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HOW EFFECTIVE ARE FACTORS SUPPORTING SUSTAINABILITY OF BEEF CATTLE FARMING?

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ABSTRACT
Studies were done to determine how well various aspects of the farm's operation contribute to its long-term viability. Kupang Regency was the location of the study. Kupang Regency's 24 sub-districts were randomly split into 3 samples; from those, 2 villages were chosen at random. The sample villages and sub-districts were selected based on the highest population of the beef cattle and the distance among the sub-districts was relatively far. 240 cattle farmers as sampels were selected non-proportionally from the three sub-districts samples. Data, then, were analysed by applying Structural Equation Modeling (SEM) using a software 'smartPLS 3'. The result showed that the factors effects significantly on the productivity of the beef cattle farm were: supporting of animal production fascilities, supporting of human resources, supporting of market, include motivation of social and cultural. The significant influence factor towards the sustainability of the cattle farm was the human resources. Factors that significantly effect on the sustainability through productivity were supporting fascilities of catlle production, supporting of the human resources called the cattle farmers, supporting of the market, and correlation of social-cultural motivation. The productivity of the cattle farm has a significantly correlation to the sustainability of the beef cattle farm.

KEY WORDS
Beef cattle farming, Kupang Regency, productivity, supporting factors, sustainability.

Modern Indonesian beef cattle farming are mostly dependent on community farms, which carry a high danger of becoming unsustainable. In a supply chain, an imbalanced pattern of escalating prices caused this issue, which in turn hampered output and productivity. While fattening has already been completed in a semi-intensive manner, beef cattle breeding continue to follow a conventional extensive pattern. Regarding the conventional extensive pattern, the cattle were left on the pasture without the farmers' intervention in terms of the quantity and quality of feed and animal health care, which resulted in low farm output. A complete agricultural system will be disturbed by the presence of non-synergistic and unbalanced situations upstream. Imports were a great short-term solution to the demand-supply imbalance, but they will lead to a high level of dependency on imports in the long run, which will negatively affect the nation's ability to meet its own consumption needs.

In East Nusa Tenggara, Kupang Regency served as one of the major production hubs for beef cattle (NTT). The sustainability of the beef cattle industry depends on a variety of internal and external factors, both of which affect production. The existence of a practice known as productive cattle slaughtering (which reached 81%) in some production center locations, such as West Timor, is a persistent result of a high number of productive cattles being sold by owner farmers (Krova et al, 2019). Other sections of the production centers experienced the same situation. In South Sulawesi, Bali, and Nusa Tenggara, the slaughter of cattles averaged 72% of the overall slaughter, with more than (>) 90% of those cattles being productive, according to Priyanti et al (2017) research.

Specifically in Kupang Regency and frequently in West Timor, farmer behavior and decisions were two irrational contributing causes. It was discovered that even if the cattle

have been growing to market weight, the farmers refuse to sell the matured beef cattle when they are not yet in need of money. Therefore, they won't sell the cattle unless they absolutely have to have the money for an emergency necessity at home. According to Krova et al. (2018), one factor that contributed to the large number of productive cattles sold was the pressure on households to have a lot of cash on hand, despite the fact that farmers lacked any savings that could be withdrawn to meet their demands. Lau, et al. (2020) also noted this circumstance, stating that the key factor influencing the decision of the farmers to sell their productive cattles was their lack of access to alternative male cattle that could be sold to generate income.

The government made some efforts to address the issue, which were realized in some instruments, including an extension program, the introduction of feed technology, a program for artificial insemination (AI), the preparation of animal market facilities, direct control of cattle for out-of-market sales, direct control of cattle for the market, and socialization of any applicable rules and regulations. Since cattle were classified as a premium commodity at the level of NTT Province, each government has such strategic programs in connection to cattle. Red wine, productive cattles, Upsus Siwab, and plant mayze harvest cattle are those initiatives.

The management of the farmers' farms, the farmers' cultures, and the farmers' behaviors, along with the government initiatives, were all described in detail, and it was clear that each of these elements significantly influenced the sustainability of the beef cattle farm. The relationship between those elements and the sustainability of the beef cattle farm, however, was not previously more well-known. A study was therefore conducted to determine the significance of the relationship between the supporting internal and external elements for the productivity and sustainability of the beef cattle farm at the level of the farmers.

METHODS OF RESEARCH

This characteristic of the research was explanatory and causal with regard to the research aims (cause-effect). The cattle ranchers in West Timor's Kupang Regency made up the research population. 24 sub-districts in the Kupang Regency were used to collect 3 sub-district samples, and 2 village samples were then purposefully chosen to reflect each sub-district sample. The sub-district and village samples were chosen because they were farther apart than the sub-district samples and because the sites had the highest livestock populations.

According to Supranto (2011), a reasonable sample size can be calculated by multiplying the number of questionnaires by five (5) to ten (10) to determine the number of respondents for this study (10). Additionally, as the study indicator employed roughly 48 questionnaires, 240 respondents made up the farmer samples. The respondents were then chosen using a non-proportional random method, with 80 cattle farmers being chosen from each hamlet.

