CENTIVE
VOL. 4, NO. 1, PP.938-950, DEC 2024

ISBN : 978-602-53004-0-0

Conference on Electrical Engineering, Informatics, Industrial Technology, and Creative Media 2024

Implementation of Multi-Criteria in Supply Chain Optimization Analysis of the Livestock Sector on Java Island

Fadiana*[1], Delia Pebina Br Ginting[2], Alfino Rianandha[3], Sukmadiningtyas[4]

Departement of Information System, Telkom University
D.I. Street Panjaitan No.128, South Purwokerto District, Purwokerto
Banyumas Regency, Central Java, Indonesia 53147
[1] 2211103055@ittelkom-pwt.ac.id
[2] 2211103037@ittelkom-pwt.ac.id
[3] 2211103035@ittelkom-pwt.ac.id
[4] sukmadinityas@ittelkom-pwt.ac.id

Received on 11-11-2024, Revised on 18-11-2024, Accepted on 28-11-2024

Abstract

The rapid development of technology has had a significant impact on various sectors, including the livestock industry. This study examines the application of the Multi-Criteria Decision Making (MCDM) method, especially the Analytical Hierarchy Process (AHP), to optimize the supply chain in the livestock sector in Java. The purpose of this study is to determine the most efficient livestock production area by evaluating criteria such as production quantity, average production, production cost, and percentage increase in production over a certain period. In addition, this research integrates Artificial Intelligence (AI) as a controller to improve data management and monitor the livestock production process. This study uses quantitative methods to analyze supply chain data from Central Java, West Java, and East Java. The findings show that Central Java has the highest livestock production efficiency with an index of 0.4511, contributing significantly to the island's overall production. The study concluded that integrating AI into supply chain management can significantly improve efficiency and productivity in the livestock sector.

Keywords: Multi-Criteria Decision Making (MCDM), Artificial Intelligence, Livestock Production

Corresponding Author:
Fadiana
Progr Departement of Information System, Telkom University, D.I. Street Panjaitan No.128, South Purwokerto District, Purwokerto, Banyumas Regency, Central Java, Indonesia 53147 Indonesia Email: 2211103055@ittelkom-pwt.ac.id

I. INTRODUCTION

Technological developments are constantly increasing and undergoing many changes from time to time. Technology has a dominant role in supporting the needs of every user, both for activities in the academic field, research, management, etc. *Finance*, *marketing*, and so on [1]. Within the scope of management, technology will be *controllers* who are reliable in regulating and managing the pace of management operations. The current technology that is in the spotlight and widely used by all circles is artificial intelligence which is an automated software engineering that can execute tasks according to the instructions and inputs given [2]. Many large companies have applied AI in business operations because it is considered easy and efficient. One of the roles of AI in the Company is that it can help optimize the *Supply chain* company [2]. *Supply chain* It is a series of supply chain network processes that focus on cooperating in the process of producing, managing, distributing, and marketing them to end consumers. *The supply chain* has a very important influence on business continuity in its mission to meet consumer needs [3]. Management *Supply Chain* The right one can have a good impact on the business because resources will be allocated efficiently [4].

Livestock is one of the fields that needs a lot of attention, especially in the various management processes carried out [5]. In providing consumer needs, various wise steps must be taken, ranging from service arrangements, resource allocation, production process arrangements, marketing, and so on. The livestock sector is one of the sectors that has attracted a lot of attention from the Indonesian people [6]. According to the One Agricultural Data Portal, Java Island and its surrounding areas, including Central Java, West Java, and East Java, are regions with the highest livestock production levels. In 2023, Central Java ranked first as the region with the highest livestock production level, contributing approximately 80% of livestock income, which is consistent with the other two regions. Based on quantitative calculations, it can be observed that the most produced livestock types in Java Island include chickens, cattle, goats, sheep, buffaloes, and pigs, followed by livestock products such as eggs and milk. The high level of production in Java Island is driven by the large number of livestock companies actively engaged in producing livestock products. According to official government reports on agricultural production, Central Java is capable of producing 45 million broiler chickens annually, 5 million beef cattle per year, and livestock products such as 1.5 million tons of chicken eggs annually. Most of the production is supplied to the Greater Jakarta (Jabodetabek) area. Similarly, West Java and East Java are able to produce livestock products with a total production reaching 2–30 million tons per year and distribute them to regions such as Bali, Nusa Tenggara, and other export destinations. This high productivity is undoubtedly supported by effective productivity management. Companies in each region have their respective strengths; however, these strengths have not yet been clearly identified in terms of the effectiveness of their production processes in meeting market demand. Market demand tends to fluctuate over time depending on consumer interest in livestock products. Therefore, to determine the level of production effectiveness in each region's livestock companies, a concrete analysis of the production performance of livestock products is required.

