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Full Length Research

Policy for increasing feeder stock of Bali cattle (*Bos javonicus domesticus*) in Kupang District

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ABSTRACT: The scarcity of feeder stock of Bali cattle **(***Bos javonicus domesticus*) in Kupang Regency is currently increasing. One of the contributing factors is the difference in management between the fattening business that produces beef cattle and the breeding business that produces feeders and heifers. The research aims to determine: the interaction between actors to increase the supply of feeder; the behavior of feeder population based on actual stock management, and the necessary policy interventions to increase the supply of feeder. The research was conducted by applying a dynamics systems approach. This modelling used ventana systems software. Data and mental models were collected through observation, focus group discussions, and in-depth interviews with key informants. The results showed that the interaction between actors was limited to the marketing of cattle for both local and domestic markets. The actual feeders supply management shows that cattle population tends to decline due to low calving rate (70%), high calves mortality (35%), and the high slaughtering of productive females (80%). The necessary policy interventions are to implement various efforts to increase the calving rate to be 80%, reduce the mortality rate by applying 2% feed supplementation, and reduce the sales of productive females to be 50%. The actual supply management of Bali feeders needs to be engineered by increasing stakeholder services that coordinate synergistically for learning innovation and technology. It is necessary to establish a breeder cooperative to suppress the sale of productive cows as the cause of its high slaughtering.

Keywords: Calf, dynamic system, feeder, management, policy, stakeholders.

INTRODUCTION

Currently, the scarcity of feeder cattle in Indonesia has an increasing trend. The most significant indicators seen in the market are the increasing number of imports and the its increasing price. According to Budiyono (2010), the second largest import of 11 commodities imported by the Indonesian government is feeder cattle (25.53%). The import of feeder shows an increasing trend where in 2006 it reached 380,000 heads, in 2019 there were 500,000 heads, and in 2020 the government plans to import as many as 550,000 heads (Boediyana, 2007, CNN Indonesia, 2019).

The trend of increasing feeder cattle prices also occurred in Kupang Regency, Nusa Tenggara Timur (NTT) Province as one of the cattle production centers. Data for 2015 shows that the price of feeder cattle with an age of about 2 years reaches IDR 3,000,0000.00 to IDR 3,500,000.00 per head (Krova, 2015). However, with the same age at the end of 2016 the price of Balinese feeder reached to IDR 5,039,326 / head (Sunarto et al., 2016). In fact, according to Rusdianto et al. (2015) in Nusa Tenggara Barat (NTB) Province and NTT, the average purchase price for a feeder cow reaches IDR 6,740,707. According to Rudatin (2016), the increasing of import is also caused by the price of imported beef which has lower price compared to local beef. Analogous to the reason for importing meat, it can be said that the high import of feeder cattle is because the price of imported Bali heifer is cheaper than the heifer price in Indonesia. According to other sources, the feeder steer rate for Darwin was AUD $ 3.15 at the end of August, a significant rise from $ 2.95 to $ 3.00 in July (Ainsworth, 2019). Despite the increase in prices in Darwin, heifer prices are still relatively low in

Indonesia. The trend of increasing prices is quite large as an indicator of a gap where the demand is greater than the production or supply.

One of the factors causing this scarcity is the difference in management between the fattening business that produces beef cattle and the business that produces heifer, even though both are in a system. Fattening business management is generally carried out by entrepreneurs or smallholder breeders intensively. Meanwhile, the management of the breeding business is generally carried out only by community breeders extensively. According to Rusdiana et al. (2018), the increase in beef production in Indonesia is constrained by the slow growth of the beef cattle population due to cattle breeding which is considered to be commercially less profitable. The characteristics of a breeding business with an extensive maintenance pattern are small scale, scattered, low feed quantity and quality, lack of control over the reproductive cycle, and poor health care.

Based on local wisdom, the cattle business in Kupang Regency has been divided into two development areas, namely: Amfoang Area as a breeding center, and Amarasi Area and its surroundings as a fattening center. However, this centralization based on local wisdom has not yet resulted in more benefits as in the actual cluster concept. Based on the cluster concept above, the relationship between the actors namely cattle breeders, collectors traders, inter-island traders, government and universities in the two cluster areas must be improved. Thus, collective efficiency, added value, economics of scale, economics of size and low transaction costs can be enjoyed by breeders in both regions. The actual conditions show that the opportunities, government efforts, natural potential, and concentration have not been able to make this area a mainstay of feeder cattle supply in NTT and domestic. This condition requires the availability of a supply management model that is closely related to domestic demand and not just local demand in Kupang Regency.

Thus, it is deemed necessary to conduct research on: "policy for increasing feeder stock of Bali cattle (*Bos javonicus domesticus*) in Kupang District". Hence, the research aims to determine: 1) the interaction between actors in an effort to increase the supply of feeder of Bali cattle, 2) the behavior of the feeder of Bali cattle population based on actual stock management, and 3) the necessary policy interventions to increase the supply of feeder of Bali cattle.

METHODOLOGY

The population in this study were all the main actors and supporting actors in the Bali cattle (*Bos javonicus domesticus*) agribusiness system in Kupang Regency which includes 24 districts. The main actors in this research are people or organizations directly involved in the Bali cattle agribusiness system. Meanwhile, the supporting actors are people, organizations, or agencies that are not directly involved but whose activities affect the Bali cattle agribusiness system.

Key informants of the actors involved were determined through the mapping of actors in the Bali cattle agribusiness network, both actors and supporters, starting from breeding and fattening farmers to traders.The number of key informants depends on the saturation of the information obtained. If the additional key informants do not add new information, it is considered sufficient. Likewise, if the results of structuring the model and understanding its behavior are very close to the real world, the number of key informants taken is sufficient.

