description:

$\beta_0$  = (zero-beta) unknown parameter

$\beta_1$  = (zero-beta) unknown parameter

$y$  = dependent variable

$x$  = independent variable

### 2.3. Information System

The definition of information system is a series of information subsystems which manages data to result information supporting the process of decision-making. Meanwhile, sale is an activity involving direct interaction with consumers for receiving orders or doing sale directly (Salamah, U., & Khasanah, 2017).

### 2.4. Forecasting

Forecasting means a systematic process in estimation on what is likely to occur in the future based on information of the past and the present, which aims to reduce forecasting errors. It helps provide a clearer picture about future and relate big data to make certain works easier (Kartika *et al.*, 2023). On the other hand, (Indarwati *et al.*, 2019) defined forecasting as one of the statistical elements of decision making. One of the forecasting methods is periodic series that aims to predict sales or demand in the coming period by using historical data.

## 3. Method

### 3.1. Data Collection Method

Data collection in this research is conducted in two ways:

- a. Observation; Researcher uses direct observation on the research subject. In this context, the researcher observes the system of recording and reporting data in PT XYZ. The result is data recording manually. The data obtained includes

weight of feed and monthly cattle weight gain until ready for distribution.

- b. Interview; Researcher does an interaction of question & answer verbally with the research subject, includes PT XYZ director, PT XYZ Field Section Head, and PT XYZ partners. Interview is conducted to obtain data of cattle weight at initial arrival, treatment of feeding, and cattle weight that is ready for distribution.

### 3.2. System Development Method

Information system development aims to record and forecast cattle weight by using Waterfall method. The method is an approach in developing or updating a software system using certain technique or models for the development process of software system. (Utama & Nuryana, 2020).

The stage conducted in the development process of information system on recording and forecasting cattle weight are as the following:

1. Stage of Needs Analysis: Analysis process conducted on the needs analysis that will be developed.
2. Stage of System Design: Designing step of system structure in detail.
3. Stage of Development: The implementation process from the previous prepare design.
4. Stage of Testing: System evaluation to make sure the operation is as wanted.
5. Stage of Implementation: The system is ready to use by end users after passing the test series.

### 3.3. System Design

The designing process of information system starts from the phase of Unified Modeling Language (UML) (Gustina & Leidiyana, 2020) as follows:

#### 1. Use Case Diagram

Use Case Diagram describes the interaction between the user and the system through a picture which tells the system use. Figure 1 describes the system of use case diagram which will be applied to the application.

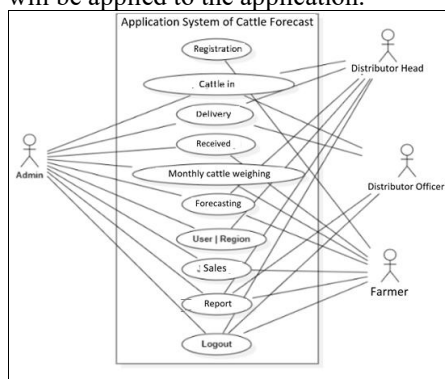


Figure 1. Use Case Diagram

In figure 1, there are 4 types of access rights which can access the application. Access rights are owned by: admin, distributor head, and distributor officer.

#### 2. Context Diagram

The definition of context diagram is a visual representation which describes the user and the system interaction. This diagram is useful to analyze system since it visualizes the flow of information and data between the system and the external environment. Figure 2 is the scope described in the context diagram.

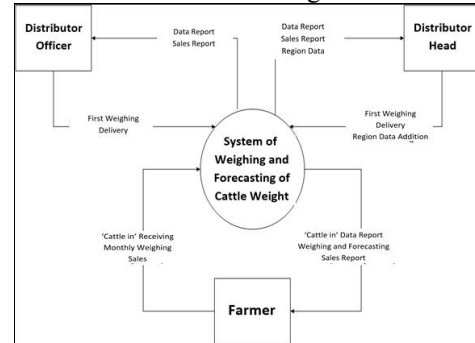


Figure 2. Context Diagram

The context diagram includes the relationship between the activities of the cattle weight recording and forecasting information system as the following:

1. The distributor Head can receive information regarding the report of cattle data, cattle sales, and regionally farmer data.
2. The Distributor Officer can receive information regarding cattle data reports and cattle sales and can do weighing on the initial cattle and cattle delivery to farmers.
3. The farmer can utilize information system for receiving information regarding a data report of weighing and forecasting cattle weight and cattle sales.