This study will conduct quantitative calculations using *Multi-Criteria Decision Making* (MCDM) using the *Analytical Hierarchy Process* (AHP), which is one of the calculation methods in a structured manner to analyze the best solution based on the given criteria (Faisal, 2019). In applying this method, several needed *variable* support, namely by determining the criteria to be analyzed as a consideration aspect in the analysis and comparison process [7]. Some of the criteria that can be put forward in supporting the analysis process include production quantity, a percentage increase in production in a certain period, production costs, and the number of livestock businesses in each region. In addition to doing calculations using the *Analytical Hierarchy Process* (AHP), to support the results of the analysis, an adjustment and comparison process is carried out on the research results and feasibility using the *Simple Multi-Attribute Rank* (SMART) which is one of the MCDM methods [1], [8]. Through the results of quantitative calculations with the *Analytical Hierarchy Process* (AHP), then data on livestock-producing areas can be obtained with the maximum level of effectiveness [9]. Based on this data, forecasting can be carried out (*Forecasting*) to the sustainability of the productivity of the potential area [10]. Forecasting is carried out to find out the level of data movement in a certain period based on the method used. In this study, the Simple Moving Average (SMA) method was used to determine the estimated production results related to the effectiveness of the application of technology.

The function of AI in livestock itself plays a controller role that can practically monitor the production process of livestock [11]. In addition, AI also has a very dominant function in the context of data management related to farm animals. Through the use of AI in data management, existing data will be more structured and well-organized [12]. Data will be managed in one scope that can be integrated between other components so that this can increase the efficiency of the data management process [13]. This research has the goal and focus to determine the level of effectiveness of running business processes by analyzing aspects of AI involvement applied in the implementation of business processes.

To support this study, the researcher conducted a literature review of the results of previous studies. In the first study entitled "Application of the SMART Method (*Simple Multi-Attribute Ranking Technique*) In Recommending the best breed of cattle for Beef cattle Farming", the main focus is on the application of the SMART method (*Simple Multi-Attribute Ranking Technique*) to choose the best breed of cattle in beef cattle farming, taking into account criteria such as origin, price, age, weight, and size. This study aims to provide recommendations that can improve efficiency in the selection of beef cattle [1]. On the contrary, this study entitled "Implementation of Multi-Criteria in Optimization Analysis *Supply Chain* Java Island Livestock Sector", applied the *Analytical Hierarchy Process* (AHP) and SMART (*Simple Multi-Attribute*

Ranking Technique) integrated with artificial intelligence (AI) to optimize the livestock production supply chain. In the analysis using MCDM, this study focuses on analyzing criteria such as the number of production, production costs, and production increases, as well as specifically targeting geographical areas in Java.

These two studies have similarities in terms of the use of *Multi-Criteria Decision-Making* (MCDM) in analyzing to determine the best alternative. However, there are significant differences in the approaches used and the targeted scope. The first study uses the SMART method for the selection of beef cattle without clear geographical restrictions, while this study combines the AHP and SMART methods by integrating the role of AI in supply chain optimization in the Java region. This research has the goal and focus to determine the level of effectiveness of running business processes by analyzing aspects of AI involvement applied in the implementation of business processes.

II. RESEARCH METHOD

The research was carried out by applying a quantitative method, where the supply chain data on each livestock product will be calculated for alternatives in the Central Java, West Java, and East Java regions. To carry out this calculation, it is carried out using one of the *Multi Criteria Decision Making* (MCDM) methods, namely *the Analytical Hierarchy Process* (AHP). The focus of this study is to determine the level of effectiveness of each supply process in each region, as well as analyze the role of IT applied in the implementation of the process. The following is the logical framework of this research shown in Fig 1.

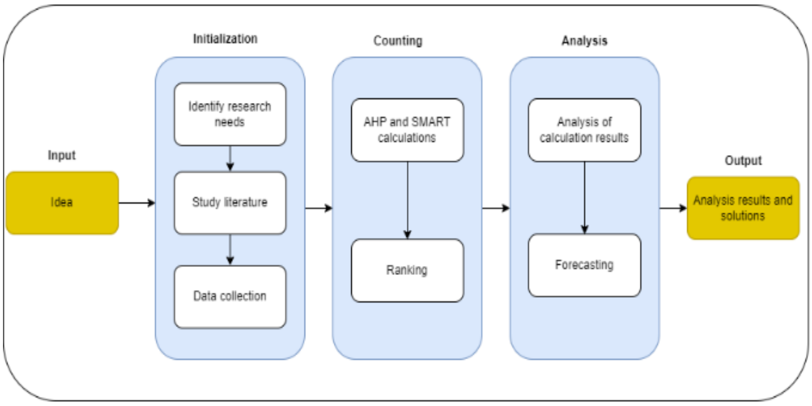

Fig 1. Research Framework

A. *Initialization Phase*

The initialization phase is the initial stage to prepare and identify the attributes needed to carry out the research process [14]. The attributes needed in this study are data real supply chain of the livestock sector, a literature review as a research guideline, and the determination of criteria for the alternative calculation process in the next phase. Meanwhile, the data collection method used in this study is real data obtained directly through the official Portal website One Agricultural Data and the Central Statistics Agency (BPS). The determination of criteria for alternative calculations is carried out by reviewing the data competencies and constraints that have been identified previously. The following Table 1 is a list of criteria in the process of calculating alternatives using MCDM.

Table 1. LIST OF CRITERION

Criterion	Information
C1	Number (J) Compare with the number of each company engaged in the livestock sector.
C2	Average (R) Identify and compare the average production each year on each regional alternative.
C3	Cost (B) Perform cost comparisons in the production process.
C4	Assumption of percentage improvement (A) Comparison of the percentage increase of each alternative within 1-3 years.