In order to achieve the research objectives, data, information and knowledge from primary and secondary sources were collected. Primary data, information and knowledge were collected based on observation, focus group discussions, and in-depth interviews with key informants (Suhartanto, 2014). The types of data collected consist of: numerical data, written data, and mental models. Modeling with system dynamics, Ventana Simulation (Vensim) software was used. The software is used at the stage of making a cause and effect diagram, making a flow chart or sub-model diagram (level and rate) of the system being studied, the stages of developing a model of the system, the testing stage of model assumptions, and the simulation stage. All of this will be built into the stock flow diagram. The results of the model design are then validated in terms of dimensions, structure, behavior and policies. If the model is valid, it will suggest a change in policy according to the problem in the system.

RESULTS AND DISCUSSION

In general, the system for raising cattle used by breeders in Kupang Regency is traditional extensive system. All cattle owned by breeders are released freely in grazing fields, moor, on roadsides, thickets or forests. The animal can find their own food and less control from the breeder. The farmer never intervenes in the problems of the quantity and quality of feed consumed, health care, and the mating system. As a result, the growth of livestock is stunted where the daily body weight gain is only about 200 grams per day, livestock mortality is high, calving rates are low, and the risk of losing cattle is high. This of course will have an impact on the low productivity of cattle both in the breeding and fattening business carried out by breeders.

Map of actor interaction in relationship with feeder cattle supply management in Kupang Regency

The results of the mapping show that the actors involved in supply management of feeder cattle include: cattle breeders, collectors traders, inter-island traders, and stakeholders (government and universities). The interactions of the actors mentioned are intended to

market beef products.

Cows that are marketed by breeders from the breeding area are: feeders, heifers, productive female cows, fattened cows and non productive cows. The variety of cows produced from this breeding cluster is because the concentration area for the breeding business has the availability of very supportive feed resources. However, transportation facilities and infrastructure to access those areas are relatively difficult compared to fattening areas.

The cattle produced by breeders are directly purchased by collectors at the subdistrict level. Furthermore, the cattle will be sold to the coordinator of collecting traders or other traders who are in the district livestock market. Some of the livestock will be purchased by fattening farmers and partly by traders, both local and inter-island markets. The types of livestock purchased by fattening breeders are feeders, heifers, and productive female cattle. Meanwhile, adult bulls without defects and unproductive cows are bought by inter-island traders to be sold out between islands, especially to Java. Slaughterhouse traders generally buy defective mature bulls, non productive cows that are not bought by inter-island traders, and productive females for local market needs.

Other actors involved are the local government and universities. Local governments, both from the Livestock Service Office and the Agricultural Technology Research Center (ATRC), interact with breeders regarding assistance programs and services to the community. The government, in this case the Animal Husbandry Service, has responsibility for development in the field of animal husbandry. Therefore, there is a flow of programs in the form of government assistance and services to breeding and fattening breeders. However, the program is only distributing livestock and socializing matters related to the program. The evaluation of the outputs and outcomes of the program has not been carried out as an indicator of program success.

The government has a distribution program for productive females and a special effort for compulsory pregnant cows for breeders who want to run a breeding business. The flow that the government gets after implementing this program is information and program success as an indicator of development in the field of animal husbandry.

Higher education has the responsibility of carrying out *tridharma*, namely: education, research and community service. Research and community service fields are spaces where lecturers and students interact with breeders. Science and technology developed by lecturers and students is a flow of technology and innovation learning services that can be adopted by breeders. Higher education institutions will get the opposite flow in the form of information and practical experience from farmers that can be used to review or carry out further research for livestock development.

The results of this mapping also show some management weaknesses, where there is no coordination and collaboration among stakeholders in providing services to breeders. Each stakeholder interacts with fattening and breeding breeders in accordance with their respective programs. Eventhough this coordination and collaboration is needed to transfer science and technology from university with government support to increase the productivity of cattle.

Another weakness in this interaction is that the outflow from the farmer in the form of cattle products to the downstream (market) should provide an inflow to the farmer in the form of money and information. But what you get is only the flow of money. Information about supply and demand as well as price fluctuations as an important element in decision making was not obtained. This is because the breeders themselves are less concerned with this information. Even if there is concern, farmers are not able to manage this information for rational decision making. In addition, traders or the market cannot provide this information to farmers so that farmers have a weak bargaining position.

Model of validation

A trustworthy model is a model that describes behavior in accordance with the real world. In order to build confidence in the model, various validation tests have been carried out. Sterman (2000) discusses a test that can be used to assess a dynamic model adapted and developed from Forrester and Senge (1980). Model testing can be grouped into 3 tests, namely: model structure test, model behavior test, and policy implication test of the model.

The test on the ability of the built model causes the reproduction of behavior in accordance with the system in the real world. Several statistical tests have been carried out, such as: r, RMSPE, and Theil test (UM, US and UC). The value of the correlation coefficient (r) obtained from the five parameters tested is above 0.90 and below 1. The test results indicate that historical data and simulation data have high correlation. Root Mean Square Percent Error (RMSPE) statistical test results show a relative value below 0.2. The test results indicate that Theil's coefficient (Theil's Inequality Coefficient or U) is useful for knowing the ability of a valid model to forecast. The value of the proportion of bias (MW) and the value of the proportion of variance (US) of the model were very small, close to zero, which ranged from 0.0001 to 0.11 and 0.0004 to 0.21, respectively. While the value of the proportion of covariance (UC) was relatively large, ranging from (0.64 to 0.99) (Table 1).