There were two kinds of research data, namely primary and secondary data. The primary data needed were qualitatively. The primary data were taken based on interview result with the respondents guided by prepared questionnaires. On the other hand, the secondary data were needed to add and to underline discussion based on the relevant literatures. The answer of each question or statement in the questionnaires has each value score as follows: Do not agree very much (1), Does not agree (2), Neutral (3), Agree (4) and Very Agree (5). The data, then, were analysed by applying Structural Equation Modeling (SEM) using PLS (Partial Least Squares) method. Further, the analysis data were done using software ‘smartPLS 3’.

RESULTS AND DISCUSSION

Age factor can influence a farmer’s ability either physically or mentally. A younger person, of course, has physical ability faster and more adapt to new information and technologies

suggested, and more brave to take the risk. The result showed that average age of the beef cattle farmers was 52.30 (± 10.52) years old with the age variation range between 29-85 years old and it can be categorized in productive age at 15-65 years old was 90.07% and unproductive age at ≥65 years old was 9.92%. This result indicated that the farmers in Kupang Regency were in productive age and they can do their cattle farm well.

The majority of beef cattle farmers in Kupang Regency were men (94%), while only 6% were women (Figure 1). Due to the fact that male farmers are physically more capable than female farmers, male farmers dominated the beef cattle farming industry in Kupang Regency. In addition, the dominance of male farmers was associated with the tradition of growing cattle on farms where the animals were typically released in the forest or pasture. In fact, both woodland and grassland were remote from the farmers' home or means of subsistence.

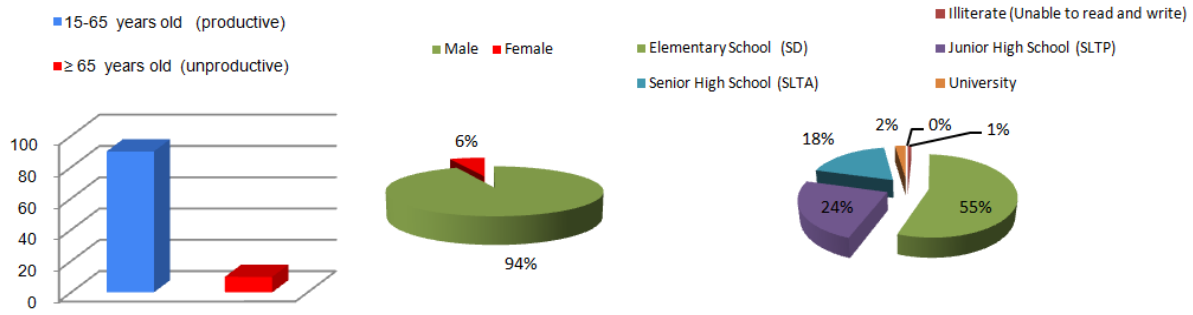

Figure 1 – Profile of Beef Cattle Farmers in Kupang Regency.

Formal education was an indicator describes quality of human resources. The result showed that 58% of the farmers were mainly Elementary School graduated, while 42 % of them were educated in Junior High School and Senior High School. Low level of the formal education becomes a description about the business actors of the cattle farm in Kupang Regency.

Commonly, the beef cattle raised by the farmers were their owned. The result showed that average of the beef cattle owned on the farmers'level in Kupang Regency was as follow: calves were 0.28±0.21 AU, veals 1.36±2.52 AU and cattle were 1.89±2.45 AU.

Usually, the raising system for breeding was done by releasing the cattle on the pasture. The cattle were freely to seek feed with less control by the farmers. The beef cattle raising pattern in Kupang Regency still categorized as a traditionally system without technology application. This condition caused the productivity and production of the beef cattle was low and it influences the sustainability of the beef cattle farm.

Cattleshed was a shelter for the beef cattle, so it will helpful the farmers to control their cattle. Type of the cattleshed for breeding in Kupang Regency was a communal cattleshed without roof and made from simple local materials and it needs as an emergency shelter; while for fattening, the farmers just preparing a crosswood without roof. The cattleshed or the crosswood were usually established under the shady trees to protect the cattle from hot sun and rain. Actually, the cattleshed and the crosswood were just an emergency shelter, so these two typical shelters must be renovated every year and the shelters can be moved to another places. The crosswood length average was 4.3 m, while the cattleshed large average was 43.5 m^2. The cattleshed was only used incidentally such as for marking the cattle, collecting the cattle for selling purposes or for health care and vaccination.

Feed was an essential component of Kupang Province beef cattle farms. On the research location, there were several types of feed, including Leucaena leucocephala, Sesbania grandiflora, grass, Caliandra, ficus, kapok, and putak, as well as agricultural waste such as banana stem and rice and maize straw. The quantity of forage supplied was 21.21 kg per head per day, depending on the quantity of feed available. The quantity of feed supplied varies with the season. The amount of feed supplied during the rainy season was greater than throughout the summer. The frequency of forage feeding was two to three times per day. There were two types of health treatment in the Kupang Regency to combat any

sickness affecting beef cattle: preventative and curative. The Department of Animal Husbandry administered vaccinations twice yearly as a prophylactic measure. The immunization cost was IDR5,000 per head of cattle. There were two approaches to curing beef cattle: commercial medicine and traditional medicine. The traditional medicine were mixed by the farmers themselves. There were two kinds of diseases found, namely Helminthiasis and Diarrhea. Cost of curative care was vary from IDR25,000/ head up to IDR 50,000/head.