B. Counting Phase

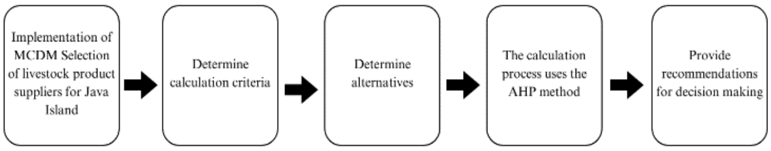

Fig 2. AHP Calculation Phase

In the *Count* will be carried out a calculation process on the data that has been obtained previously using the *Analytical Hierarchy Process* (AHP). The calculations using the *Analytical Hierarchy Process* (AHP), there are:

a. Determining the Purpose of Calculation

Based on the problems raised, the goal to be achieved from the calculation results using this method is to determine the alternative with the most effective productivity level by considering several criteria.

b. Determining the Criteria

To perform calculations using the *Analytical Hierarchy Process* (AHP) several conditions or regulations must be met, one of which is the determination of criteria and weighting or determining the level of interest for each of these criteria [15]. Table 2. is a determination of the level of interest in the AHP method according to Thomas L. Saaty.

Table 2. LEVEL OF IMPORTANCE

Information	**Range**
More important (*extreme*)	9
Very important (*very*)	7
More important (*strong*)	5
Moderate	3
Equally important (*same*)	1

Based on the level of interest table, the level of importance of each criterion can be formulated as follows according to the views of the 3 respondents we obtained.

Table 3. WEIGHTING

Criterion	**Weight**	**Kind**
Number of businesses	3	*Benefits* (B)
Average production	7	*Benefits* (B)
Cost	5	*Cost* (C)
Percentage increase	3	*Benefits* (B)

Table 3. shows the level of importance of each criterion in the calculation of AHP. The determination of this level of interest is carried out by considering the aspect of interest in the level of production fluctuations.

c. Determining Alternatives

In the calculation, the *Analytical Hierarchy Process* (AHP) uses three alternative regions, which are livestock-producing locations on the island of Java.

Table 4. LIST OF ALTERNATIVES

Alternative	Total Company
Central Java	78
East Java	104
West Java	204

Table 4. showing alternative livestock-producing areas on the island of Java with different numbers of companies and productivity levels.

d. Forming a Hierarchy of Information

In determining the best livestock-producing areas using the *Analytical Hierarchy Process* (AHP), based on these alternatives and criteria, the hierarchy of information can be determined as follows.

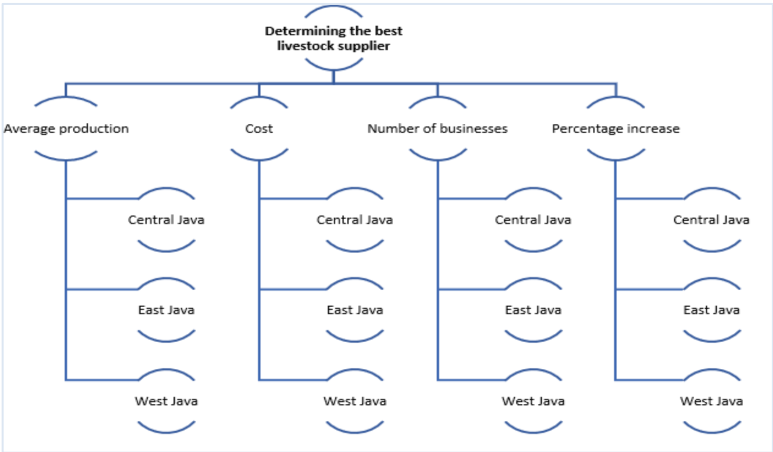

Fig 3. Hierarchy of Criteria and Alternatives

C. Calculation

a. Pair Comparison

Pair comparisons are carried out by sorting the level of importance of each criterion [16]. The following are the results of the ranking of the level of importance in the pair comparison.

$$\begin{bmatrix} R \\ B \\ J \\ P \end{bmatrix} \begin{array}{cccc} R & B & J & P \\ \end{array}$$
$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$

b. Matrix Normalization

Based on the results obtained at the stage of pairing comparison against the criteria, it is necessary to normalize the results obtained using the following formula.

$$\sum_i a_{ij} \tag{1}$$

Information:

$a_{ij}\ =\ Values\ in\ columns\ and\ rows\ of\ a\ matrix$

$1\ =\ Indication\ that\ column\ A\ value\ is\ not\ >\ 1$

c. Calculating the Row Average

The average calculation result of each row will be used as a weight for each criterion. The following is the formula for calculating the line average.

$$W_i = \frac{1}{n} \sum_j a_{ij} \tag{2}$$

Information:

$W_i\ =\ Weights\ for\ each\ row\ of\ the\ matrix$

$\frac{1}{n}\ = Number\ of\ columns\ or\ matrix\ criteria$

$a_{ij} \ = \ Matrix\ column\ and\ row\ values$

d. Consistency Test

Consistency testing was carried out to determine the level of consistency of the normalization calculation results on the matrix in the *Analytical Hierarchy Process* (AHP). The *result* is produced through this calculation, namely consistent or inconsistent.