Figure 2. The context diagram can be lowered to level 0 thereby it has 8 processes as follows: cattle for distributor, cattle for farmer, cattle delivery, regional addition, reporting, forecasting, weighing monthly, and sales. Figure 3. Image visualization from context diagram of level 0.

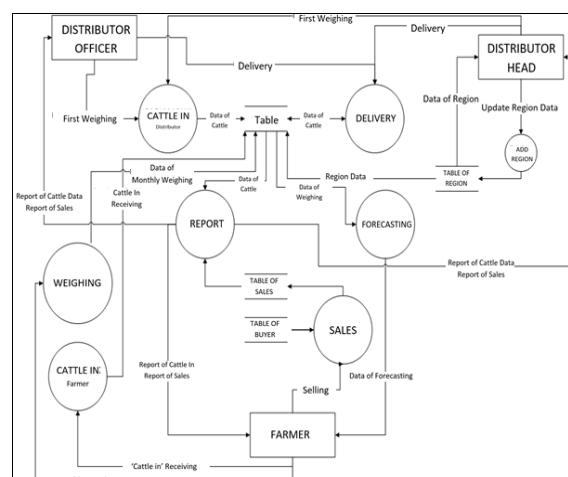


Figure 3. Diagram context of level 0

### 3. Entity Relationship Diagram

Entity relationship model is a model describing the relationship between data in a database system based on an assumption that the real world of basic objects having the relationship between the objects. Entity relationship diagram is presented in figure 4.

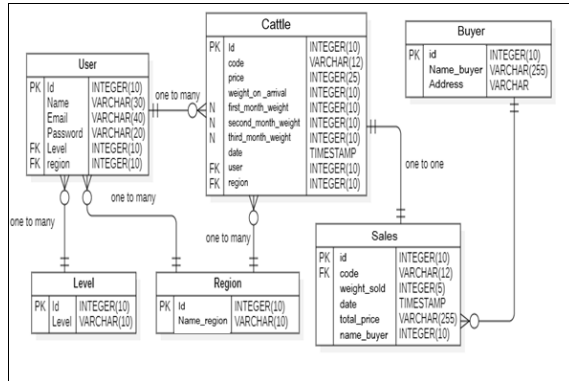


Figure 4 Entity Relationship Diagram

In Figure 4. There are 6 tables, such as user, level, cattle, region, buyer, and sales. First, user table has a relationship with level table and cattle table, that the user table has 'one for one' flow meaning one user owns one level. But, the relationship of the cattle table is 'one for many' meaning one user can add many cattle. Second, in the cattle table, it shows the relationship between the region table and the cattle sales table. The relationship with region table is 'one for one' flow meaning one cattle for one region. The relationship with cattle sales table is 'one for one' meaning one cattle just for one cattle sales record. Last, buyer table has a relationship of one buyer can buy more than one cattle.

### 3.4. System Development

This phase involves program code writing by using the Laravel framework in accordance to the system design plan that has been previously prepared. In this phase, the developer will implement business logic, user interface, and interaction with database in accordance to the specifications that has been designed before. This process transforms abstract designs to functional application.

### 3.5. System Testing

The testing focus on software from a perspective of logic and function aims to ensure all components have been tested. It is conducted for minimizing errors and ensuring that the results are in line with predetermined expectations. With thorough testing, the software can be identified and fixed the problem before being introduced to end user so that it improves the quality and reliability of the application (Gustina & Leidiyana, 2020).

Black-Box Testing means a method of software testing focusing on functional testing and software

specification regardless internal detail or program code structure (Hidayat & Muttaqin, 2018)

## 4. Result and Discussion

### 4.1. Result

#### 1. Page View of User Login

The Page View of Login is the application initial display when accessed by the user. In this login display, there are 2 inputs, such as: user email and password. Users in this system are buyer and partners or fostered by PT.XYZ located quite far away. The page display of user login is presented in Figure 5.

Figure 5. Page View of User Login

On this page, users can input their email and password to login to the application.

