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Risk Mitigation Analysis of Bali Cattle Smallholder Farming Using House of Risk Approach

By

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Abstract

This study aimed to identify and mitigate the risks of the Bali cattle business to avoid business losses. The need for cattle in Indonesia is soaring due to the increasing human population and public awareness of animal nutrition's importance to the human body. The risk management process in this study used the House of Risk (HOR) matrix. Based on the results of using the House of Risk Phase I approach, 17 Risk Events were found as sources of risk and 31 Risk Agents that could cause various risk events with a certain value weight in the whole series of Bali cattle activities, consisting of the stages of breeding, cultivation, marketing, and support. The results that are the output of HOR 1 are input for the next step, namely HOR 2, which is the framework of mitigation actions for all sources of risk. HOR 2 results obtained ten mitigation actions prioritized from 5 Risk Agents that have the highest ARPj value, namely improved maintenance management, attention to feeding nutritional balance, improved hygiene and sanitation of cages, supervision of feed health, expansion of feed area, feed storage, taking into account feed quality, delays feeding, Participating in AUTS, and Coordination with the service.

Keywords: Risk Management, Bali cattle, Livestock, HOR analysis

Introduction

The need for cattle in Indonesia is soaring with the increase in the human population and the increasing public awareness of the importance of animal nutrition for the human body. In suppressing meat imports, the government empowers farmers in all corners of the country to develop the cattle sector to support national food security, especially cattle commodities. The cattle farmers in South Sulawesi generally cultivate Bali cattle to produce healthy meat to support the provision of national animal protein.

Bali cattle have good adaptability and endurance and the potential to be developed in areas with extreme weather. Generally, Bali cattle (local cattle of Indonesia) are developed on a small scale of ownership to provide a smaller profit. Although Balinese cattle farming is carried out on a small scale, it is carried out on a massive scale, so that around 70% of the national demand for meat is supplied. Bali cattle have high fertility in producing calves, and this advantage becomes a reliable potential in supporting efforts to increase the population (Sari et al., 2020). The population of cattle in South Sulawesi Province tends to increase in the last 5 years, in 2016 by 1,366,665 heads; in 2017 amounted to 1,419,018 tails, 2018 amounted to 1,310,194 tails; by 2019 is 1,370,797, and in 2020 is 1,405,244 (BPS Barru, 2020). But its output is still inadequate to satisfy domestic demand, leading to an extremely heavy reliance on imports (Saleh et al., 2021).

Some risks can be detrimental in every activity, including the Bali cattle business. Risks in the agricultural sector include risks in production, costs, income, post-harvest risks, and marketing activities (Misqi, R.H & Karyani, 2020; Noor et al., 2019). The beef cattle farming industry is particularly reliant on the availability of business capital (Rohani et al., 2021). The severity of business risk is determined by the attitude considered by the business actors, and the risk can be avoided and taken but with minimal damage. The response of farmers who are afraid of the risk to their production will allocate fewer inputs, and brave farmers will allocate inputs more rationally and optimally (Budiman et al., 2019). To improve performance efficiency and effectiveness, risk management measures, analyzes, and controls risks in business or corporate activities (Astaman et al., 2021).

Risk management in the company is an internal process that is very important for the resilience and is unavoidable in the security of a process (Buganová & Šimíčková, 2019). The high uncertainty of an event, the higher the risk that will be posed in making a decision; therefore, identifying the source of risk is very important for the decision-making process in managing risk (Suharyanto et al., 2015). The risk management process in this study uses the help of FMEA (Failure Mode Effect Analysis) analysis which is enhanced by the HOR (House of Risk) matrix to identify and handle existing risks. House of Risk is an appropriate and more specific method for identifying risk agents and determining mitigation strategies for identified risks (Noerdyah et al., 2020). The House of Risk is easy to apply to identify risk events and agents and analyze efficient risk management strategies in production risk (Larasati et al., 2021). So that the process of handling Bali cattle business risks in this study applies the HOR matrix to mitigate business risks in order to avoid losses and provide optimal profits.