$$t = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{element\ -i\ \ (A)(W^T)}{element\ -i\ \ W^T}\right) \qquad (3)$$

Information:

$\frac{1}{n} \ = Number\ of\ columns\ or\ matrix\ criteria$

$eke - i(A)(W^T) = Addition\ of\ matrix\ multiplication\ results$

$e\ ke - i\ (W^T) = \ Weight\ of\ each\ criterion$

$$CI \ = \frac{t \ - \ n}{n \ - \ 1} \qquad (4)$$

Information:

$t \ - \ n \ = \ Consistency\ calculation\ results$

$n \ - \ 1 \ = \ Alternative - 1$

Formula 4 is used to determine the consistency index of the matrix calculation results.

$$\frac{CI}{RI_n} \qquad (5)$$

Based on the results of the consistency test index, it is necessary to determine the random index (RI) value in the results of the consistency calculation, with the following information.

Table 5. RANDOM INDEX

n	RI_n
2	0
3	0,58
4	0,90
5	1,12
6	1,24
7	1,32

$CI \ = \ 0, A\ is\ consistent$

$\frac{CI}{RI_n} \ \leq \ 0{,}1, A\ is\ pretty\ consistent$

$\frac{CI}{RI_n} \ \geq \ 0{,}1, A\ is\ very\ inconsistent$

D. SMART Calculations

Simple Multi-Attribute Rating (SMART) is one of the calculation methods in the Decision Support System (DSS) to determine the best alternative based on the results of the weighting [17]. In this study, the SMART method is applied to compare the results of the AHP calculation and ensure the accuracy of the calculation results. Formula (6) is the formula for normalizing the criteria and formula (7) is the formula for calculating the value of the *Utility score*.

$$B \ = \ Nij \ = \ \frac{Xij}{Xmax}, C \ = \ Nij \ = \ \frac{Xmin}{Xij} \qquad (6)$$

$$Ui \ = \ \sum(W_j\ x\ N_{ij}) \qquad (7)$$

Table 6. WEIGHTING OF SMART

Criterion (C)	Weight
R	0,4
B	0,3
J	0,2
P	0,1

Table 6. It is the result of weighting each criterion based on the viewpoint of 3 respondents that we obtained. Ranking is the last stage in the calculation process *Analytical Hierarchy Process* (AHP). The purpose of the ranking process is to sort the results of alternative calculations against the criteria and will be selected based on the results that have the maximum value.

E. Analysis Phase

The results of the AHP calculation can show the alternative with the best level of effectiveness compared to other alternatives. The process that occurs in business, especially livestock, there is a role of artificial intelligence technology (*Artificial Intelligence*) in it. In this phase, the level of influence of technology utilization in the livestock production process was identified. As for *variables* What is used in this analysis is to compare the average variable of production with the amount of production costs.

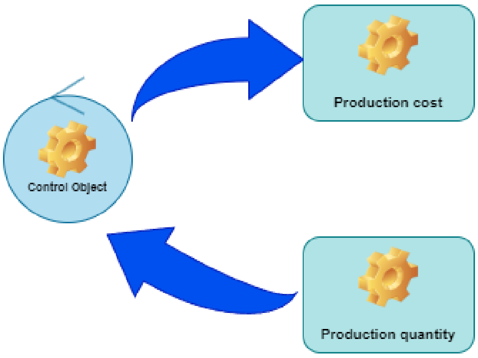

Fig 4. The Role of AI

Forecasting or forecasting is a process to estimate future needs which include needs in terms of quantity, quality, time, and location needed to meet demand [18]. *Forecasting* In this study, it is used to predict the level of effectiveness of technology utilization in supporting the production process carried out with the size of the present and the future. The forecasting method used is *Simple Moving Average* (SMA) which is one of the forecasting methods by calculating the arithmetic average of a certain point (period).

$$F_t = \frac{\sum Demand\ in - n\ period}{n}$$

$$F_t = \frac{A_{t-1} + A_{t-2} + A_{t-n}}{n} \tag{8}$$

Information:

$n = Number\ of\ period$

$\sum Pn = Number\ of\ requests\ in\ a\ certain\ period$

$A_{t-n} = Value\ in\ the\ period\ \ t - i$

III. Results and Discussion

This study has the focus and purpose of analyzing the level of production effectiveness of each livestock *product supplier* from all regions on the island of Java, which includes Central Java, East Java, and West Java. The analysis was carried out quantitatively by applying *the Multi Criteria Decision Making* (MCDM) method to select alternative levels of effectiveness. Here is the data we used to conduct the analysis.