#### 2. Dashboard Page View

The dashboard page is the first page accessed by users if they have logged in successfully. On the page of 'cattle in', the displays are total weight of cattle in, the total number of cattle, and the price of cattle in. There is the table of cattle in and form as well to add the data of cattle in. The Display of the Dashboard Page is presented in Figure 6.

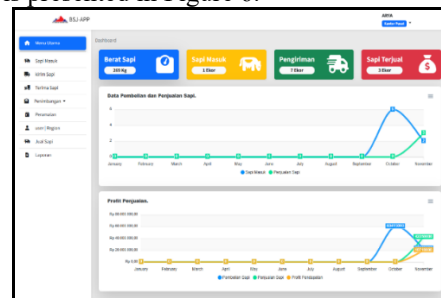


Figure 6. Display of Dashboard Page

This main page displays information regarding cattle weight, cattle in, cattle out, cattle sales, and chart of cattle sales profit.

#### 3. Page View of 'Cattle In' for Distributor

The page of 'cattle in' is a page to add the number of cattle in at PT XYZ. This page can only be accessed by admin, distributor head, and distributor officer. The page display of 'cattle in' is presented in Figure 7.

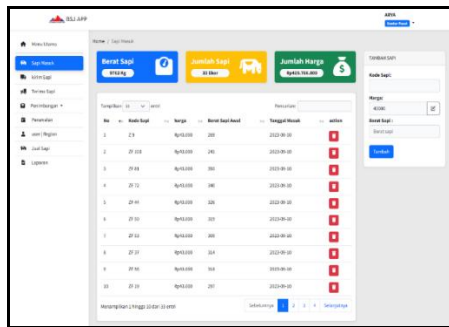


Figure 7. Page View of Cattle In

On the page of 'cattle in', the displays are total weight of cattle in, number of cattle, and total price of cattle in. There is the table of cattle in and the form as well for adding the data of cattle in.

#### 4. Page View of Delivery

The page of delivery means a page to deliver cattle to farmer. This page can only be accessed by admin, distributor head, and distributor officer. The page display of cattle delivery is presented in Figure 8.

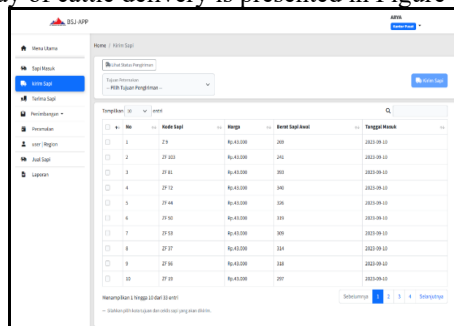


Figure 8. Page View of Delivery

This page displays the data of cattle in the form of table which can be selected to deliver to the destination farm. This page can display as well delivery status to each region.

#### 5. Page View of Delivery Status

The page of delivery status will display the table that contains the region and the status of delivery. If the cattle delivery still transits, the column of status will display the description of 'in transit' with blue background. While if the cattle have been received, the description is 'received' with green background. The page display of delivery status is presented in Figure 9.

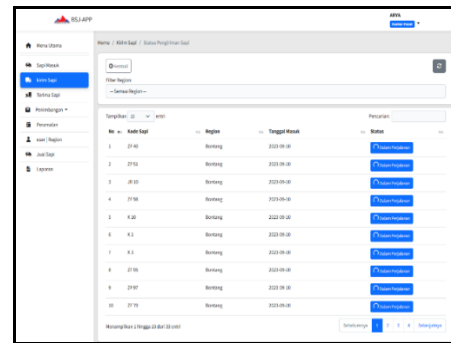


Figure 9. Page View of Delivery Status

After doing cattle delivery, the user can select option of 'view delivery status'. The page of delivery status will display the table that contains the region and the delivery status. If the cattle are still in transit, the column of status will display the description of 'in transit' in blue background. Meanwhile, if the cattle have been received, the description is changed to 'received' in a green background.

#### 6. Page View of Receive

The page of receive is a page displaying data regarding cattle delivered to the farm by the distributor.

