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Cost and Benefit Analysis: Two Scenarios in the Treatment of Worm Disease (Coccidiosis) as a Cause of Calf Death in the District of Mukomuko City, Mukomuko District, Bengkulu

Tri Guntoro
Epidemiology, DIC Lampung
Lampung, Indonesia
guntoros2_2005@yahoo.co.id

Elwaldrus Wera
Kupang State Agricultural Polytechnic
NTT, Indonesia
nanawaldi@yahoo.com

Ferro
Epidemiology, DIC Lampung
Lampung, Indonesia

***Abstract*— Losses due to parasitic infections, especially worms in livestock in Indonesia are very large. Helminthiasis is a disease in beef cattle which is common in traditional farms. This study aims to use a cost-benefit analysis for two scenarios in handling helminthiasis (*coccidiosis*), namely Program A (controlling worming with Albendazole and one type of antibiotic) and Program B (controlling administering coccidiosis drug and two types of antibiotics). The activity began with the investigation of animal diseases in the city of Mukomuko, Kab. Mukomuko, Bengkulu in the activity obtained information that calves were not given worm medication 8.14 times the risk of helminthiasis that ended in death and worms found 40% Eimeria (*Coccidiosis*). The results of a cost-benefit analysis of helminthiasis with details of the first scenario (NPV: 191,682,324; BCR: 2.95; IRR: 169.08%) and the second scenario (NPV: 1,018,538,931; BCR: 4 , 37; IRR: 241,62). From this value the two programs provide a positive net present value (NPV) but in the second scenario it is greater than the first and the return on investment is greater than the discount rate, while the benefit and cost ratio (B / C ratio) > 1 for both scenarios but the second scenario has a ratio of 2 times greater than the first scenario. Taking into account the three criteria of benefit cost analysis, it can be said that the control of helminthiasis (*coccidiosis*) in the second scenario is better and more efficient than the first scenario.**

Keywords*— *Benefit Cost Analysis, Pedet, Worming (coccidiosis)

I. INTRODUCTION

Cattle rearing systems in Muko-Muko are generally still carried out extensively and semi-intensively. Cattle rearing systems that are still classified as traditional as this are susceptible to infections from various diseases. This situation results in significant losses and affects the income of farmers. Losses due to disease infection include a decrease in production results due to stunted growth of livestock and increased costs that must be spent for the treatment of infected cattle (Subronto, 2007). Diseases that are often ignored by farmers are diseases caused by worm parasites. In terms of economic calculations, cattle disease caused by worm parasites results in very high losses for farmers. Worm infections in the digestive tract cause digestive disorders of cows and competition occurs in the absorption of food nutrients so that cow growth will be hampered (BPTP NTB, 2011). Especially if the worms are zoonotic, in addition to economic losses caused by their health is also threatened (Medicastore, 2011). Animal disease investigation in the city of Mukomuko, Kab. Mukomuko, Bengkulu in the activity obtained information calf 40% infected with *coccidiosis* (Susilo, 2019). The results of tests conducted by the Disease Investigation Center of parasitology laboratory are as follows: 40% (*Eimeria*), 5% (*Paramphistomum*), 5% (*Ascaris*), 5% (*Strongiloides*), and 10% (*Trichostrongylus*).

The most common health disorders especially in the pre-weaning calf are diarrhea (Wudu et al., 2008, Debnath et al., 1995, Azzizadeh et al., 2012, Wymann etal, 2006, Smith, 2009). Diarrhea which causes huge losses because it not only causes an increase in maintenance costs and mortality, but also reduces livestock productivity in the future. Diarrhea occurs due to an increase in the number of pathogenic bacteria, especially coliform in the small intestine, but there is a decrease in the population of bacteria Lactobacillus and Bifidobacteria (Krehbiel et al., 2003; Ouwehand et al., 2002). Health problems in pre-weaning calf in addition to diarrhea are umbilical cord infections, bloat / bloating, intestinal worms, enteritis and pneumonia. The mortality rate of pre-weaning calves in community farms can reach 68% in India (Tiwari et al., 2007), 35% in Zimbabwe (French et al., 2001), 10% to 19% in traditional and intensive farms in Mali (Wymann et al., 2006), and 25% in Tanzania (Kivaria et al., 2006). Lower calf mortality rates occur in European countries, varying from 4% in Sweden (Svensson et al., 2009) and 7.8% in Norway (Gulliksen et al., 2009).