Table 7. AHP CALCULATION DATA

Alternative	**Criterion (C)**			
	R	B	J	*P*
Central Java	210.2075/ will	3,956, 97	*78/will*	*1.1%/year*
East Java	114.3508/ will	45,334 ,28	*104/will*	*1,2%/year*
West Java	75.1662/ will	397,37 2,93	204/will	*0,8%/year*

Table 7. are actual data used in conducting quantitative calculations using the *Analytical Hierarchy Process* (AHP). The data is data that has been processed, based on data obtained through the official website of the One Data Portal in Indonesia called Badan Pusat Statistik (BPS) or the Central Statistics Agency.

a. AHP Calculation Results

$$\begin{bmatrix} R \\ B \\ J \\ P \end{bmatrix} \begin{array}{cccc} R & B & J & P \end{array} \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} 1 & 7/5 & 7/3 & 7/3 \\ 5/7 & 1 & 5/3 & 5/3 \\ 3/7 & 3/5 & 1 & 1 \\ 3/7 & 3/5 & 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1,4 & 2,3 & 2,3 \\ 0,714 & 1 & 1,6 & 1,6 \\ 0,428 & 0,6 & 1 & 1 \\ 0,428 & 0,6 & 1 & 1 \end{bmatrix}$$

Based on the results of the calculation of the pair comparison, the cumulative results of the matrix columns are obtained as follows:

$$Column_1 = 2{,}57$$
$$Column_2 = 3{,}6$$
$$Column_3 = 6$$
$$Column_4 = 6$$

The number of columns can be used to determine the weight of each matrix column criterion, i.e. by finding the average value on each row.

$$\begin{bmatrix} 1/2{,}57 & 1{,}4/3{,}6 & 2{,}3/6 & 2{,}3/6 \\ 0{,}714/2{,}57 & 1/3{,}6 & 1{,}6/6 & 1{,}6/6 \\ 0{,}428/2{,}57 & 0{,}6/3{,}6 & 1/6 & 1/6 \\ 0{,}428/2{,}57 & 0{,}6/3{,}6 & 1/6 & 1/6 \end{bmatrix} = \begin{bmatrix} 0{,}389 & 0{,}389 & 0{,}389 & 0{,}389 \\ 0{,}278 & 0{,}278 & 0{,}278 & 0{,}278 \\ 0{,}167 & 0{,}167 & 0{,}167 & 0{,}167 \\ 0{,}167 & 0{,}167 & 0{,}167 & 0{,}167 \end{bmatrix} \quad W = \begin{bmatrix} 0{,}389 \\ 0{,}278 \\ 0{,}167 \\ 0{,}167 \end{bmatrix}$$

Based on the matrix of normalized results for each criterion in a column, the average weight of the rows is obtained as follows:

$$B1_{K1} + B1_{K2} + B1_{K3} + B1_{K4}/4 = 0{,}389$$
$$B2_{K1} + B2_{K2} + B2_{K3} + B2_{K4}/4 = 0{,}278$$
$$B3_{K1} + B3_{K2} + B3_{K3} + B3_{K4}/4 = 0{,}167$$
$$B4_{K1} + B4_{K2} + B4_{K3} + B4_{K4}/4 = 0{,}167$$
$$W = (0{,}389;\ 0{,}278;\ 0{,}167;\ 0{,}167)$$

$$\begin{bmatrix} 1 & 1{,}4 & 2{,}3 & 2{,}3 \\ 0{,}714 & 1 & 1{,}6 & 1{,}6 \\ 0{,}428 & 0{,}6 & 1 & 1 \\ 0{,}428 & 0{,}6 & 1 & 1 \end{bmatrix} \text{x} = \begin{bmatrix} 0{,}389 \\ 0{,}278 \\ 0{,}167 \\ 0{,}167 \end{bmatrix} \begin{bmatrix} 1{,}556 \\ 1{,}111 \\ 0{,}667 \\ 0{,}667 \end{bmatrix}$$

The results of the multiplication of the above matrix can be used as a basis for calculating the level of consistency of the given data. The following are the results of the consistency calculation with the AHP method.

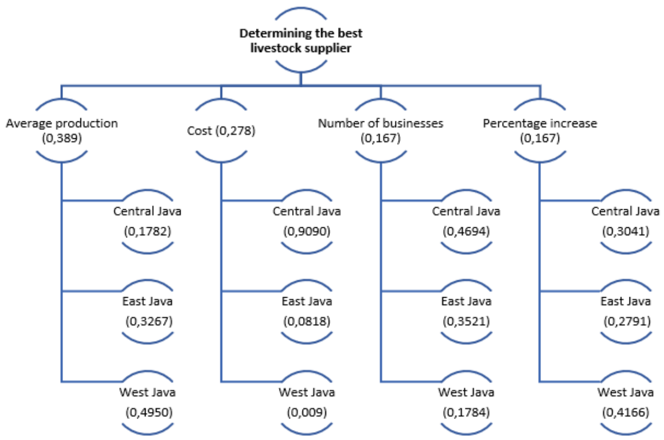

Fig 5. Hierarchy of The AHP Calculation Process

b. SMART Calculationn Results

Based on the weighting of the criteria in Table 6, the results of normalization of the calculation of the criteria can be obtained as follows.