On the other hand, the Bali cattle farming business can experience business losses, so it is necessary to deal with these losses before causing even greater losses. The application steps in implementing risk management are carried out in several stages, including identification, assessment, response/response, and handling (Nawaz et al., 2019). In other words, the risks faced by business actors, in this case, are Bali cattle breeders, good management must be carried out in order to avoid unwanted business losses, and the risk mitigation process is determined based on direct tracing by taking into account a certain value index. This study aims to identify and mitigate the risks of Bali cattle farming so that smallholder farms are protected from business losses.

Research Methodology

The research was conducted in Barru Regency, and the location selection was carried out purposively considering that the location was a Bali cattle development center in South Sulawesi Province. Data were collected by observation, Focus Group Discussion and in-depth interviews with 50 respondents of farmers-livestock using a questionnaire. Quantitative data analysis uses the House of Risk (HOR) matrix, which is a modification of the HOQ, which is carried out in two stages, namely HOR 1 and HOR 2, to determine risk events, risk agents and risk management strategies where this matrix will be able to detect more than one source of risk.

The HOR model seeks to take preventive measures to reduce the possibility of a risk agent that can cause several risk events because one risk agent can give rise to more than one risk event. HOR differs from the FMEA method, where FMEA performs a risk assessment using RPN as an output in the multiplication of three factors: occurrence, severity, and detection. However, the HOR model relates the risk agent and the severity that will result from the risk event; in this case, the risk agent will be calculated with the aggregate risk potential through the following equation:

$$\mathrm{ARPj} = \mathrm{Oj} \sum_{\mathrm{i}} \mathrm{SiRij}$$

Where:
Oj = Probability of risk agent j
Si = Severity of risk i
Rij = Correlation of risk agents with severity
ARP = Aggregate risk potential of the risk agent j

HOR adopts the HOQ model in determining which risk agents are prioritized for preventive action. In determining priority risk, the amount of ARPj value is used as a reference in rating each j. This study uses 2 HOR stages, namely HOR phase 1, to identify risk agents and determine the priority of risk agents in carrying out mitigation actions. Furthermore, HOR 2 determines the most effective mitigation action in dealing with risk agents.

Table 1. *HOR Model Matrix 1*

Risk Event (Ei)	**Risk Agents (Aj)**				**The severity of Risk Event i**
	A1	**A2**	**A3**	**An**	
E1	R11				S1
E2	R21	R22			S2
E3					S3
E…n					Sn
Occurrence of Agent j	O1	O2	O3	On	
Aggregate Risk Potential j	ARP1	ARP2	ARP3	ARPn	
Priority rank of agent j	P1	P2	P3	Pn	

House of Risk 1

HOR 1 is used to identify risk agents through responses to what causes and how risk occurrences can occur, then Proceeds with an assessment of the Correlation between these responses, starting from no correlation, low Correlation, medium correlation, and high Correlation, in the translation of HOR 1 will be applied in the following steps:

1. Identification of risk events (Ei) that can occur in each production process.
2. Assessing the impact of the risk agent if it occurs, using a scale of 1-10; the higher the number, the higher the impact.
3. Assessing the Probability of occurrence of each risk agent, using a scale of 1-10 where a value of 1 indicates that it rarely occurs and a value of 10 indicates that it almost certainly occurs. The risk agent (Aj) is shown in the table with the notation Oj.
4. Applying the HOR matrix system to assess the relationship between each risk agent and risk event, with a Rij value of 0 no correlation, 1 low correlation, 3 moderate correlation, and 9 high correlation.
5. Calculating the aggregate risk potential of agent j (ARP) due to the occurrence of risk agent j and the impact of the aggregate of risk events caused by risk agent j.
6. Give risk agents a rating based on the ARPj value amount (from the largest to the smallest value).