Rahayu's research results, 2014 showed that the calf mortality rate in category people's livestock farms was high, amounting to 48 out of 245 calves in the study sample (19, 59%). Disease events found in farm companies include: diarrhea (61.73%), pneumonia (25.61%), umbilical cord infection (4.22%), post-cut horn infection (4.22%), and limp (4) , 22%). The mortality of Balinese calf kept in oil palm plantations is quite high reaching 30% (Toelihere, 2002). The highest incidence of calf death is a newborn calf, not getting the attention of its parent and an unsupported management system. In addition, most calf deaths in Bali cattle are thought to be caused in the dry season when the quality and quantity of feed sources is low, which causes low milk production of less than 1.5 liters per day (Belli, 2002). Calf that eats grass under oil palm plantations is susceptible to endoparasites and other protozoa that cause bloody diarrhea, Eimeria sp. In general, coccidiosis treatment therapies are considered ineffective due to mucosal lesions in the intestine (Fitzgerald, 1980), so tissue damage due to coccidiosis will inevitably lead to the severity of diarrhea disease. Economic losses due to calf mortality are quite high, calves are the investment and the main result of the integration of cattle and oil palm plantations.

Benefit cost analysis is often used in handling animal diseases, this analysis is used to find the value and comparison of costs and benefits of an activity and convert it to economic value to see which gives the best benefits by using the most efficient resources (Turnbull et al., 1998; Otte and Chilonda. 2002; Gilfoyle, 2006; Mongoh et al., 2008; APHIS, 2009).

This study aims to use a cost-benefit analysis for two scenarios in handling helminthiasis (*coccidiosis*), namely Program A (controlling worming with Albendazole and one type of antibiotic) and Program B (controlling administering *coccidiosis* drugs and two types of antibiotics). The results of this study are expected to provide benefits to the government/ policy makers in determining the most appropriate control program to be implemented based on the scale of priorities and the most beneficial form of strategy.

II. MATERIALS DAN METHODS

A. Determination of Sample and Data Collection

Respondent data collection was carried out in Muko Muko District, Bengkulu Province, which was preceded by an investigation by the DIC Lampung team, from the results of the FGD and secondary data collection, the data for this study were only in the Muko Muko sub-district because of higher death compared to other regions.

The sampling method is purposive random sampling by modifying the technique carried out by Dhand *et al*. (2005) and Ugwu (2009). The data used in this study are primary data and secondary data. Primary data are input and output of helminthiasis activities in calves obtained from interviews with cattle farmers affected by helminthiasis. Secondary data include data on livestock population, investigation costs, laboratory testing costs, treatment of helminthiasis, cases of helminthiasis, calf cattle prices and livestock transportation as well as other data related to this study. Secondary data were collected from related agencies or agencies such as the Livestock Service Office of Muko Muko Bengkulu District, type A laboratories and veterinary medical staff.