$$\boldsymbol{R(Benefit)}, N_{RCentral} = \frac{210{,}2075}{210{,}2075} = 1,$$

$$N_{REast} = \frac{114{,}3508}{210{,}2075} = 0{,}358,\ N_{RWest} = \frac{75{,}1662}{210{,}2075} = 0{,}544$$

$$\boldsymbol{B(Cost)}, N_{RCentral} = \frac{3{,}95697}{3{,}95697} = 1,$$

$$N_{REast} = \frac{3{,}95697}{45{,}33428} = 0{,}087, N_{RWest} = \frac{3{,}95697}{397{,}37293} = 0{,}01$$

$$\boldsymbol{J(Benefit)}, N_{RCentral} = \frac{78}{204} = 0{,}382,$$

$$N_{REast} = \frac{104}{204} = 0{,}510, N_{RWest} = \frac{204}{204} = 1$$

$$\boldsymbol{P(Benefit)}, N_{RCentral} = \frac{1{,}1}{1{,}2} = 0{,}917,$$

$$N_{REast} = \frac{1{,}2}{1{,}2} = 1, N_{RWest} = \frac{0{,}8}{1{,}2} = 0{,}667$$

Based on the results of the normalization of the criteria, the score of each alternative can be determined, as follows.

$$U_{Central} = (0{,}3x1) + (0{,}2x1) + (0{,}3x0{,}382) + (0{,}2x0{,}917) = 0{,}798$$
$$U_{East} = (0{,}3x0{,}544) + (0{,}2x0{,}087) + (0{,}3x0{,}510) + (0{,}2x1) = 0{,}533$$
$$U_{West} = (0{,}3x0{,}358) + (0{,}2x0{,}01) + (0{,}3x1) + (0{,}2x0{,}667) = 0{,}542$$

The results of the calculation using the SMART method show results that are directly proportional to the results of the AHP method calculation. Central Java Province is an alternative with the highest level of effectiveness compared to the other two regions.

c. Results Analysis

The results of quantitative calculations using the AHP and SMART methods show the level of production effectiveness in the Java Island region. Different levels of productivity between regions can be affected by factors beyond the criteria. One of the factors that tends to affect productivity levels is the implementation of tools and materials according to portions. Livestock has an index as one of the sectors that applies a lot of technological sophistication, ranging from supply chain arrangements, production processes, and distribution to documentation. In the following, a forecasting analysis (*Forecasting*) on the effectiveness of production in the Central

Java, East Java, and West Java regions based on the optimization of production results and the balance of costs used.

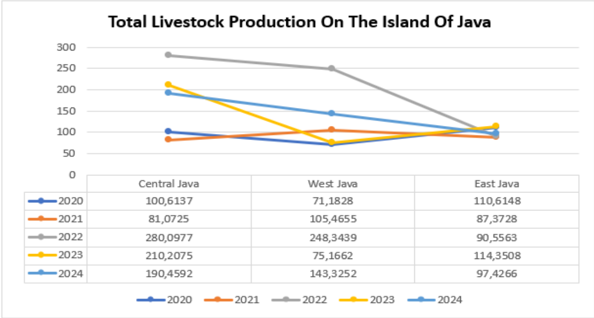

Fig 6. Production Quantity Graph

Fig 6. shows the growth of productivity levels in the Central Java, West Java, and East Java regions in the 2020-2023 period.

Table 8. PRODUCTION DATA 2020-2023

Alternative	**Year**			
	2020	2021	2022	2023
Central Java	100,6137	81,0725	280,0977	210,2075
East Java	110,6148	87,3728	280,0977	114,3508
West Java	71,1828	105,4655	248,3439	75,1662

Table 8. presents data on livestock production in the three regions on the island of Java, within 3-4 years. Based on this data, forecasting can be carried out using the *Simple Moving Average* (SMA), as follows.

$$Central\ Java\ = SMA_{2024} = \frac{81{,}0725\ +\ 280{,}0977\ +\ 210{,}2075}{3} = 190{,}4592$$

$$West\ Java\ = SMA_{2024} = \frac{71{,}1828\ +\ 105{,}4655 +\ 248{,}3439}{3} = 143{,}3252$$

$$East\ Java = SMA_{2024} = \frac{110{,}6148\ +\ 87{,}3728\ +\ 90{,}5563}{3} = 97{,}4266$$

The results of forecasting calculations using the *Simple Moving Average* (SMA) method show accurate results, where the highest level of productivity is expected to be produced by the Central Java region which continues to experience a significant increase when compared to the percentage of decline. The following is a graph predicting the number of livestock production in the Central Java, West Java, and East Java regions in the 2024 period based on the results of the calculation.

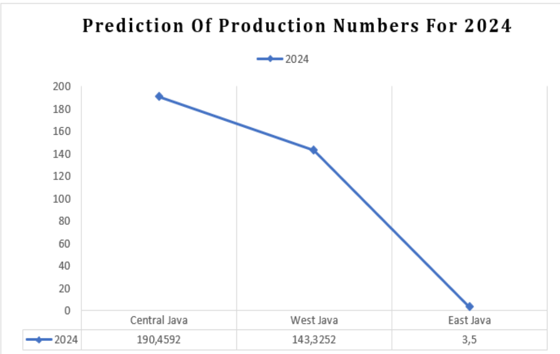

Fig 7. 2024 Production Vloume Forecast Graph

The prediction results are actual data that can happen the same or not. The results of this prediction can be used as a reference in determining the level of production of livestock products on the island of Java in the coming period. In addition to the regional production level, another variable that can be used as a parameter in measuring the efficiency of technology applications is relatively cheap production costs with high production rates.