Labors used in the beef cattle farm in Kupang Regency were from the farmers' household about 1 to 3 persons. There were some farmers hire outside labors with the wage in natura inkind (one calve for each cattle calving) or its value reached IDR1,500.000/year. The hired labors' jobs were to prepare feed and drink water.

Evaluation of this measurement model covers convergent validity, cronbach alpha, composite reliability, dan discriminant validity. Value of Convergent Validity was value of loading factor on laten variable with its indicators. According to Hair et al (2017), the value of outer loading must be more than 0.7. If the value of loading factor was less than (<) choosed limitation, therefore the indicator must be erased from the model. This research used the value of loading factor more than 0.7 so the value that less than 0.7 must be erased.

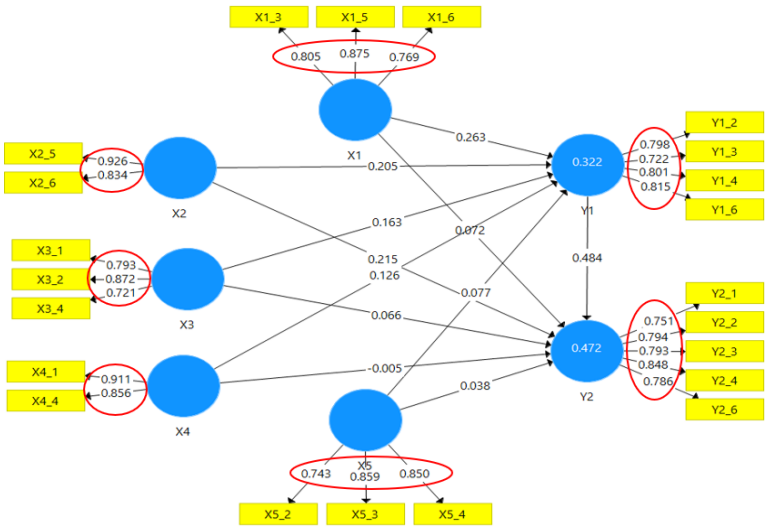

Figure 2 – The Research Model with the Value of Loading Factor was more than 0.7.

Vincenzo (2010) stated that data which have composite reliability and cronbach alpha more than (>) 0.7 means the data have a high reliability. Hair et al (2017) also mentioned that limitation value for cronbach alpha and composite reliability must be more 0.7 but less than 0.95 for all construct.

Table 1 – Composite Reliability, Cronbach's Alpha, and Average Variance Extracted (AVE)

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
X_1	0.754	0.786	0.858	0.668
X_2	0.722	0.795	0.874	0.777
X_3	0.715	0.748	0.839	0.636
X_4	0.724	0.750	0.877	0.782
X_5	0.752	0.754	0.859	0.671
Y_1	0.798	0.816	0.865	0.616
Y_2	0.855	0.870	0.896	0.632

Average Variance Extracted (AVE) described variety value or indicator variation (variable manifest) owned by construct. The bigger the variant of the manifest variable owned by the construct, the bigger the manifest variable representative for its latent construct. Limitation Value of AVE or AVE value expected must be more than (>) 0.5. This

value described sufficient convergent validity that means one latent variable can explain more than half (50%) variant of indicators on average.

Table 2 – Discriminant Validity Fornel and Lacker

n/n	X1	X2	X3	X4	X5	Y1	Y2
X1	0.818						
X2	0.322	0.881					
X3	0.375	0.345	0.798				
X4	0.241	0.138	0.201	0.884			
X5	0.390	0.346	0.381	0.243	0.819		
Y1	0.450	0.390	0.387	0.269	0.343	0.785	
Y2	0.398	0.462	0.368	0.195	0.330	0.637	0.795

The Discriminant Validity can be seen not only from the value of cross loading factor, but also from Fornell Larcker criterion (Fornell and Larcker, 1981). The Discriminant Validity function was to determine wether a reflective indicator was surely be a good measure for its construct. The construct will valid if Fornell Larcker criterion (AVE root) was more than correlation among latent variables. The result showed that all indicators were good indicators for the construct (its latent variable).

Some experts stated that cross loading and Fornell_larcker Criterion were less sensitive in evaluating value of discriminant validity. Heterotrait_Monotrait ratio (HTMT) was an alternative model recommended to evaluate the discriminant validity (Henseler et al, 2015). HTMT was a mean of all indicator correlation at all construction that measure different construction (namely correlation of heterotrait-heteromethod) relative toward mean (geometryc) of indicator average correlation that measure the same construction. The value of HTMT expected must be lower (<) than 0.9, that described all constructs were valid. The result analysis showed that all HTMT values must be lower (<) than 0.9, therefore it can be stated that all constructs in the model were valid. Refers to the same source that disattenuated correlation between 2 construct approximately 1 or (>0.9) showed less of discriminant validity.