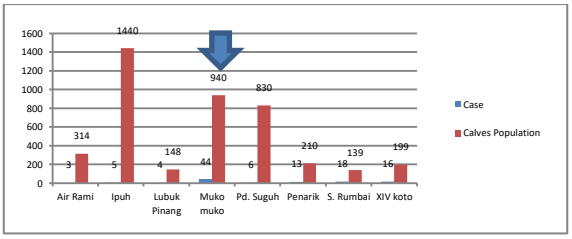

Fig. 1. Distribution of Bali calf mortality compared to the population in each district in 2016 - 2018 (Susilo, J 2019)

B. Data analysis

Benefit cost analysis is carried out with the following stages: (1) determination of current gross profit in the presence of worm disease (*coccidiosis*), (2) preparation of variables that affect the gross margin with a disease control program, (3) determination variable costs needed to carry out disease control programs, (4) determination of the length of time of the benefits and costs and the year that the benefits are fully felt, (5) compilation of a list of initial costs (investment costs) that will be needed and specify when these costs are included , (6) determining the size of the area to be analyzed, for example the number of animals to be included in the program, (7) making three-year cash flows for both scenarios, (8) determining the applicable discount, and (9) comparing control alternatives using criteria net present value (NPV), benefit / cost ratio (benefit / cost ratio, BCR) and internal rate of return (IRR). Cost benefit data are analyzed for the scope of the veterinary economy and control strategies (Kusbianto, 2012).

III. RESULTS AND DISCUSSION

The implementation of environmental sanitation management is an important factor to minimize gastrointestinal parasitic infestations (Taylor et al. 2007; Zajac, 2012). Provision of worm medicine that is routinely carried out is a practice of animal health management that is needed calves and broodstock. Stefaniak (2004) argues that the period of neonatal diarrhea is one of the main reasons for morbidity and calf death. It is estimated that the acute diarrhea period causes 75% of calf deaths at the age of three weeks. Death is most often caused by enterotoxigenic strains of Escherichia coli and Rotavirus, which are followed by complex infections.

In this study two scenarios are presented in the handling of helminthiasis (*coccidiosis*) events that have an impact on mortality in calves in the district of Muko Muko, Muko Muko Regency, Bengkulu Province:

1. Calves are treated with worm medicine (albendazole group) and sulfa group antibiotics (scenario 1);
2. Calves are given treatment with special worm medicine for eimeria (coccidia), antibiotics (sulfa and penicillin) added with additional milk (scenario 2)

From the results of testing in the Laboratory of Parasitology, Disease Investigation Center 40% found eimeria (*coccidiosis*), therefore this research is more focused on the incidence of coccidiosis. Analysis of the cost of the benefits of coccidiosis control in cattle is done by making a cash flow calculation for a period of 3 years and using the input data contained in these tables. From the cash flow data, three control parameters can be calculated, namely the NPV value, the B / C ratio and the IRR (in Tables 2 and 4) Based on the NPV obtained, controlling coccidiosis through a treatment program with Kalzoril (coccidiosis drugs) and antibiotics (sulfa and penicillin) provide greater income when compared to other programs. This can be understood because the number of livestock (calves) that can be saved is more due to the death of calves in Muko Muko from 2016 to 2018 (57%) (Susilo, 2019).

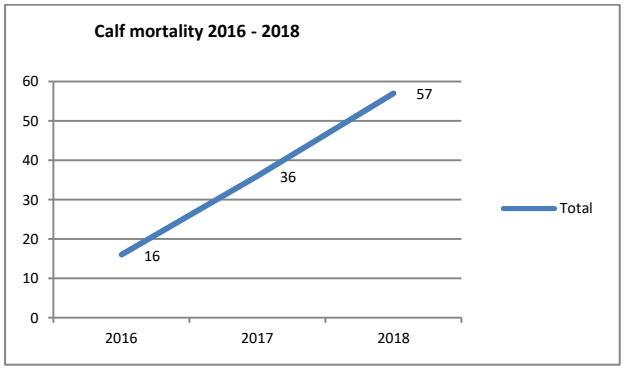

Fig. 2 Death patterns of Balinese cattle calf in the District of Muko Muko in 2016 - 2018 (Susilo, J 2019)

Government efforts in this disease control program will be more precise and bring benefits with the second scenario, namely treatment with the good drugs in accordance with those found in accordance with the results of previous investigations 40% incidence of Coccidiosis in calves in Muko Muko sub-district, Muko Muko district, Bengkulu Province . The main problem in the case of calf diarrhea and also in adult livestock is dehydration caused by loss of fluid in the body and decreased milk intake from the mother. Long-term and persistent diarrhea can cause fatal homeostasis disorders (Sobiech, P 2007). The addition of milk substitutes is very helpful in dehydration conditions so that the calf can be saved. Based on information from the veterinary medical district Muko Muko after proper treatment, almost 100 percent recovered and calves can develop into adulthood. So that the second scenario is more efficient and can save calves born in oil palm plantations.