Actual behavior of feeder cattle supply management in Kupang Regency

The physical structure and decisions in Bali cattle supply management in Kupang Regency that have been modeled

Table 1. Statistical testing recapitulation simulation result data.

Parameters	Bali cattle heifer		Bali cattle fattening		Selling Bali cattle in coordinator of colector traders
	Female calf	Male calf	Female calf	Male calf	
r	0.99	0.99	0.98	0.96	0.99
RMSPE	0.01	0.01	0.11	0.19	0.04
UM	0.0001	0.04	0.06	0.11	0.08
US	0.0004	0.11	0.01	0.07	0.21
UC	0.99	0.81	0.87	0.73	0.64

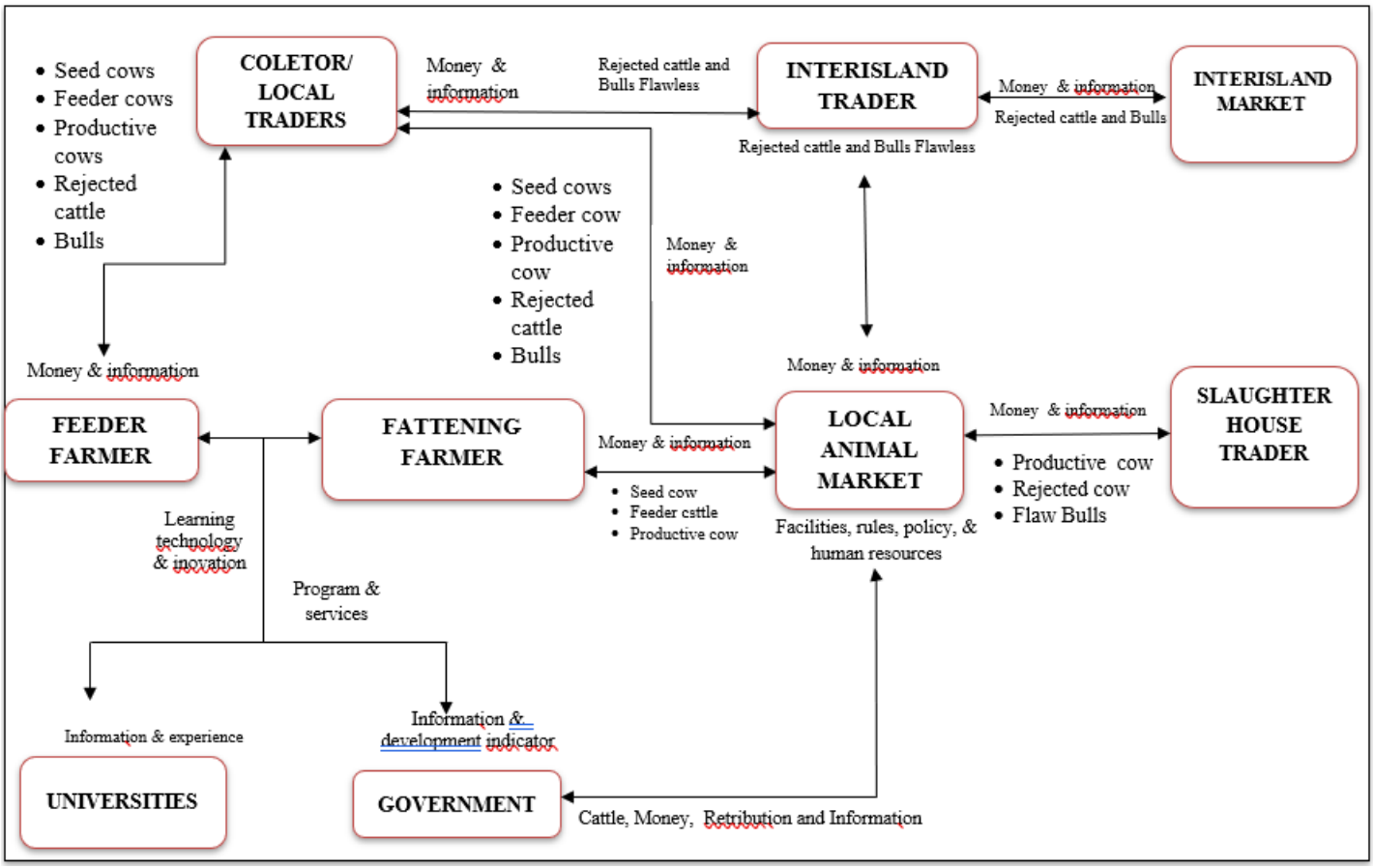

Figure 1. Map of the interaction of actors in feeding cattle supply management.

are having a dynamic behavior. This dynamic behavior is caused by changes in time and related components in the sub-models of Bali cattle development that have been modeled previously. The research discusses behaviors related to actual management abilities of breeders in an effort to provide feeder for the sustainability of Bali cattle agribusiness in Kupang Regency. The development of Bali cattle agribusiness will be demonstrated by the behavior of the elements in each subsystem. Therefore, important indicators related to supply management for feeder of Bali cattle will be explained. These indicators are: the population structure of adult females' cows, heifers, and feeders; adult bulls ready for slaughtered; and breeders' profit obtained both in the breeding and fattening business.