Table 3 – Heterotrait-Monotrait Ratio (HTMT)

n/n	X1	X2	X3	X4	X5	Y1
X1						
X2	0.418					
X3	0.462	0.474				
X4	0.319	0.197	0.293			
X5	0.503	0.483	0.498	0.326		
Y1	0.556	0.447	0.477	0.343	0.425	
Y2	0.454	0.558	0.444	0.256	0.394	0.732

Analysis of Inner Model can be seen from some indicators as follow: path coefficient, determination coefficient (R square or R^2), f square (f^2), and Predictive Relevance (Q square or Q^2). Analysis result of direct effects value also known as path coefficient. The measurement of path coefficients among construct in order to evaluate significancy and power of the relationship as well as to examine hypothesis. The value of path coefficients was range between -1 up to +1. The value of the path coefficients was approximately at value of +1, it means the relationship of those two constructs was getting stronger. The relationship that next to hubungan kedua konstruk semakin kuat. The relationship that close to -1 was indicated that the relationship has a negative relationship (Sarstedt et al., 2017).

Regarding analysis result of the direct effects inner model, it can be concluded that: direct effect of X_1 to Y_1 was 0.263 it means if X_1 increases one unit, therefore Y_1 will increase 26.3%. Direct effect of X_2 to Y_1 was 0.205 it means if X_2 increases one unit, therefore Y_1 will increase 20.5%. Direct effect of X_3 to Y_1 was 0.163 it means if X_1 increases one unit, therefore Y_1 can increase16.3%. Direct effect of X_4 to Y_1 was 0.126 it means if X_4 increases

one unit therefore Y_1 can increase 22.1%. Direct effect of X_5 to Y_1 was 0.077 it means if X_5 increases one unit, therefore Y_1 can increase 7.7%.

Table 4 – Path Coefficients among Constructs

n/n	Y1	Y2
X1	0.263	0.072
X2	0.205	0.215
X3	0.163	0.066
X4	0.126	-0.005
X5	0.077	0.038
Y1	-	0.484

It also showed direct effect of latent variable on sustainability (Y_2). Direct effect of X_1 to Y_2 was 0.072 means if X_1 increases one unit therefore Y_2 can increase 7.2%. Direct effect of X_2 on Y_2 was 0.215 means if X_2 increases one unit therefore Y_2 can increase 21.5%. Direct effect of X_3 to Y_2 was 0.066 means if X_1 increases one unit it makes Y_2 increases 6.6%. Direct effect of X_4 on Y_2 was 0.005 means if X_4 increases one unit therefore Y_2 will decline 0,5%. Direct effect of X_5 on Y_2 was 0.038 means if X_5 increases one unit therefore Y2 will increase 3.8%. Direct effct of Y_1 on Y_2 was 0.484 means if Y increases in one unit it will make Z can increase 48.4%.

Table 5 – Specific Indirect Effects among Constructs

n/n	Specific Indirect Effects
$X_1 \rightarrow Y_1 \rightarrow Y_2$	0.127
$X_2 \rightarrow Y_1 \rightarrow Y_2$	0.099
$X_3 \rightarrow Y_1 \rightarrow Y_2$	0.079
$X_4 \rightarrow Y_1 \rightarrow Y_2$	0.061
$X_5 \rightarrow Y_1 \rightarrow Y_2$	0.037

Based on the result analysis of indirect effects, it can be concluded that: Indirect effect of X_1 on Y_2 through Y_1 was 0.127 means if X1 increases in one unit therefore Y_2 can increase indirectly through Y_1 at 12.7%. The indirect effect of X_2 on Y_2 through Y_1 was 0.099 means if X2 increases in one unit therefore Y_2 can increase indirectly through Y_1 at 9.9%. Indirect effect of X_3 to Y_2 through Y_1 was 0.079 means if X1 increases in one unit therefore Y_2 can increase indirectly through at 7.9%. Indirect effect of X_4 to Y_2 through Y_1 was 0.061 means if X2 increases in one unit therefore Y_2 can increase indirectly through Y_1 at 6.1%. Indirect effect of X_5 to Y_2 through Y_1 was 0.037 means if X2 increases in one unit therefore Y_2 can increase indirectly through Y_1 at 3.7%.

Table 6 – Total Effects

n/n	Y_1	Y_2
X_1	0.263	0.200
X_2	0.205	0.314
X_3	0.163	0.145
X_4	0.126	0.056
X_5	0.077	0.075
Y_1	-	0.484

It can be concluded as follow: y X_1 towards Y_2 was 0.200 means if X1 increases in one unit therefore Y_2 can increase both directly and indirectly through Y_1 at 20%. The indirect effect of X_2 to Y_2 through Y_1 was 0.335 means if X2 increases in one unit therefore Y_2 can increase either directly or indirectly through Y_1 at 33.5%. Total Effect of X_3 to Y_2 was 0.145 means if X_3 increases in one unit therefore Y_2 can increase either directly or indirectly through Y_1 at 14.5%. Total Effect of X_4 to Y_2 was 0.056 means if X_4 increases in one unit therefore Y_2 will increase directly and indirectly through Y_1 at 5.6%. Total Effect of X_5 to Y_2

was 0.075 means if X_5 increases in one unit therefore Y_2 can increase directly and indirectly through Y_1 at 7.5%.