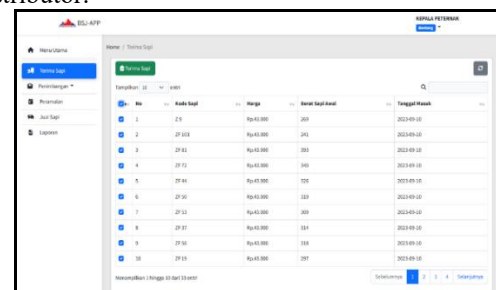


Figure 10. Page View of Receive

This page shows the data of cattle in the form of a table, ticking the cattle data by selecting the option of 'received' if the cattle have been received. The display is presented in Figure 10 above.

#### 7. Page View of Weighing

The page of the weighing monthly means a page to do monthly weighing of cattle by the farmers. The page view of weighing cattle is presented in figure 11.

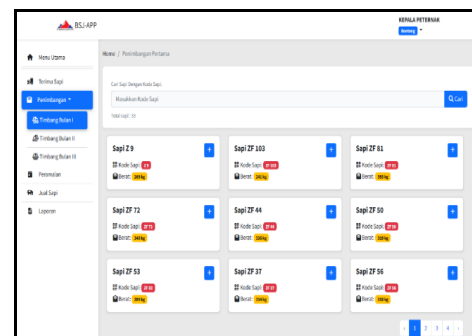


Figure 11. Page View of Weighing

. On this page, the farmers can search cattle by using the code of the cattle, then add the result of the weighing.

## 8. Page View of Forecast

Forecast view means a page to view the estimation of cattle weight in the second and third month after fattening. This page displays the increase of cattle weight and the forecasting of weight in average. The page view of forecast is presented in figure 12.

No	Kode Sapi	Berat Awal	Berat Akhir	Pertumbuhan Berat Sapi	Pertumbuhan Berat Sapi
1	23	201 Kg	281 Kg	25,4%	25,4%
2	23 001	201 Kg	281 Kg	25,4%	25,4%
3	23 01	201 Kg	281 Kg	25,4%	25,4%
4	23 02	201 Kg	281 Kg	25,4%	25,4%
5	23 03	201 Kg	281 Kg	25,4%	25,4%
6	23 04	201 Kg	281 Kg	25,4%	25,4%
7	23 05	201 Kg	281 Kg	25,4%	25,4%
8	23 06	201 Kg	281 Kg	25,4%	25,4%
9	23 07	201 Kg	281 Kg	25,4%	25,4%
10	23 08	201 Kg	281 Kg	25,4%	25,4%

Figure 12. Page View of Forecast

The Forecast view is able to be accessed by admin, distributor head, and farmer. The approach used to do forecasting of the increase on cattle weight is a linear regression approach.

## 9. Page View of Sales

The page of sales means a page to do transaction of selling cattle by the farmer. The page view of sales is presented in figure 13.

No	Kode Sapi	Berat Awal	Berat Akhir	Total Harga	Aksi
1	23	201 Kg	281 Kg	Rp 14.750.000	

Figure 13. Page View of Sales

This page shows cattle data based on the users' farm in the form of table. The farmer can sell cattle by selecting option 'add' in the action column, then the cattle data will be moved into widget of basket of cattle. After that, inputting the buyer data and the date, then select 'sell'.

## 10. Page View of Report Record

The report view means a page showing progress data of cattle weighing and monthly report printing of cattle sales. On this page, cattle progress is shown in the form of table as well as the report data of monthly sales. The page view of report I presented in figure 14.

No	Kode Sapi	Berat Awal	Berat Akhir	Total Harga	Aksi
1	23	201 Kg	281 Kg	Rp 14.750.000	
2	23 001	201 Kg	281 Kg	Rp 14.750.000	
3	23 01	201 Kg	281 Kg	Rp 14.750.000	
4	23 02	201 Kg	281 Kg	Rp 14.750.000	
5	23 03	201 Kg	281 Kg	Rp 14.750.000	
6	23 04	201 Kg	281 Kg	Rp 14.750.000	
7	23 05	201 Kg	281 Kg	Rp 14.750.000	
8	23 06	201 Kg	281 Kg	Rp 14.750.000	
9	23 07	201 Kg	281 Kg	Rp 14.750.000	
10	23 08	201 Kg	281 Kg	Rp 14.750.000	

Figure 14. Page View of Report

The page of report means a page showing progress data of cattle weighing and monthly report printing of cattle sales. On this page, the data of cattle progress is shown in the form of table as well as the report data of monthly sales. Farmers and distributor head are able to print the report by selecting the option in the column of 'print report'.