Determination of the initial time of the simulation is in 2017. Thus, the time span of historical data and forecasting data is the same for 3 years, so the total time in this simulation is 6 years or 72 months. Historical data from 2017 to 2019 (first month to month 36th) and simulation data starting from 2020 to 2022 (or month 37th to month 72th). The historical data that will be used to validate the simulation results data is in accordance with the availability of data on male and female Balinese calves, as well as sales data at the coordinator of traders and

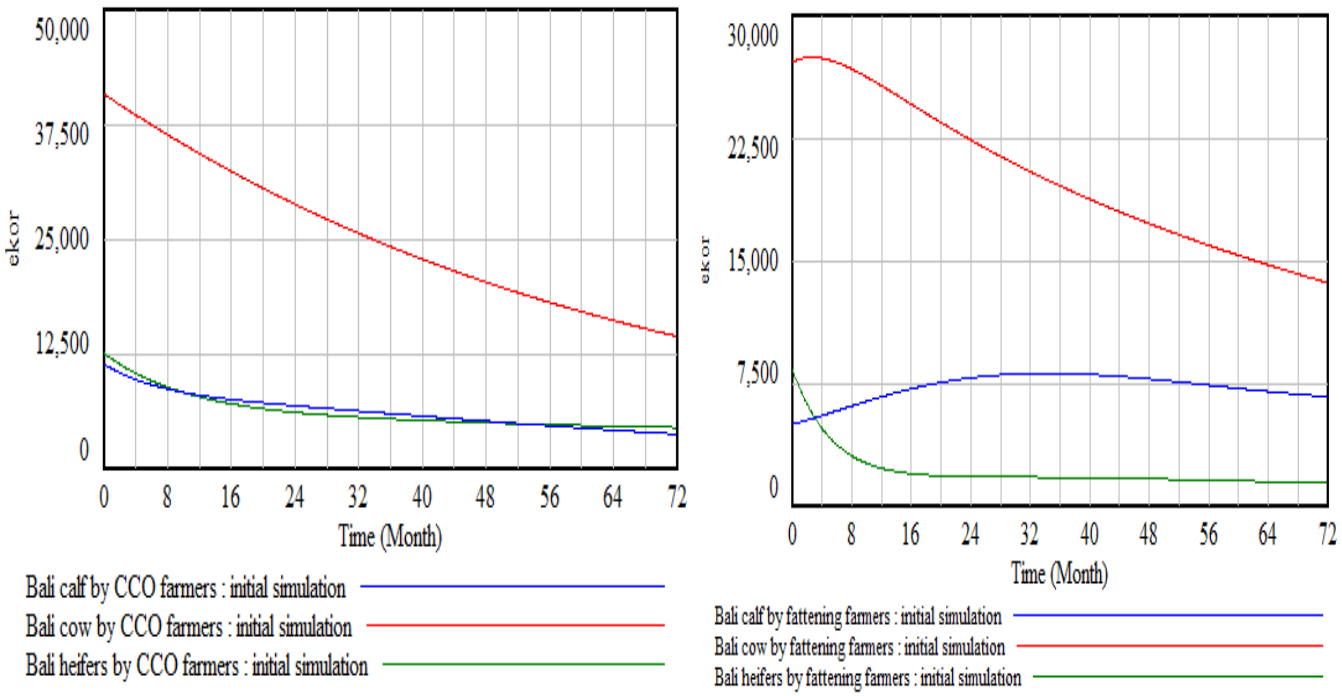

Figure 2. Actual beef cattle population structure in the field of breeding and fattening.

gatherers for the domestic market. The initial conditions of the simulation are determined based on the equilibrium conditions of the model. The number of parameters used in the model is obtained from various sources, such as: related literature, the results of numerical data processing, interviews with experts and key actors involved in feeder cattle supply management.

Figure 2 shows that in general there is a decreasing trend of cattle population in the next 3 years in all structures, both in breeding and fattening businesses. This population decline is the result of the traditional extensive supply.management of the feeder of Bali cattle. Thus, it is easy to understand that productivity and product quality are relatively low and tend to decline in the future. This is in accordance with Lisson et al. (2010) who stated that the population of Bali cattle is declining in most areas of Eastern Indonesia because demand for beef cattle exceeds the local capacity to supply these animals. Indonesian agencies recognize that new strategies are required to improve the productivity of Bali cattle and to address major constraints relating to animal husbandry and nutrition.

Some of the indicators shown were that the quality of seeds and seedlings was very low and their availability tended to decline due to the absence of adequate innovation and technology. In general, breeders in Kupang Regency carry out a breeding business only based on traditions passed down from their ancestors. Cows are left in the forest without intervention of farmers in the provision of drinking water, feed, and medicines. In addition, the livestock mating system is not intervened by breeders. Cattle are allowed to mate naturally if there are males around. If there are no males, the chances of the cows mating are very small. Not every farmer who owns a cow in the breeding business also has a male. Mulik et al. (2008) found that the calving rate in NTT is still very low, reaching only 70%, whereas the potential calving rate for Bali cattle can reach 85%. The calf mortality rate for Bali cattle is quite high, namely 35% with a very wide range of livestock mortality between 6.12 to 65.5% (Mulik et al., 2008) whereas the mortality range for beef cattle that could be tolerated was only 5 to 10% (Directorate General Animal Husbandry and Animal Health, 2016). In addition, the slaughter behavior of productive female cows reached 84% (Jelantik et al., 2008b).

Domestic market needs are met from mature bulls as a result of fattening or rejects. The high supply of productive female cows in the slaughterhouse is a further result of high sales by breeders. When farmers are pressed by the need for cash, any livestock will be sold including productive female cows, pregnant cows, feeders, heifers and also calves. Such breeders' behavior patterns have been understood by traders. In this urgent condition, traders will get livestock at a lower price than the prevailing price. This is again burdened by government regulations that prohibit productive female cows from being sold outside the inter-island area.