The determinant coefficient (R^2) of productivity construct (Y_1) at 0.322 and sustainability (Y_2) at 0.472. It means that 32.2% of productivity variation can be explained by variation of latent variable of production input (X_1), human resources (X_2), market (X_3), motivation of social cultural (X_4) and government policy (X_5). At least 67.8% can be explained by the other constructs at outside of the model. In addition, the sustainability construct variation (Y_2) at 47.2% can be explained by constructs of X_1 until X_5; while the left was 52.8%. Chin (1988) stated that R^2 value at 0.19 was categorised as weak, 0.33 was categorised as moderate, 0.67 was categorised as substantial, and if more than (>) 0.7 was categorised as strong. The result showed that either determinant coefficient (R^2) of productivity (Y_1) or sustainability (Y_2) was existed at moderate level.

Table 7 – Values of Q square, R square, and R square adjusted

n/n	SSO	SSE	Q^2 (=1-SSE/SSO)	R Square	R Square Adjusted
Y_1	1012.000	646.738	0.361	0.322	0.308
Y_2	1265.000	700.290	0.446	0.472	0.459
X_1	759.000	503.118	0.337		
X_2	506.000	345.772	0.317		
X_3	759.000	543.876	0.283		
X_4	506.000	343.266	0.322		
X_5	759.000	500.931	0.340		

On PLS PLS it can be evaluated based on Q-square (Predictive Relevance) for model variables. Q-square measures how good the observation value was produced by the model and estimated its parameters. The value of Q-square was more than (>) 0 (zero) proved that the observationed values were well reconstructed, therefore the model has relevant predictive; while if the value of Q-square was less than (<) 0 (zero) it will show that the model has less relevant predictive. If the value of Q-square (Q^2) obtained was 0.02 (small), 0.15 (moderate) and 0.35 (big). The research result showed that the value of Q-square of all constructs were categorised relatively big, more than moderate category approached to 0.35 that categorised as big. Moreover, the value of Q-square of the sustainability construct (Y_2= 0.446) was beyond 0.35 which has been categorised as big. This condition showed that the observationed value was well reconstructed therefore the model has relevant predictive.

The other indicator used was Standardized Root Mean Square Residual (SRMR). SRMR less than 0.10 or 0.08 means suitable (Hu and Bentler, 2009). Henseler et al (2014) introduced SRMR as goodness of fit measure for PLS SEM that can be used to avoid misspesification model.

Table 8 – Model of Fit

n/n	Saturated Model	Estimated Model
SRMR	0.090	0.090
d_ULS	2.058	2.058
d_G	0.664	0.664
Chi-Square	1021.478	1021.478
NFI	0.609	0.609

The research SRMR gained was 0.09 > 0.08 but it still less than (<) 0.10. It means the established model was fit (suitable) categorized. NFI model as a result of analysis in this research reached 0.609 although small it still on the range between 0 and 1. Therefore, the established model can be stated as relatively good and appropriate.

The hypothetical test can be seen based on the value of t-statistic and value of probability. The hypothetical test was done by applying t-statistic therefore for alpha 5% the t-statistic used was 1.96 (t-table). The research was designed to examine the signification correlation among input (X1), human resources (X2), market (X3), motivation of social

cultural (X4), government policy (X5) to productivity (Y1) and sustainability of the cattle farm (Y2) and all of X variables to Y2 through the intervention of Y1 (Figure 3).

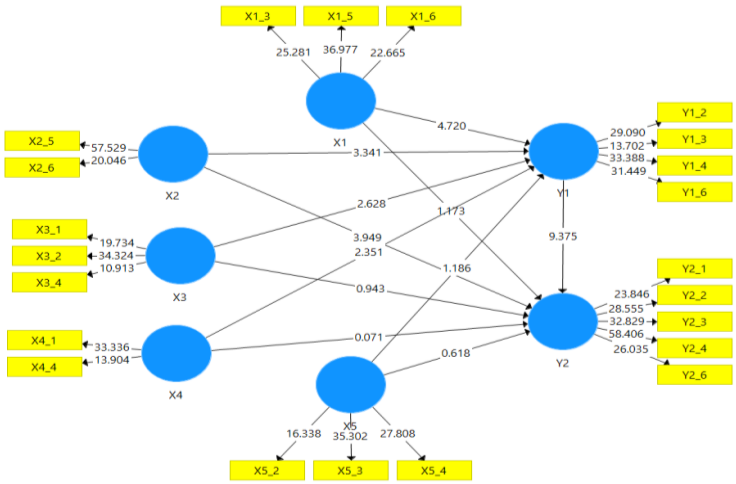

Figure 3 – Result of Hypothetical Test.