House of Risk 2

HOR 2 is used to decide which action to take first, considering the different efficiencies, the resources involved, and ease of implementation. Ideally, the company will choose a series of actions that are not difficult to carry out but can effectively reduce the likelihood of the emergence of risk agents. The steps are as follows:

1. Selecting several risk agents with higher priority, possibly using Pareto analysis of ARPj, will be discussed in the second HOR. Those selected will be placed to the left (what) of HOR2, as shown in Table II. Put the appropriate ARPj value in the right column.
2. Determining the actions that are considered related to the prevention of risk agents. Note that more than one action can be used to address a risk factor, and one action can reduce the likelihood of several risk factors occurring simultaneously. For this HOR, the operation will be placed on the first line as "how".
3. Determining the relationship between each precaution and each risk agent, ext. The value can be {0, 1, 3, 9}, which represents the ratio of none, low, medium, and high between share k and agent j

Table 2. *HOR Model Matrix 2*

To Be Treated Risk Agent (Aj)	**Preventive Action (PAj)**				**Aggregate Risk Potentials (ARPj)**
	PA1	**PA2**	**PA3**	**PAn**	
A1	E11				ARP_1
A2	E21	E22			ARP_2
A3					ARP_3
An					ARPn
The total effectiveness of action k	TE1	TE2	TE3	TEn	
Degree of difficulty performing action k	D1	D2	D3	Dn	
Effectiveness to difficulty ratio	P1	P2	P3	P…n	
Rank of priority	R1	R2	R3	Rn	

This relationship (Ejk) can be considered as the effectiveness of action k to reduce the possibility of the emergence of risk agents j.

4 Calculating the total effectiveness of each action with the following equation:

$$TEk = \sum j\, ARPj\, Ejk\ \forall k.$$

5 Evaluating the difficulty of performing each action, Dk, and placing its continuous value under total effectiveness. The difficulty level represented by a scale (such as a Likert or other scales) should reflect the funds and other resources required to operate.
6 Calculating the relationship between efficiency and total difficulty, i.e. ETDk = TEk/Dk.
7 Setting a priority level for each action (Rk), where level 1 is assigned to the action with the highest ETDk.

Results And Discussion

Characteristics of Respondents

This study groups the characteristics of the respondents into five parts, namely the age of the respondent, the education level of the respondent, the dependents of the respondent's family, the ownership of livestock, and the experience of raising livestock. The study's respondents were 50 farmers who joined the farmer-livestock group, as described in the following Table 3.

Age

The age of the breeder is very closely related to performance for business development, and productive age will make work more efficient than those who are no longer productive. From the age group of Bali cattle breeders, the most dominant characteristics are the 46-55-year-old group (16 people with a percentage of 60%), then the 17-25 age group; 26 – 35; and 36-45 years (each person in each group with a percentage of 20%), then the age group 56-65; and 66 -75 (2 people each with a percentage of 4%).

Education Level

Education provides knowledge for someone in carrying out life activities, one of which is to earn family or personal income to meet daily life needs. The education in question is education that the respondents of Bali cattle breeders have completed. The respondents' most dominant level of education is the high school education group, with 30 people (60%), followed by elementary education.

Table 3. *Dominant Characteristics of Respondents*

General Characteristics	Dominant Characteristics	Frequency	Percentage
Age	46-55 YO	16	32%
Education Level	SHS	30	60%
Family Dependent	1-3 People	25	50%
Ownership	1-5 Head	32	64%
Farming Experience	1-15 Year	39	78%
Total Respondents: 50 People			

Source: *Research Data after processing, 2021.*

*YO: year old
*SHS: Senior High School

With 9 people (18%), then 6 people in junior high school (12%), and 5 people with a bachelor's degree (10%).

Family Dependent

Family dependents are an obligation for the head of the household to ensure the fulfillment of primary, secondary, and tertiary needs for family members. Judging from the number of dependents of Bali cattle breeders, there are three groups where the most dominant group is 1 – 3 dependents, as many as 25 farmers with a percentage of 50%, then 4 – 6 dependents as many as 21 farmers with a percentage of 42%, the last dependents 7 – 10 people as many as 4 farmers with a percentage of 8%.