Figure 3 shows the slaughtering behavior in the slaughterhouse which tends to decline. The decrease in the number of slaughtering is in line with the decline in Bali

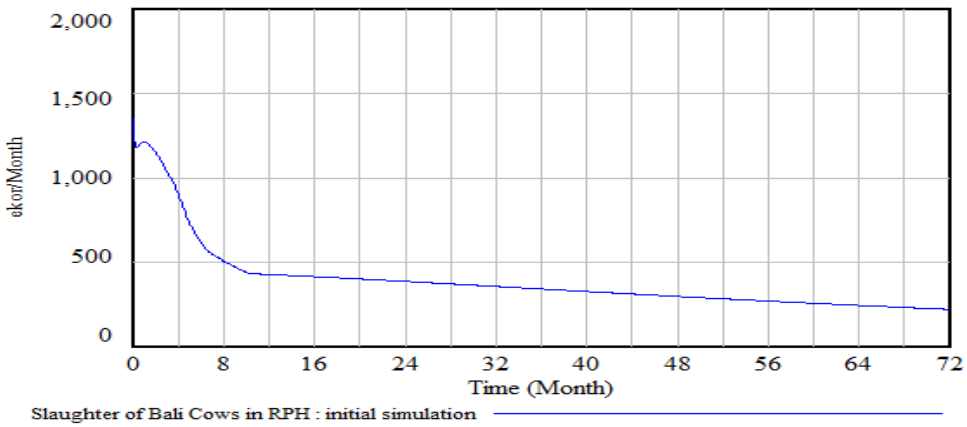

Figure 3. Actual behavior of slaughtering cows in slaughterhouses.

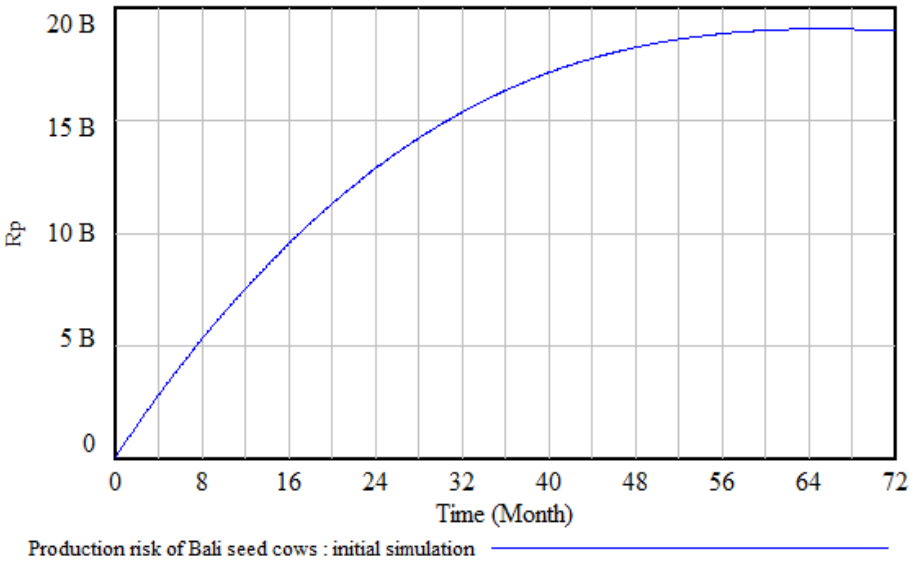

Figure 4. Actual production risk behavior of bali cattle breeders and fattening.

cattle population. This of course will affect the fulfillment of beef demand in the local NTT market. If this condition continues, then one day NTT has to import cattle from outside the island to meet local demand. The government must immediately respond to this condition at the district and provincial levels as well as national level. When the supply of meat for local and national needs decreases and demand tends to get higher as a result of the various factors that influence it, the price of meat will tend to be high. This has a dual impact on various industrial and service sectors that use beef as raw material.

Figure 4 shows that the risk of Bali cattle production in Kupang Regency tends to increase. If the above conditions are allowed to continue, in the long term it is feared that the replacement stock for unproductive cows which is the main input in the breeding business will be lost. Likewise, the stock of feeder cattle which is the main input in the fattening business also experiences the same thing because the feeder production is getting lower. Thus, a policy intervention is needed to increase the productivity of beef cattle to prevent a decline in the beef cattle population in Kupang Regency.

This production risk is the value of cows that die at all ages and has an economic impact. The economic loss due to the death of the cattle in the first year was accumulatively IDR 7.51664 billion and increased to IDR 18.9596 billion or an increase of 152.24 percent. The high risk of production in this cattle business is an accumulation of the above maintenance systems. Although most breeders are aware of the losses they are experiencing, breeders just surrender to the situation. There have been many outreach efforts from the government and universities, but there are many obstacles to reaching drugs and health workers. Communication and transportation facili-