IV. Conclusions

- Appropriate treatment according to the type of worm eggs found will be more useful;
- Supplementation of extra milk will be very helpful when the cow is dehydrated because of lack of good milk intake from the mother;
- With limited resources, we can choose the second scenario to reduce calf mortality in cattle with traditional rearing and or rearing of oil cows.

V. Limitation

The cure rate is based on judgment (interview) not literature.

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APPENDICES

TABLE 1. PARAMETERS IN THE FIRST SCENARIO

Economic impact of Coccidiosis			Unit
population	N	760.00	heads
A. direct loss			
morbidity rate	Ks	60.00%	
mortality rate	K_m	90.00%	
number of dead animals	n_m	684	heads per year
number of diseased animals	n_s	456	heads per year
Vitamin	V_a	Rp 5,000.00	per head
calves sale price without Jembrana outbreak	H_{tw}	Rp 2,000,000.00	per head
Loss due to calves death	K_{mt}	Rp 1,368,000,000.00	per annum
Vitamin	B_{va}	Rp 2,280,000.00	per annum
Total direct loss	K_l	**Rp 1,370,280,000.00**	per annum
B. Indirect loss			
B.1. Loss due to the quarantine of the area			
B.1.1. Farmers			
Percentage of price drop during outbreak	P_{ph}	90%	
Percentage of sold calves	P_{sj}	10%	
Loss for the farmers	$\mathbf{K_{pt}}$	**Rp 82,080,000.00**	per annum
B.1.2. Traders			
Percentage of calves sent out of Muko muko	P_{sl}	11%	
Number of cattle sent out of the area	N_l	83.60	per annum
Loss to inter-area traders	Kp	Rp 250,000.00	per head
Loss for the inter-area (interdistrict) traders	$\mathbf{K_{pd}}$	**Rp 20,900,000.00**	per annum
B.1.3. Livestock transportation business owners			
Transportation cost for cattle out of Muko muko	T_{sl}	Rp 200,000.00	per head
Loss for the transportation business	K_{tt}	**Rp 16,720,000.00**	per annum
Total loss due to the quarantine of the area	K_{pw}	**Rp 119,700,000.00**	per annum
B.2. Jembrana control costs			
B.2.1. Investigation costs			
Number of personnel	n_i	4	pax
Daily rate	L_i	Rp 380,000.00	per person / day
Accommodation	B_a	Rp 550,000.00	per room / day
Accommodation unit	n_a	2	room
accommodation days	H_m	3	day
Transportation	T_i	Rp 750,000.00	per day
Investigation days	H_i	4	day
stationaries	A_t	Rp 250,000.00	per package
materials and equipment	A_b	Rp 500,000.00	per package
investigation costs	$\mathbf{B_i}$	**Rp 13,130,000.00**	per annum
B.2.2. Laboratory costs			
Cost of worm detect	B_{pcr}	Rp 6,000.00	per sample
Number of feses samples	n_{pcr}	20	sample
sample submission costs	B_{ps}	Rp 50,000.00	per package
Laboratory costs	B_l	**Rp 170,000.00**	per package
B.2.3 Albendazole + Antibiotic (One type)			
Coverage	C_v	100%	
dosages	n_{va}	760	dosage