Livestock Ownership

Livestock ownership illustrates that the more livestock you have, the greater the income the farmer will generate to meet his family's needs. However, it will make farmers' work more difficult to take care of the nutritional needs for the growth and development of their Bali cattle. The scale of livestock ownership has a dominant group on the ownership of 1-5 heads (32 farmers, 64%), then on a scale of 6-10 heads (15 farmers, 30%), then on a scale of 11-15 heads (2 farmers, 4%), and scale 16 -20 tails (1 breeder, 2%).

Farming Experience

The experience of raising cattle indicates the duration of time that has been used and knowing the potential and losses of business by farmers in cultivating Bali cattle, thus providing much knowledge for farmers to try to produce live cattle or in the form of meat. The farming experience group is divided into 4, namely 1-15 years (39 breeders or 78%), followed by 26-35 years (5 farmers or 10%), then 16-25 years (4 farmers or 8%), and 36 – 45 years (2 farmers or 4%).

Risk Identification

Collecting data using a questionnaire instrument in the form of a list of questions with the help of the expert judgment method. Based on the study results, there are four dimensions of risk in the Bali cattle husbandry business system partnership pattern: breeding risk, cultivation risk, marketing risk, and supporting risk. Processing the data using the HOR (House of Risk) Matrix stage 1 and Stage 2, which is a modification of the House of Quality (HOQ) and Failure Modes and Effect Analysis (FMEA). House of Risk is the development of the QFD (Quality Function Deployment) and FMEA (Failure Modes and Effect Analysis) methods which are used to develop a framework for managing risk (Cahyani et al., 2016).

Table 4. *The results of the identification of Bali cattle business risks.*

Risk Variance	Risk Agent	Code	Severity
Nursery	Passionate Parent	E1	3
	Pregnancy	E2	6
	Post-natal care	E3	6
	Improper maintenance management	E4	8
Cultivation	Cattle death	E5	9
	Maintenance	E6	9
	Feed health	E7	7
	Environment	E8	6
	Poor Security System	E9	8
Marketing	Availability of cattle	E10	5
	Unpreparedness in selling cattle	E11	8
	Demand	E12	9
	Price	E13	6
	Market loss	E14	7
Support	Availability of capital to start a business	E15	8
	Lack of supporting institutions	E16	7
	The support system in raising livestock	E17	8

Source: *Research data after processing, 2021.*

*E1: Event 1

The purpose of the House of Risk (HOR) is to identify risks and design risk mitigation based on the results of risk assessment calculations to reduce the Probability of a risk agent occurring through prevention efforts by the priority level of the risk agent (Hadi et al., 2020). In the first stage, HOR 1 has several processes. The identification of risk event (Ei) results are 17, and the risk agent (Aj) is 31. Questionnaires are distributed to assess the scale of occurrence and severity of the risk event and risk agent variables. At the same time, the risk indicators will be described in Table 4.

HOR 1 determines which risk sources are prioritized for preventive or treatment actions. The stages in the strategic planning framework use the HOR tools to help identify risks and mitigate the identified risk agents (risk agents). The HOR tool is divided into 2 phases: risk identification and risk management. The risk identification phase has been calculated in stages until the ARP calculation. It ranks the priority of the ARP value from the one with the largest ARP value to the smallest ARP value. After setting the priority of ARP values, a Pareto diagram of ARP is made for all risk sources.