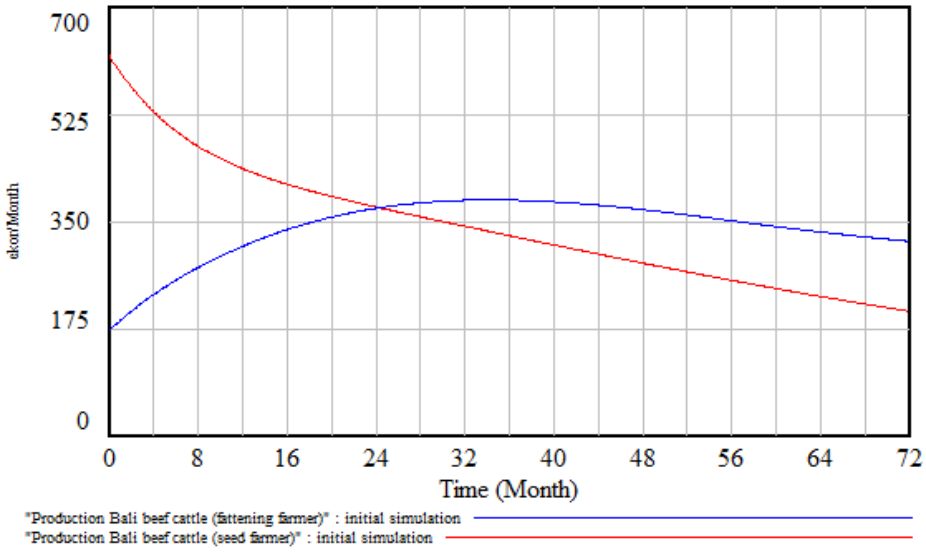

Figure 5. Actual beef cattle production in breeding and fattening business.

ties and infrastructure are the main inhibiting factors. Besides that, the location of the nursery business area which can only be accessed by certain vehicles due to geographic conditions and difficult and inadequate transportation facilities and infrastructure are obstacles experienced by breeders in doing business up to now. Therefore, policy intervention is needed in order to reduce the risk of the above production.

Breeders in Kupang Regency breed Bali cattle as well as fattening male of Bali cattle. Although based on local wisdom, the geographical concentration of breeding and fattening has occurred, business combinations are still being carried out. The breeders assume that the fattening business is more profitable because its duration of production is shorter than the breeding business. Apart from running the cattle fattening business, fattening breeders also raise breed cows to keep feeder stock which tends to decrease.

The breeders in the breeding business in Kupang Regency generally own cows, but they do not necessarily have bulls. Breeding needs only rely on wild males or males belonging to other people who are released in the forest or on common pasture. According to Mulik et al. (2008), ownership of bulls in general is not an absolute in beef cattle production. This condition increases the chances of the breeders' adult females being bred by unselected bulls. If this is the case, the calf crop performance will be lower and this will affect the calving rate and calf crop rate.

The simulation results in Figure 5 show that the production of bulls in both the breeding and fattening business in Kupang Regency tends to decline. The culture of fattening is carried out both by breeders in breeding and fattening businesses. The size of the production of fattening beef cattle is body weight (BW).

The decline in production behavior of adult bulls reflects that the quality of feeder cattle is low (initial body weight) and the daily gain of cattle is low (± 0.2 kg / head / day) so that it requires a relatively long production time (13 to 21 months). Whereas daily weight gain of Bali cattle can reach (± 0.5 kg / head / day) so that market weight is achieved in a short time (6 to 8 months).

The low production of fattening bulls is due to feed and farmer management factors. In the dry season, cattle experience a shortage of feed both in quantity and quality which can cause weight loss. If taking into account the dry season in Kupang Regency which occurs around 8 months, the reduction in body weight is quite large, namely 6.25 kg per month. Increasing body weight of cattle cannot be returned easily during the rainy season so that it is difficult for breeders to achieve this return. Farmers need to adopt feed preservation technology to maintain the risk of weight reduction.

This fact occurs because breeders have lack of knowledge in feed management where the production of feed has an abundant production pattern in the rainy season and in the dry season is very less or limited. Farmers do not apply feed preservation technology in their production business because they are used to providing fresh forage. In addition, the farmer never uses the concentrate required to achieve the desired weight in a short time. This results in the process of fattening bulls taking a relatively long time so that it has an impact on the greater total cost incurred. This of course will have an effect on the profits obtained by breeders.

Policy analysis to Increase feeder cattle supply at the breeder level in Kupang Regency

The results of understanding through causal diagrams and flow charts show that actual supply management of feeder

Table 2. Simulation model parameters of actual conditions and policy scenarios for increasing feeder bali cattle stock in Kupang Regency.

Policies	Actual condition	Scenario			
		I		II	III
		A	B		A
Increasing calving rate	0.70	0.75	0.80	0	0
Feed Suplementation to decline mortality of calf:	0.35	0	0	2%	0
Reducing cutting productive Bali cow	0.84	0	0	0	0.50
Increasing calving rate, additional Suplemen feed to reducing pedet mortality, and decline cutting productive bali cow					
Simultaneous I		0.75		2%	0.50
Simultaneous II			0.80	2%	0.50