## 11. Modeling of Linear Regression

Weight gain and feed weight means two variables used in modeling of linear regression. The data from the two variables are presented in Table. 1 below:

Table.1. Table of feed weight and weight gain of cattle

No	Feed Weight (X) Kg	Weight Gain (Y) Kg
1	26,9	27
2	24,1	27
3	39,3	27
4	34	26
5	32,6	27
6	31,9	25
7	30,9	26
8	31,4	26
9	31,8	23
10	29,7	27
11	31,2	26
12	28,5	24
13	26	26
14	24,6	26
15	37,2	23
16	30,1	27
17	22,6	25
18	28,9	26
19	26,5	27
20	38,9	23
21	30,8	27
22	26,3	24
23	31,7	24
24	33	25
25	31,7	26
26	33,6	24
27	24	27
28	23,8	26

No	Feed Weight (X) Kg	Weight Gain (Y) Kg
29	23,7	25
30	30,1	26
31	23	24
32	24,4	25
33	33	27

Table. 1. is the data processed to forecast cattle weight gain of the next month. Variable X refers to the data of feed weight, classified as independent variable. While, variable Y refers to weight gain and is classified as dependent variable.

## 12. Result of System Testing

The system testing result with the method of Black Box Testing shows that the system is in line with the design which has been made before and all of the functions on the application pages run well. It indicates that the information system development successfully implements the design that has been planned and the system is ready to use by end users.

## 4.2. Discussion

Through this information system, user is able to find out regarding recording report of cattle weighing from the data input result into the application. Next, information system will provide monthly calculation analysis of cattle weight gain forecasting to assist the plan of cattle sales. The condition is supported with the implementation of forecasting in company management and will provide a significant assistance to the plan of sales strategy.

Farmer is key user of information system in recording and forecasting cattle weight. This system provides support to the farmers to decrease error risk while recording the cattle weight gain, avoids damage or file loss, and assists in the process of decision-making regarding cattle sales. On the other hand, distributor company also gets benefit of this system to monitor the report of cattle data and cattle sales. In accordance with the aim of information system where the information system can be an effective solution to handle the problem of recording and reporting. With the application of information system, the process of recording can decrease data duplication and has a function as a digital data storage container.

Information system utilization means is a step in resolving many challenges, such as resource lacks, late report, incomplete and inaccurate data, and the needs of reports which have not been met. Rapid development of information system provides new potential for management to present appropriate information supporting decision making in the various management levels.

The forecasting result of cattle weight gain presented in figure 12 can be used by farmers in decision making to plan sales, allow them to adjust

sales strategies in accordance with projection of cattle weight gain in the future. Figure 12 presents the forecasting of cattle weight gain for the first month in a range of 23 kg up to 27 kg. The cattle weight gain is influenced by the feed provision thereby the forecasting is based on the data of feed weight and weight gain used as a forecasting with linear regression using Table. 1.

From Table.1. by using the equation of 3 and 4. the calculation values of  $\beta_0$  and  $\beta_1$  are 27,14 and - 0,053 thereby the equation of linear regression is as the following:

$$y = 27,14 - 0,053 X$$

The equation of a constant value is 27,14 meaning if the variable of feed weight (X) increases 1 unit, it will decrease the cattle weight of 0,053 Kg

Another result is system testing by using a method of Black Box Testing firms proves the system suitability with the design that has been planned. The functions on each page of application operate well, indicating the success of system design implementation which is ready to use by end users. This success reveals the system ability in supporting the activity of recording and forecasting cattle weight efficiently and effectively.

## 5. Conclusion

The Website-Based Information System of Recording and Forecasting Cattle Weight using Laravel framework is successfully set up. The output is in accordance with the design and run well. This system development provides facility to farmers to replace manual method to record and report data. Also, this system has a function as a monitor tool for distributor company to monitor reports of cattle fattening and to produce various reports, for example monthly progress of cattle weighing and monthly reports of cattle sales. Forecasting analysis of cattle weight gain by using linear regression is very helpful for farmers, especially regarding reports of cattle sales.

With this information system, operational efficiency increases, possible errors of recording are decreased, and transparency of data management increases. Those reports assist leaders to make decisions more informative and precise to manage cattle sales and fattening aspects.

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