Table 5. *Results of risk event identification using the FMEA method*

Risk Event	Code	Occurrence
Delay in handling lust cattle	A1	6
Errors in the interpretation of the timing of the estrous cattle	A2	4
The death of the mother during the birth of the cattle	A3	5
Death of cattle in the womb (abortion)	A4	5
Pygmy cattle	A5	6
Accuracy in feeding management	A6	8
Not gaining weight	A7	7
Disease infection	A8	8
Death during the breeding process	A9	8
Availability of sufficient feed	A10	8
Cage eligibility	A11	6
Water availability	A12	7
Feeding pattern	A13	6
Preservation of feed	A14	7
Extreme weather	A15	6
Cattles are sick	A16	4
Stolen cattle	A17	6
Rejecting demand	A18	3
Selling cattle in a condition of pressed funds	A19	9
The demand exceeds the supply capacity of cattle	A20	7
Cattle not sold	A21	5
High imports cause demand to fall	A22	4
Market mechanism causes price uncertainty	A23	6
High market demand in certain months/moments	A24	6
Partnering	A25	5
Government assistance	A26	8
Lack of assistance from extension agencies	A27	5
Not insuring cattle to the AUTS program	A28	7
Not doing traditional "teseng" partnerships	A29	4
Not participating in Modern Partnership	A30	5
Profitable Farmer-livestock groups	A31	6

Source: *Research data after processing, 2021.*

*A1: Agent 1

Data from the risk analysis of Bali cattle according to the criteria of Severity (S) and Occurrence (O) through questionnaires to farmer respondents found 31 risk events at each stage of Bali cattle farming activities. The Severity value reflects the severity of the impact of each risk indicator's potential failure or loss. In contrast, the Occurrence Value is the Probability or opportunity for failure or loss of each risk indicator. Further assessment is carried out by an expert panelist, the Farmers-Livestock Group Chair. Furthermore, completing all stages of the process in phase 1 of HOR, the next step enters phase 2 of HOR. The HOR model underlies risk management on a prevention focus, namely reducing the likelihood of risk agents occurring (Magdalena, R., 2019).

Identifying risk events for each business process that has been identified is all events that may arise/appear and cause disruption in the company's supply chain activities in achieving company goals (Ulfah et al., 2016).

Determination of Business Risk Urgency

Bali cattle business risk was assessed from the relationship between risk sources and other risk events and assessed 0, 1, 3, and 9 as the correlation score of each risk agent and risk event, where zero indicates no correlation, and 1, 3, 9 shows a low correlation to a high correlation, the higher the correlation value, the stronger the relationship between risk variables. The degree of Correlation is usually classified as none (and given an equivalent value of 0), low (one), moderate (three), and high (nine) (Pujawan & Geraldin, 2009). In the HOR 1 process, aggregate risk potential (Aggregate Risk Potential of Agent j = ARPj) is also carried out.

It is determined as a result of the Probability of occurrence of the source of risk j and the set of impact causes of each risk event caused by risk j as in the above equation. The calculation of ARPj is carried out on 17 risk events and 31 risk agents so that the calculation results show the strength of the Correlation between variables and will find potential risks that occur in Bali cattle farms.

The calculation of HOR 1 provides an overview of the potential risks that will be carried out specifically to overcome these risks. The output steps of the HOR 1 Matrix include the Aggregate Potential Risk, the most critical risk agents, and the Pareto diagram (Samodro, 2020). Then it will be illustrated in the following Pareto diagram.

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	Risk Agent																															
Risk Event	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30	A31	Severity of Risk
E1	9	9																														3
E2	1	1	3	9	1	1		1					9														3					6
E3			9		9	5	3	1	9		1				1												1					6
E4	1	1		3		9	3	9	9	9	3	9	9	9	9	3											1					8
E5			9	9		3		9	9	3	1	1	3		9	9											1	9	3	3		9
E6			3	9	9	3	9	9	9	9	9	9	3	3		3	3										1	1	1	1	1	9
E7				3		3	3	1	1	1			1	9		3											3					7
E8				1				9	3	3	9	3	1		9	9	9					3	3	1							1	6
E9			1						3						1	1	9															8
E10			1			1		1	1	1								9	3	9	9	3	1	3	1				1	1	1	5
E11																		9		1			3	1	1				1	1		8
E12																		9	3	9	3	9	3	9	1				1	1		9
E13																			1			9	9	3	1							6
E14																		3	3	1	9	3	9									7
E15																										9	3	9	9			8
E16					3																				3	1	9	3	3	3	9	7
E17																									3	3	9	3	9	9	9	8
Occ of Agent	6	4	5	5	6	8	7	8	8	8	6	7	6	7	6	4	6	3	9	7	5	4	6	6	5	8	5	7	4	5	6	
ARPj	246	164	965	1335	846	1504	1008	2496	2736	1688	1050	1260	1158	1134	1326	860	918	657	621	987	675	756	1146	134	500	824	1150	1449	892	755	930	
Ranking	29	30	16	6	21	4	14	2	1	3	13	8	9	12	7	20	18	26	27	15	25	23	11	31	28	22	10	5	19	24	17	