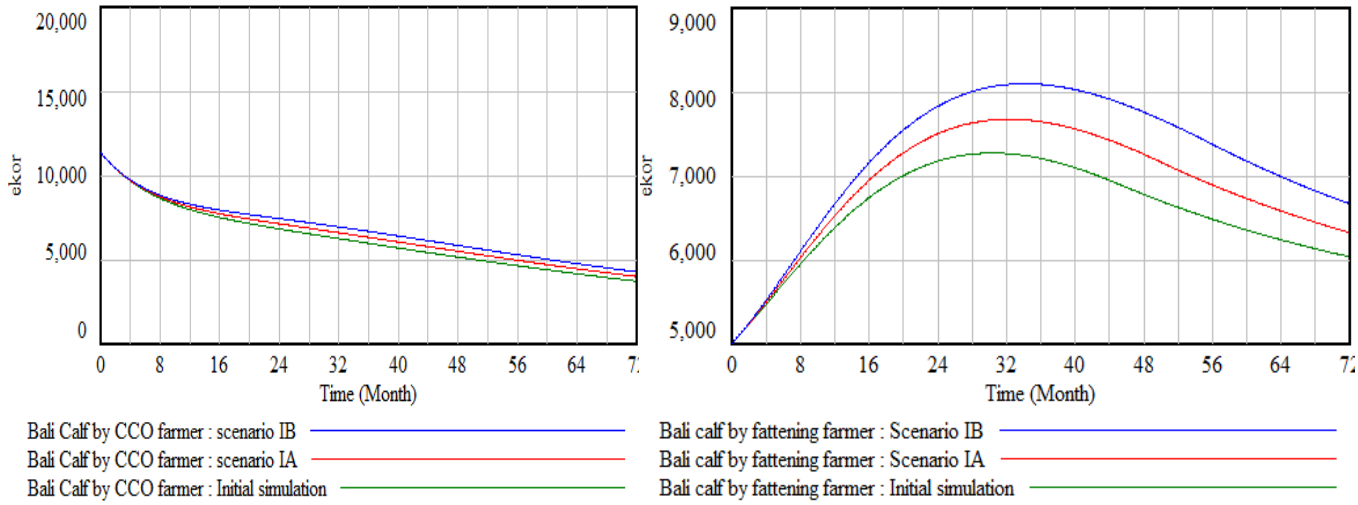

Figure 6. Population behavior of young male Bali cows from scenario simulation results increasing the calving rate.

cattle by breeders can cause cattle agribusiness in Kupang Regency to not develop. There are still several problems that constitute leverage points that must be intervened in order to get improvement, namely: low birth rates, high production risks (mortality rates), high slaughter of productive females, and low farmer profits.

Several policies that need to be intervened to increase the supply of feeder bulls are: 1) increasing the calving rate of Bali cattle, 2) reducing the mortality rate of Bali cattle, 3) reducing the slaughter of productive female of Bali cattle, and 4) combining policies to increase the calving rate of Bali cattle from 70% to 75% and 80%, provides 2% supplementation to reduce calves mortality and reduces the slaughter rate of productive female of Bali cattle from the actual of 84 to 50% (Table 2).

Scenario I: Increasing calving rate of Bali cattle at the breeder level in Kupang Regency

The results of the implementation of the policy scenario increase the calving rate from the actual of 70% to be 75% and 80% in the model indicating an increase in the number of feeders in both breeding farms and fattening farms. The simulation results indicate that when the calving rate is increased, the cattle population at each level of age will increase. Increasing the calving rate can be done by implementing Artificial Insemination (AI) technology, improving breeding management and feed.

Figure 6 also shows that although the simulation results show an increase, the downward trend is still occurring. The decline is due to only scenario I being applied. Meanwhile, sales of productive female of Bali cattle that flow to the slaughter house still remain 84%.

The simulation results also show that applying the policy scenario to increase the calving rate at the level of 75% and 80% can increase the production of adult bulls, both in breeder and fattening breeders, has increased compared to actual production. It can be seen that adult bulls in the breeder business immediately decline and are much steeper than the fattening business. In the business of fattening, adult male Bali cattle production initially increased until the 32nd month after experiencing a decline.

Figure 7 shows that an increase in the calving rate will

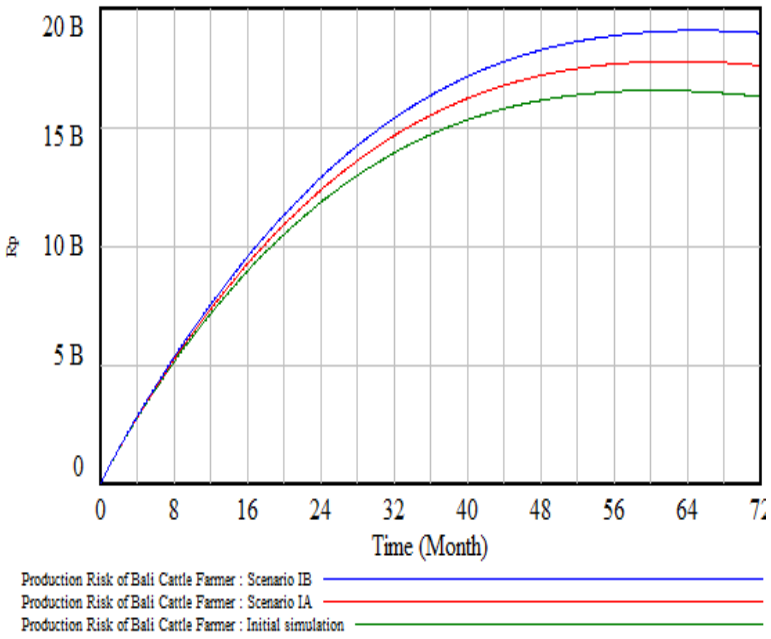

Figure 7. Risk behavior of Bali cattle production from scenario simulation results increasing the calving rate.

also increase the risk of production at each level. This is because efforts to partially increase the calving rate can only increase the number of births. The higher the number of births without improved management to reduce the risk of production, the higher the mortality rate.

One of the well-known technologies is Artificial Insemination (AI). The use of AI technology is considered important considering that male Bali cattle owned by breeders are increasingly scarce both in quantity and quality. This scarcity is due to the fact that male Bali cattle have a relatively high selling value, so that more breeders use them for fattening or selling. The difficulty of owning or obtaining bull cows causes the natural mating system to become unreliable by breeders in the long run. For this reason, efforts are needed to increase the productivity of Bali cattle through the calving rate indicator as well as the calf crop by utilizing the available artificial insemination technology and other management improvements.