Therefore, there were 16 hypotheses tested. The hypotheses test was done by comparing t-statistic with t-table, or based on P-value. Criteria of accepted the hypothetic if the t-statistic value was > 1.96 (t-table=1.96). In contrary, criteria of rejected the hypothesis if t-statistic < 1.96. Decision making principle was at P-value < 0.05 means rejected H_0 and accepted Ha. In contrary, if P-value ≥ 0.5 therefore H_0 was accepted or rejected Ha. Besides, if P-value was less than (<) 0.05 means the correlation was significant.

Table 9 – T_Statistics and P_values for Direct Correlation

n/n	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
$X_1 \rightarrow Y_1$	0.263	0.263	0.056	4.720	0.000
$X_1 \rightarrow Y_2$	0.072	0.071	0.062	1.173	0.241
$X_2 \rightarrow Y_1$	0.205	0.209	0.061	3.341	0.001
$X_2 \rightarrow Y_2$	0.215	0.217	0.054	3.949	0.000
$X_3 \rightarrow Y_1$	0.163	0.167	0.062	2.628	0.009
$X_3 \rightarrow Y_2$	0.066	0.068	0.070	0.943	0.346
$X_4 \rightarrow Y_1$	0.126	0.128	0.054	2.351	0.019
$X_4 \rightarrow Y_2$	-0.005	-0.006	0.067	0.071	0.943
$X_5 \rightarrow Y_1$	0.077	0.077	0.065	1.186	0.236
$X_5 \rightarrow Y_2$	0.038	0.041	0.061	0.618	0.537
$Y_1 \rightarrow Y_2$	0.484	0.481	0.052	9.375	0.000

The t_satistics and P_value of direct correlation of latent variable X to productivity (Y_1) and latent variable X to sustainability (Y_2). The result of analysis showed that input X_1 has a significant correlation to productivity (Y_1) since its value of t-statistic was 3.154 > 1.96 and its P_value was 0.002< 0.05. Additionally, the correlation of X_2, X_3, X_4, and X_5 to Y_1. However, X_1, X_3, X_4, and X_5 has no significant correlation to the sustainability Y_2. It means, only the human resources have a significant correlation to the sustainability (Y_2). Further, the productivity (Y_1) also has a significant correlation to the sustainability (Y_2).

Table 10 – T-Values, P-Values Indirect Correlation among Latent Variables

n/n	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
$X_1 \rightarrow Y_1 \rightarrow Y_2$	0.127	0.127	0.032	4.034	0.000
$X_2 \rightarrow Y_1 \rightarrow Y_2$	0.099	0.101	0.032	3.131	0.002
$X_3 \rightarrow Y_1 \rightarrow Y_2$	0.079	0.080	0.031	2.563	0.011
$X_4 \rightarrow Y_1 \rightarrow Y_2$	0.061	0.061	0.025	2.414	0.016
$X_5 \rightarrow Y_1 \rightarrow Y_2$	0.037	0.037	0.032	1.179	0.239

All variables X_1, X_2, X_3, and X_4 have significant correlation to sustanability (Y_2) through intervening variable namely productivity (Y_1). There was only variable of government policy (X_5) has no correlation to sustainability (Y_2) through intervening variable namely productivity (Y_1), as showed by its T-statistic value that more than (>) 6 but its P value was less than (<) 0.05.

Supporting Factors of Beef Cattle Productivity. Beef cattle farm productivity was significantly impacted by internal factors including: the availability of animal production facilities, the availability of human resources, and the motivation of social and cultural elements. Then, the market has the backing of an external factor that significantly correlates with or affects the output of beef cattle farms. There is no discernible impact of government policies on beef cattle output..

The significant link between supporting facilities (X1) and productivity (Y1) can be rationalized due to the fact that the supporting of production facilities was required for living organisms such as beef cattle. The animal production facilities include feed, medicine, a livestock shed, and equipment. Commonly, feed was still derived from forage on natural pastures. However, some people have been cultivating fodder for feed. Although extension was frequently acquired, there has been no use of concentrate. According to the findings of Richardson et al. (2010), concentrate-fed cattle produce more offspring than non-concentrate-fed cattle, although weaning period has no consistent effect on successful conception (as valued by the next level of birth). This study revealed that feeding cattle concentrates can extend their productive time, allowing them to produce more calves per animal.

The significance of the link between supporting human resources (HR) (X2) and beef cattle productivity (Y1) was recognized because farmer labor was a reasonably major input. According to the findings of Manulangga et al. (2020), the potential of human resources supporting power had the greatest effect on the effectiveness of the Koppel program for beef cattle breeding in Kupang Regency. Clearly, the beef cattle production will increase as the human resources supporting the management of the beef cattle farm improve. The human resource assistance can be viewed from two perspectives: quantity and quality. Productive age was a factor in determining quality. This result contradicted Suwarta's (2012) conclusion that the older the farmers, the lower their productivity. The discrepancy was likely due to the fact that the farmers in this study were of productive age.