Figure 1. *Analysis of HOR 1 risk management for Bali cattle.*

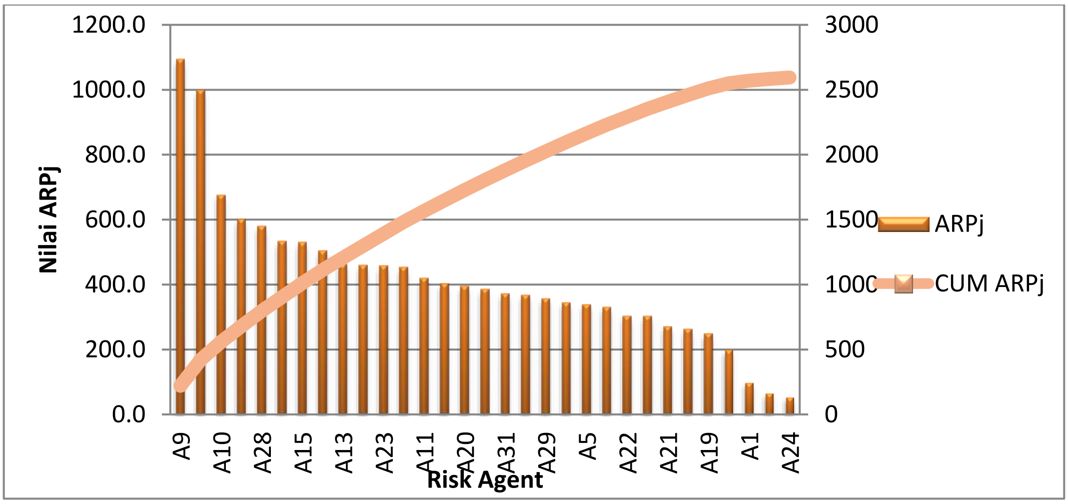

Figure 2. *Pareto diagram of Aggregate Risk Potential Risk Agent (ARPj)*

Based on the Pareto diagram, it was found that five potential risks had the largest ARPj value of the 31 risk agents, including cattle dying during the breeding process (A9), cattle infected with the disease (A8), Availability of adequate Feed for cattle rearing (A10), Accuracy in feeding management (A6), and Not insuring cattle to the AUTS program (A28). Select some risk sources with a high priority ranking using Pareto analysis from ARPj (Emmanuel & Basuki, 2019).

Based on the results of the identification of potential risks through the HOR 1 stage, 5 potential risks were determined; the A9 code on Ei resulted in the calculation of ARPj of 2736 in the first position, the second position of Ei with code A8, which resulted in the calculation of ARPj of 2496, then code A10 which resulted in the calculation of ARPj of 1688, position fourth is code A6 with ARPj of 1504, while the last position is code risk event A28 of 1449. After knowing the risk agent to be mitigated, the following is the stage of designing a mitigation strategy with HOR 2 (Tampubolon et al., 2013). Furthermore, the second phase in the risk management stage is risk management which will be carried out with the HOR 2 stage in the next discussion

Table 6. *Results of identification of potential risks.*

Risk Event	Code	ARPj	Ranking
Cattle death during the breeding process	A9	2736	1
Disease infection	A8	2496	2
Availability of sufficient feed	A10	1688	3
Accuracy in feeding management	A6	1504	4
Not insuring cattle to the AUTS program	A28	1449	5