Drug price	H_{va}	Rp	10,000.00	per dosage
vaccinators	n_{vr}		2	pax
operational needs	O_{vr}		10000	per dosage
vaccination costs	$\mathbf{B_v}$	**Rp**	**22,800,000.00**	per annum
Coccidiosis control costs	$\mathbf{B_{pj}}$	**Rp**	**36,100,000.00**	per annum
Indirect loss	K_t	**Rp**	**155,800,000.00**	per tahun
Coccidiosis total loss	$\mathbf{T_{KJ}}$	**Rp**	**1,526,080,000.00**	**per annum**

TABLE 2. CALCULATION OF THE FIRST SCENARIO COST AND BENEFIT ANALYSIS (WITH DISCOUNT RATE 5.00%)

Item	Year				Total
	0	1	2	3	
Change of *Coccidiosis* levels		0%	30%	20%	
Costs					
Capital					
Recurrent costs					
Investigation costs		13,130,000	13,130,000	13,130,000	39,390,000
Laboratory costs		170,000	170,000	170,000	510,000
Albendazole + Antibiotic (One type)		22,800,000	22,800,000	22,800,000	68,400,000
		0	0	0	0
Total costs	***0***	***36,100,000***	***36,100,000***	***36,100,000***	***108,300,000***
Benefits					
Losses of animals and treatments		0		274,056,000	274,056,000
General economy		0	35,910,000	23,940,000	59,850,000
Total benefits	***0***	***0***	***35,910,000***	***297,996,000***	***333,906,000***
Undiscounted benefits minus costs	**0**	**-36,100,000**	**-190,000**	**261,896,000**	**225,606,000**
Discounted costs	**0**	**34,380,952**	**32,743,764**	**31,184,537**	**98,309,254**
Discounted benefits	**0**	**0**	**32,571,429**	**257,420,149**	**289,991,578**
Discounted benefits minus costs	**0**	**-34,380,952**	**-172,336**	**226,235,612**	**191,682,324**
NPV	**191,682,324**				
BCR	**2.95**				
IRR	**169.08%**				

TABLE 3. PARAMETERS IN THE SECOND SCENARIO

Economic impact of Coccidiosis				Unit
population	N		760.00	heads
A. direct loss				
morbidity rate	Ks		60.00%	
mortality rate	K_m		90.00%	
number of dead animals	n_m		684	heads per year
number of diseased animals	n_s		456	heads per year
Vitamin	V_a	Rp	5,000.00	per head
calves sale price without Jembrana outbreak	H_{tw}	Rp	2,000,000.00	per head
Loss due to calves death	K_{mt}	Rp	1,368,000,000.00	per annum
Vitamin	B_{va}	Rp	2,280,000.00	per annum
Total direct loss	K_l	**Rp**	**1,370,280,000.00**	per annum
B. Indirect loss				
B.1. Loss due to the quarantine of the area				
B.1.1. Farmers				
Percentage of price drop during outbreak	P_{ph}		90%	
Percentage of sold calves	P_{sj}		10%	
Loss for the farmers	$\mathbf{K_{pt}}$	**Rp**	**82,080,000.00**	per annum
B.1.2. Traders				
Percentage of calves sent out of Muko muko	P_{sl}		11%	
Number of cattle sent out of the area	N_l		83.60	per annum
Loss to inter-area traders	Kp	Rp	250,000.00	per head
Loss for the inter-area (interdistrict) traders	$\mathbf{K_{pd}}$	**Rp**	**20,900,000.00**	per annum
B.1.3. Livestock transportation business owners				
Transportation cost for cattle out of Muko muko	T_{sl}	Rp	200,000.00	per head
Loss for the transportation business	K_{tt}	**Rp**	**16,720,000.00**	per annum
Total loss due to the quarantine of the area	K_{pw}	**Rp**	**119,700,000.00**	per annum
B.2. Coccidiosis control costs				
B.2.1. Investigation costs				