A beef cattle farm of a certain size requires a certain number of workers. Regarding the feeding sources and feeding system in the Kupang Regency, which still rely on natural forage and a small amount of forage plantation, this circumstance impacts the significance of the work force. The fewer workers there are, the less input (mostly food) is required. Typically, farmers in Kupang Regency gave their cattle substandard food based on the availability of grain. In addition, they have not yet considered the need for fiber and other nutrients in cattle. These circumstances will affect the output of beef cattle.

In addition, the quality of the human resources used to run the beef cattle farm in the Kupang Regency remained low due to traditional management practices. The expansion of farm size has not yet matched the planning of feed supply plantations for adequate feeding. Therefore, beef cattle in Kupang Regency tend to have a low body score.

The managerial function can only be performed by the labor of the farmers. The production of a beef cattle farm improved proportionally to the quality of its management. Walmsley (2016) revealed that management decisions and livestock and calf characteristics had a significant impact interaction on cattle productivity. Management issues such as date of birth and selection decision interacted with environmental elements such as period and production features such as feed consumption and degree of previous output to influence the growth of heifers and the body's energy reserve. Ideally, a definition should encompass both the inputs and outputs of cattle production.

This condition refers to the findings of Rojas et al(2020).'s evaluation of the effect of human-animal relationships on animal wellbeing and productivity. The outcome demonstrated that agriculture with improved technology and automation may foster a

stronger human-animal relationship (HAR). This link remained a fundamental requirement for enhancing animal welfare, which was extremely beneficial for health and output.

The analysis also revealed a substantial association between the market (X3) and the beef cattle farm's productivity (Y1). It indicates that the market played a significant role in enhancing the beef cattle farm's output. In an agribusiness system, the market serves either as a puller or a pusher of boosting beef cattle farm output. This requirement was consistent with the motive to raise cattle in order to boost household income.

The correlation study revealed a substantial relationship between social cultural motivation (X4) and beef cattle farm productivity (Y1). This conclusion was consistent with Sutanto and Hendraningsih's (2011) assertion that the social-cultural dimension has a high degree of sustainability. Cattle generate the greatest monetary income for farmers in Kupang Regency, followed by other animals. The income was derived through the sale of animals or from the animals themselves, which were utilized to fulfill the farmers' social and cultural demands. According to Krova (2019), farmers in West Timor, notably in the Kupang Regency, regularly use beef cattle as a form of savings. Farmers will only sell their animals if they are in need of cash. The necessity for a substantial amount of cash will influence the decision to sell the beef cattle, such as for the education of children, the establishment of a home, the expense of healthcare in a hospital, or a family celebration (Lau et al, 2020).

The usage of beef cattle as a kind of savings was not profitable since the cattle would be sold to meet these pressing financial demands. The greater the level of emergency, the lower the price of cattle. However, this reality may be used to describe the position of the community's cattle producers, who have limited access to financial institutions for both saving and borrowing, including loans.

The study indicated that there was no correlation between government policy (X5) and beef cattle farm productivity (Y1). The government's policies in the sector of beef cattle farming have been used in numerous programs and executed at the level of the farmers; yet, these programs have had no significant influence on the production. According to research conducted by Manulangga et al. (2020), the Koppel program in cattle breeding in Kupang Regency has not yet proven beneficial in boosting cattle productivity and farmers' incomes.

Veyssets et al. (2018) conducted research over the course of 36 years, from 1980 to 2015, utilizing the surplus accounting method to evaluate the trend of how company productivity factors (intermediate input, capital, land, and labor) and the profit of productivity were redistributed to economy actors. The majority of the increase in beef cattle farm productivity was only profitable for the downstream value chain (64% of the cattle value chain); in this case the processors, distributors, and consumers.

Supporting Factors of Beef Cattle Farm Sustainability. This section describes the causal relationship between variable X and sustainability (Y2). Only the human resources (HR) supporting variable has an effect or significant correlation to sustainability (Y2) among the five latent variables X that have a potential influence or significant correlation to sustainability (Y2). The other factors, X1, X3, X4, and X5, have no effect or correlation on sustainability.

The research revealed a favorable and statistically significant association between the support of human resources, specifically the cattle farmers (X2), and the viability of the cattle farm (Y2). This criterion said that the breeding management performed by the farm's actors, mainly the farmers, was a significant variable in regard to the farm's sustainability effort. This study differed significantly with the research conducted by Simamora (2020) in the Regency of Timor Tengah Utara, which demonstrated that farmer traits have a negative impact on farm sustainability. The disparity may be due to the differences in the farmer characteristics utilized as variables in this study, including age, gender, and expertise in producing beef cattle on a farm.

The outcome also revealed a substantial relationship between beef cattle farm productivity (Y1) and sustainability (Y2). Rojas et al. (2020) did a study on the positive and negative stimulation offered by humans to cattle and animals. The study's findings demonstrated that stimulation had a good impact on animal welfare and production.

Therefore, the expansion or contraction of the beef cattle farm will have an influence on the calves population as stock replacement in terms of sustainability.