Source: *Research data after processing, 2021*

Table 7. *Mitigation Actions for risk minimization.*

Mitigation Actions	Mitigation Code
Improving rearing management	PA1
Pay attention to the nutritional balance of the feed	PA2
Improving the cleanliness and sanitation of the cage	PA3
Keeping Feed healthy	PA4
Expansion of forage plant area	PA5
Feed storage	PA6
Quality of feed	PA7
Avoid delays in feeding	PA8
Following AUTS*	PA9
Coordination with agricultural services	PA10

Source: *Research data after processing, 2021.*

*AUTS (Insurance of Cattle)

Mitigation Actions and Risk Management

The analysis of mitigation or risk management is carried out through the HOR 2 stage, where a mitigation strategy design will be carried out to provide priority actions by considering effective resources. The second stage of HOR is used for risk management by designing a risk mitigation action strategy (Munawir & Krismiyanto, 2016). The mitigation actions obtained will be described in the following table.

Based on the HOR 2 risk analysis regarding mitigation actions, the next step to enter the HOR 2 stage is realized based on the ranking of the preventive action (PA), namely in the form of Improving rearing management (PA1), Paying attention to the balance of feed nutrients (PA2), Improvement of cage hygiene and sanitation (PA3), Feed health monitoring (PA4), Feed area expansion (PA5), Feed storage (PA6), Taking feed quality into account (PA7), Avoiding delays in feeding (PA8), Participating in AUTS (PA9), and Coordination with the agency (PA10). HOR phase 2 will select several treatment strategies that are considered effective to reduce the Probability of the impact caused by risk agents (Rozudin & Mahbubah, 2021).

	PA1	PA2	PA3	PA4	PA5	PA6	PA7	PA8	PA9	PA10	ARP
A9	9	1	3	9			3	1	1		2736
A8		1	9	3			1				2496
A10	3	3		9	9	9	3	1			1688
A6	3	1		3			9	9			1504
A28									9	3	1449
Tek	34200	11800	30672	51816	15192	15192	29304	17960	15777	4347	
Dk	4	5	4	5	3	4	5	3	4	5	
ETD	8550	2360	7668	10363	5064	3798	5861	5987	3944	869	
Ranking	2	9	3	1	6	8	5	4	7	10	

Figure 3. *HOR 2 analysis of risk management for Bali cattle*

At this stage of HOR 2, the total effectiveness calculation of each coordination action between the Total Effectiveness of Proactive Action (TEk) is obtained. By assessing the degree of difficulty for each prevention action, the estimation of the degree of difficulty in carrying out each handling action (Dk); weight 3 for mitigation actions that are easy to implement, weight 4 for mitigation actions that are somewhat difficult to implement and weight 5 for mitigation actions that are difficult to implement. Then put the values in a row on the bottom line with the Effectiveness to Difficulty Ratio of Action k (ETDk) with the equation formula:

$$\text{ETD} = \frac{\text{TEk}}{\text{Dk}}$$

Furthermore, the priority ranking for each action (Rk), where ranking 1 means the action with the highest ETDk. Rank 1 in Prevention Action 4 (PA4) with a TEk value of 51,816, a Dk value of 5, and an ETD of 10,363. Based on the ARP rating, risk mitigation actions can be handled for Improvement based on risk events and risk agents so that improvement proposals can be obtained that can be considered by the company (Hamidi, A, & Wahyuni, 2019).

Conclusion

In risk identification using the House of Risk approach phase, We found 17 Risk Events as a source of risk and 31 Risk Agents that can cause various risk events with a certain correlation value weight in all stages of Bali cattle farming activities which consist of stages of breeding, cultivation, marketing, and support. Identification results of HOR 1 are input for the next stage, namely HOR 2, which is the framework of mitigation actions for all risk sources. The output of HOR 2 is 10 mitigation actions, and 5 Risk Agents are prioritized with the highest ARPj value.

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