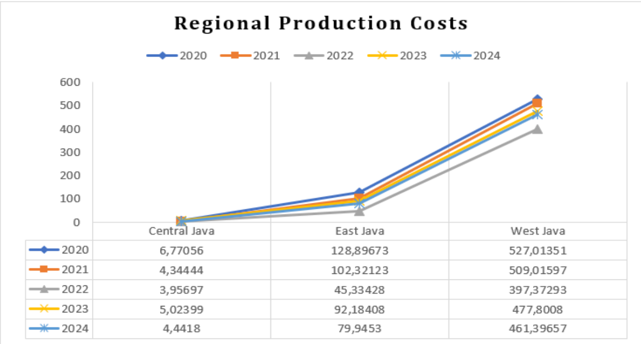

Fig 8. Production Cost Chart 2020-2024

Fig 8. It shows the level of cost used in the production process in each region which is very varied. This is due to differences in the quantity of livestock-producing companies and other expenditure achievements, such as worker wages, livestock feed financing, and other treatments.

Table 9. PRODUCTION COST 2020-2022

Alternative	**Year**			
	2020	2021	2022	2023
Central Java	6,77056	4,34444	509,01597	-
East Java	128,89673	102,32123	45,33428	-
West Java	527,01351	509,01597	397,37293	-

Table 9. presents production cost data in each region from 2020-2022, with 2023 data that has not been verified. The following is a forecast of production costs for the three alternatives, in the 2023 and 2024 periods.

$$Central\ Java = SMA_{2023} = \frac{6{,}77056 + 4{,}34444 + 3{,}95697}{3} = 5{,}02399$$

$$Central\ Java = SMA_{2024} = \frac{4{,}34444 + 3{,}95697 + 5{,}02399}{3} = 4{,}441{,}80$$

$$East\ Java = SMA_{2023} = \frac{128{,}89673 + 102{,}32123 + 45{,}33428}{3} = 92{,}18408$$

$$East\ Java = SMA_{2024} = \frac{102{,}32123 + 45{,}33428 + 92{,}18408}{3} = 79{,}94653$$

$$West\ Java = SMA_{2023} = \frac{527{,}01351 + 509{,}01597 + 397{,}37293}{3} = 477{,}80080$$

$$West\ Java = SMA_{2024} = \frac{509{,}01597 + 397{,}37293 + 477{,}80080}{3} = 461{,}39657$$

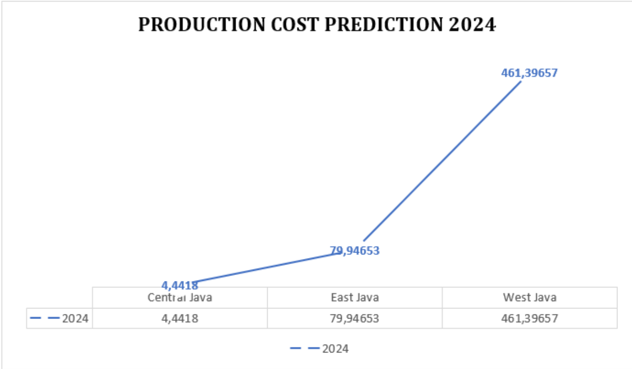

Fig 9. 2024 Production Cost Forecast Chart

Based on the results of forecasting using the *Simple Moving Average* (SMA) on production costs in the Central Java, West Java, and East Java regions, it can be known that from 2020-2024, Central Java still holds the regional index with the minimum level of production costs compared to the other two regions. This can be seen based on the production cost graph of the forecast results in Figure 9. The level of minimal cost use can be one of the components that balance the success of the production level. In contrast to other regions, such as West Java which has the highest cost index among others. This is because the number of companies in the West Java region is more when compared to Central Java and East Java.

IV. CONCLUSION

This study successfully identified and analyzed the effectiveness of livestock production processes on Java Island using the Multi-Criteria Decision Making (MCDM) method, incorporating both the Analytical Hierarchy Process (AHP) and Simple Multi-Attribute Rating (SMART) calculation methods. The analysis results reveal that Central Java has the highest production effectiveness, followed by West Java and East Java. According to the AHP calculations, Central Java has an infinite value index, which aligns with the SMART method results of 0.798, 0.42, and 0.533. These two multi-criteria methods' calculations allow for a comparative analysis of each region's effectiveness and potential in livestock production. Forecasting analysis indicates positive outcomes, predicting an increase in production in 2024 compared to 2023. Additionally, production costs are expected to decrease in 2024, driven by factors such as implementing production priority scales, cost and raw material efficiency, and optimizing technology use to enhance the production process.

ACKNOWLEDGMENT

The authors would like to express their gratitude to the organizers, namely Telkom University Purwokerto. The authors would also like to thank the supervisor, Mrs. Sukmadiningtyas, who has provided assistance in the preparation of this research, as well as to friends and respondents who have provided support in supporting the process of preparing the research.