This research demonstrated that factors such as environment, enonomy, technology, physical, human, and institution resources have direct and indirect effects on farmers' welfare (except for social factors); and that the variable of beef cattle farm sustainability has indirect effects on farmers' welfare (Rohaeni et al, 2014).

When evaluating a system, each of its numerous sustainability components, such as welfare, biodiversity, labor satisfaction, water usage, emission of greenhouse gases, and accumulation of hazardous pollutants such as Nitrogen and Phosphorus, must be accurately monitored. Human resources' decision-making was likely influenced by the development unit, which compared each positive and negative consequence, or by weighing each negative consequence, which was so severe that there was no public-acceptable balance (Broom, 2019).

In addition, the outcome demonstrated that the productivity variable (Y1) has a considerable impact on sustainability (Y2). Sutanto and Hendraningsih's (2011) investigation on the sustainability of dairy cattle in Malang Regency revealed that the productivity of dairy cattle is moderately sustainable. It was assumed that the discrepancy was a result of unfavorable environmental conditions and the way cattle farms were handled. This research was done to investigate the beef cattle farm in West Timor's very promising environment in depth.

Sustainability Supporting Factors of Beef Cattle Productivity through Productivity. According to the indirect relationship between variable X and sustainability (Y2), four of the five latent factors X had a substantial effect on sustainability (Y2) via productivity: input production (X1), human resources (X2), market (X3), and social cultural motivation (Y1). The mere endorsement of government policy (X5) has no substantial impact on the viability of the economy through productivity. Therefore, the direct and indirect assistance of government policy has no substantial impact on the viability of the beef cattle farm.

The beef cattle farm was an agribusiness system comprised of an upstream agribusiness sub-system, an on-farm agribusiness sub-system, and a downstream agribusiness sub-system; hence, each sub-system must operate and rotate at the same rate if it is to continue to exist. According to Broom (2017), a system cannot sustain itself if there is no market for a product, if the system's resources are unavailable, or if the system's products have gathered to the point where they inhibit or prevent the system from functioning. Although keeping cattle is motivated by social and cultural considerations, it is also motivated by the need for cash. The need for cash can only be satisfied if the market exists and is capable of absorbing the farmers' beef cattle production.

Kumar et al. (2022) stated that treating cattle as production machines led to extensive resource depletion, a rise in greenhouse gas emissions, egregious animal welfare violations, and other ethical issues. Sustainability in the meat industry was a formidable problem requiring a multifaceted and integrative strategy. Existence of digitalisation in the system of agriculture and animal market, application of high technology in raising the animal farm, application of remote sensing (teledetection) and artificial intelligence to manage production and impact of Greenhouse Gass/GHG) can aid in achieving this sector's goals. He also noted that sustainability has a direct relationship with numerous social elements of meat production efficiency, such as non-market attributes, demand-supply balance, market failures, and legislation.

Kleinman et al. (2018) conducted a study in response to the rising productivity and efficiency, which included the effort to improve the management of natural resources. The question was how the agriculture of the United States might be intensified in a sustainable manner, i.e. become more productive, without aggravating local and external environmental issues. This study examined the concept of sustainable intensification as a framework for identifying measures to boost agricultural production, environmental quality, and the prosperity of rural communities. Networking of Long-Term Agroecosystem Research (LTAR) has been used to determine the past and present conditions of agricultural land

agroecosystems, pastures, and meadows, as well as the research priorities in the fields of production, resource conservation, environmental quality, and village prosperity.

This research was designed in a good way to obtain a maximum result, but it still has some weaknesses or limitations. Therefore, the result gained was imperfect because it can not be used to generalize the other conditions in relation to the beef cattle farm in other regions. The research limitations were as follow:

- The research was conducted on beef cattle farm in two different systems as follow: at the main areas of beef cattle fattening system and at the main areas of beef cattle breeding system. The difference condition may be effect to the significancy correlation among established constructs;
- The research was participated the cattle farmers community in Kupang Regency who have low understand to the used variables. This case suspected will influence unsatisfy answers given;
- The research used questionnairies also has limitation since sometimes the respondent answers were unclearly define the answers. The choosing answer of questionair only represented by an otion of “very agree”, “agree”, “neutral”, and “do not agree very much”;
- Conditions of serious attitude and care of the farmers to answer the questions raised will impact simply answers.

CONCLUSION

Factors that effect significantly on productivity of the beef cattle were: supporting of animal production fascilities, supporting of human resources, supporting of market, and motivation of social cultural. Then, factor that significantly effects on the sustainability of the beef cattle farm was human resources. Moreover, factors that significantly effect on the sustainability through productivity were supporting of cattle production fascilities, supporting of human resources namely the cattle farmers, supporting of market, and supporting of social cultural relationship. The productivity of the cattle farm has a significantly correlation to the sustainability of the cattle farm.

The research implications or recommendations were as follow:

- An effort on increasing productivity of the cattle farm can be done by heeding the supporting of animal production fascilities, the supporting of human resources, motivation of sosial cultural, and the supporting of market;
- Programs to increase the quality of the human resources and productivity were urgent to the sustainability of the beef cattle farm.

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