Number of personnel	n_i		4	pax
Daily rate	L_i	Rp	380,000.00	per person / day
Accommodation	B_a	Rp	550,000.00	per room / day
Accommodation unit	n_a		2	room
accommodation days	H_m		3	day
Transportation	T_i	Rp	750,000.00	per day
Investigation days	H_i		4	day
stationaries	A_t	Rp	250,000.00	per package
materials and equipment	A_b	Rp	500,000.00	per package
investigation costs	**B_i**	**Rp**	**13,130,000.00**	per annum
B.2.2. Laboratory costs				
Cost of worm detect	B_{pcr}	Rp	6,000.00	per sample
Number of feses samples	n_{pcr}		20	sample
sample submission costs	B_{ps}	Rp	50,000.00	per package
Laboratory costs	B_l	**Rp**	**170,000.00**	per package
B.2.3 Albendazole + Antibiotic (One type)				
Coverage	C_v		100%	
dosages	n_{va}		760	dosage
Drug price	H_{va}	Rp	21,800.00	per dosage
vaccinators	n_{vr}		10	pax
operational needs	O_{vr}		10000	per dosage
vaccination costs	**B_v**	**Rp**	**92,568,000.00**	per annum
B.2.4 Milk Replacement				
Milk Replacement	**B_{in}**	**Rp**	**5,000,000.00**	per package
Coccidiosis control costs	**B_{pj}**	**Rp**	**110,868,000.00**	per annum
Indirect loss	K_t	**Rp**	**230,568,000.00**	per tahun
Coccidiosis total loss	**T_{KJ}**	**Rp**	**1,600, 480,000.00**	**per annum**

TABLE 4. CALCULATION OF THE SECOND SCENARIO COST AND BENEFIT ANALYSIS (WITH DISCOUNT RATE 5.00%)

Item	Year				Total
	0	1	2	3	
Change of Coccidiosis levels		0%	90%	95%	
Costs					
Capital					
Recurrent costs					
Investigation costs		13,130,000	13,130,000	13,130,000	39,390,000
Laboratory costs		170,000	170,000	170,000	510,000
Coccidiosis drug + Antibiotic		92,568,000	92,568,000	92,568,000	277,704,000
Milk Replacement		5,000,000	5,000,000	5,000,000	15,000,000
Total costs	***0***	***110,868,000***	***110,868,000***	***110,868,000***	***332,604,000***
Benefits					
Losses of animals and treatments		0		1,301,766,000	1,301,766,000
General economy		0	107,730,000	113,715,000	221,445,000
Total benefits	***0***	***0***	***107,730,000***	***1,415,481,000***	***1,523,211,000***
Undiscounted benefits minus costs	**0**	**-110,868,000**	**-3,138,000**	**1,304,613,000**	**1,190,607,000**
Discounted costs	**0**	**105,588,571**	**100,560,544**	**95,771,947**	**301,921,063**
Discounted benefits	**0**	**0**	**97,714,286**	**1,222,745,708**	**1,320,459,994**
Discounted benefits minus costs	**0**	**-105,588,571**	**-2,846,259**	**1,126,973,761**	**1,018,538,931**
NPV	**1,018,538,931**				
BCR	**4.37**				
IRR	**241.62%**				

TABLE 5 RESULTS OF FECAL AND DRINKING WATER SAMPLE TESTING IN THE CASE OF DEATH OF CALF BALI CALVES IN MUKO MUKO DISTRICT IN NOVEMBER 2018 (SUSILO, J 2019)

Parasite worm	Positive	Negative
Fasciola sp.	0 (0%)	20 (100%)
Parampistomum sp.	1 (5%)	19 (95%)
Ascaris	1 (5%)	19 (95%)
Eimmeria	8 (40%)	12 (60%)
Trichostrongylus	2 (10%)	18 (90%)
Strongyloides	1 (5%)	19 (95%)
Water source		
Swamp	E.coli 3.6x10° MPN/ml	Coliform 150 MPN/ml
Well	E.coli 2.9x10° MPN/ml	Coliform 100 MPN/ml