REFERENCES

[1] F. Beby Larasati, A. Ahmad, I. Parlina, and M. Wahyudi, "Seminar Nasional Teknologi Komputer & Sains (SAINTEKS) Penerapan Metode SMART (Simple Multi Attribute Rating Technique) Dalam Merekomendasikan Jenis Sapi Terbaik Untuk Peternakan Sapi Potong," *Semin. Nas. Teknol. Komput. Sains*, pp. 202–205, 2020.

[2] L. Richter *et al.*, "Artificial Intelligence for Electricity Supply Chain automation," *Renew. Sustain. Energy Rev.*, vol. 163, no. March, p. 112459, 2022.

[3] H. Nur Cahya, "Pemanfaatan Resi Gudang Sebagai Opsi Optimalisasi Supply Chain Sebagai Alternatif Solusi Harga Panen Anjlok Pada Kelompok Tani," *JRB-Jurnal Ris. Bisnis*, vol. 2, no. 2, pp. 137–146, 2019.

[4] R. Dubey, D. J. Bryde, Y. K. Dwivedi, G. Graham, and C. Foropon, "Impact of artificial intelligence-driven big data analytics culture on agility and resilience in humanitarian supply chain: A practice-based view," *Int. J. Prod. Econ.*, vol. 250, no. July, p. 108618, 2022.

[5] S. R. Karimuna, S. Bananiek, S. Syafiuddin, and W. Al Jumiati, "Potensi Pengembangan

Komoditas Peternakan di Sulawesi Tenggara," *J. Ilmu dan Teknol. Peternak. Trop.*, vol. 7, no. 2, p. 110, 2020.
[6] D. C. Widianingrum and H. Khasanah, "Tren perkembangan, kondisi, permasalahan, strategi, dan prediksi komoditas peternakan Indonesia (2010-2030)," *Sinergitas Antara Pemerintah, Perguru. Tinggi dan DUDI dalam Pengemb. Ternak Lokal yang Berkelanjutan*, vol. 2, pp. 6–17, 2021.
[7] A.-N. F. Prayitno, A. E. P. Lasena, and S. Fernandez, "Analisis Rantai Pasok Toko Ban dengan Penerapan SCOR dan AHP," *J. Comput. Syst. Informatics*, vol. 5, no. 1, pp. 257–266, 2023.
[8] F. A. Handika, Siregar, "Decision Support System for Election of Chairman of the Mosque Prosperity Board Using the SMART Method," vol. 2, 2024.
[9] P. Ziemba, M. Piwowarski, and K. Nermend, "Software systems supporting remote education – Fuzzy assessment using a multi-criteria group decision-making method," *Appl. Soft Comput.*, vol. 149, no. April, 2023.
[10] L. Neubauer and P. Filzmoser, "Improving forecasts for heterogeneous time series by 'averaging', with application to food demand forecasts," *Int. J. Forecast.*, no. xxxx, 2024.
[11] M. Kehayov, L. Holder, and V. Koch, "Application of artificial intelligence technology in the manufacturing process and purchasing and supply management," *Procedia Comput. Sci.*, vol. 200, no. 2019, pp. 1209–1217, 2022.
[12] B. M. Mohsen, "Impact of Artificial Intelligence on Supply Chain Management Performance," *J. Serv. Sci. Manag.*, vol. 16, no. 01, pp. 44–58, 2023.
[13] L. Manning *et al.*, "Artificial intelligence and ethics within the food sector: Developing a common language for technology adoption across the supply chain," *Trends Food Sci. Technol.*, vol. 125, no. April 2021, pp. 33–42, 2022.
[14] E. Riyandana, M. G. An Ars, and A. Surahman, "Rancang Bangun Aplikasi Game Edukasi Kosakata Baku Dalam Bahasa Indonesia Di Tingkat Sekolah Dasar (Studi Kasus Sd Negeri 1 Way Petai Lampung Barat)," *J. Inform. dan Rekayasa Perangkat Lunak*, vol. 3, no. 2, pp. 213–225, 2022.
[15] A. T. Cahyono and S. Wibisono, "Sistem Pendukung Keputusan untuk Penilaian Kinerja Pegawai menggunakan Metode AHP dan COPRAS," *J. JTIK (Jurnal Teknol. Inf. dan Komunikasi)*, vol. 8, no. 1, pp. 58–66, 2024.
[16] C. S. Pramudyo and D. E. H. Purnomo, "Perancangan Sistem Pendukung Keputusan untuk Pemilihan Pemasok Nata de Coco dengan Metode Simple Additive Weighting," *J. Ilm. Tek. Ind.*, vol. 11, no. 1, pp. 80–90, 2012.
[17] D. Apdian, M. T. B. Hutabarat, R. Jayawiguna, and Y. Suherman, "Sistem Penunjang Keputusan Beasiswa Pada Smk Ristek Karawang Berbasis Web Menggunakan Metode Smart," *J. Interkom J. Publ. Ilm. Bid. Teknol. Inf. dan Komun.*, vol. 18, no. 4, pp. 17–24, 2024.
[18] A. Lusiana and P. Yuliarty, "PENERAPAN METODE PERAMALAN (FORECASTING) PADA PERMINTAAN ATAP di PT X," *Ind. Inov. J. Tek. Ind.*, vol. 10, no. 1, pp. 11–20, 2020.