Farmers in Kupang Regency have not fully implemented Artificial Insemination (AI) technology in an effort to increase cow productivity. This condition occurs because the success rate of AI is relatively low while the risk of death for calf and parent cow is high. Even though the availability of quality seeds and seedlings can only be obtained through technology and one of them is AI. According to Hadi et al. (2002), the ratio of service per conception (S/C) in implementing AI technology is still quite high, indicating the lack of success of Artificial Insemination. The causes of high S/C are: (1) breeders are late in reporting cows' heat to inseminator suspects, (2) abnormalities in the reproductive organs of cows, (3) less skilled inseminators, (4) limited insemination service facilities, and (5) lack of smooth transportation.

Scenario II: Addition of feed supplements to suppress Bali cattle mortality at the farmer level in Kupang Regency

In this scenario, efforts are made to reduce the mortality of Bali cattle owned by breeders. In actual conditions, it has been explained that the mortality rate of calves is 11%, veal 6%, and adult cows 3%. The intervention was carried out to reduce the mortality rate so that the population structure of Bali cattle breeders increased while reducing the risk of production which was quite high. Scenario II is done by adding supplementary feed in breeding and fattening cultivation. Thus, in the cultivation of breeding and fattening, the additional structure is added to the supplement (Figure 8) of 2 percent as recommended (Jelantik et al., 2008a, Mullik et al., 2008). The addition of supplements is only done for calves, feeders and adult females cows. This is because at that age status, calves are still considered very critical in their growth, while feeders are directed to the fattening process and adult female cows need additional feed to reproduce.

Mullik et al. (2008) reported that feed supplementation at the ideal one percent level increased the weight of the calves, but it is recommended to use the 2% level to reduce the calf mortality rate. The results of Jelantik et al. (2008a) who carried out the research on Balinese cows in several villages in Timor showed that supplementation at

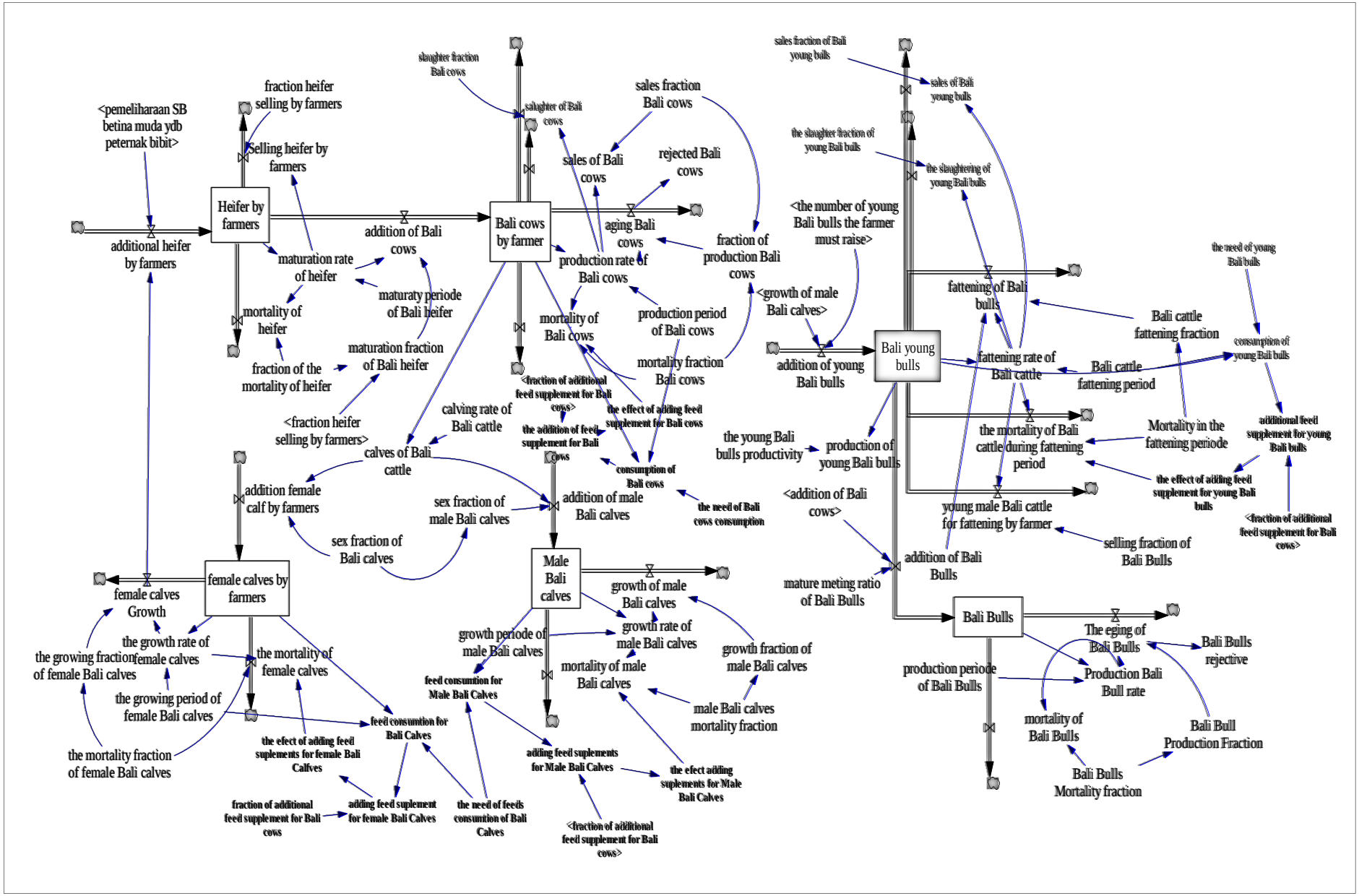

Figure 8. Structure of feed supplementation addition in sub model of Bali cattle breeding cultivation in Kupang Regency.

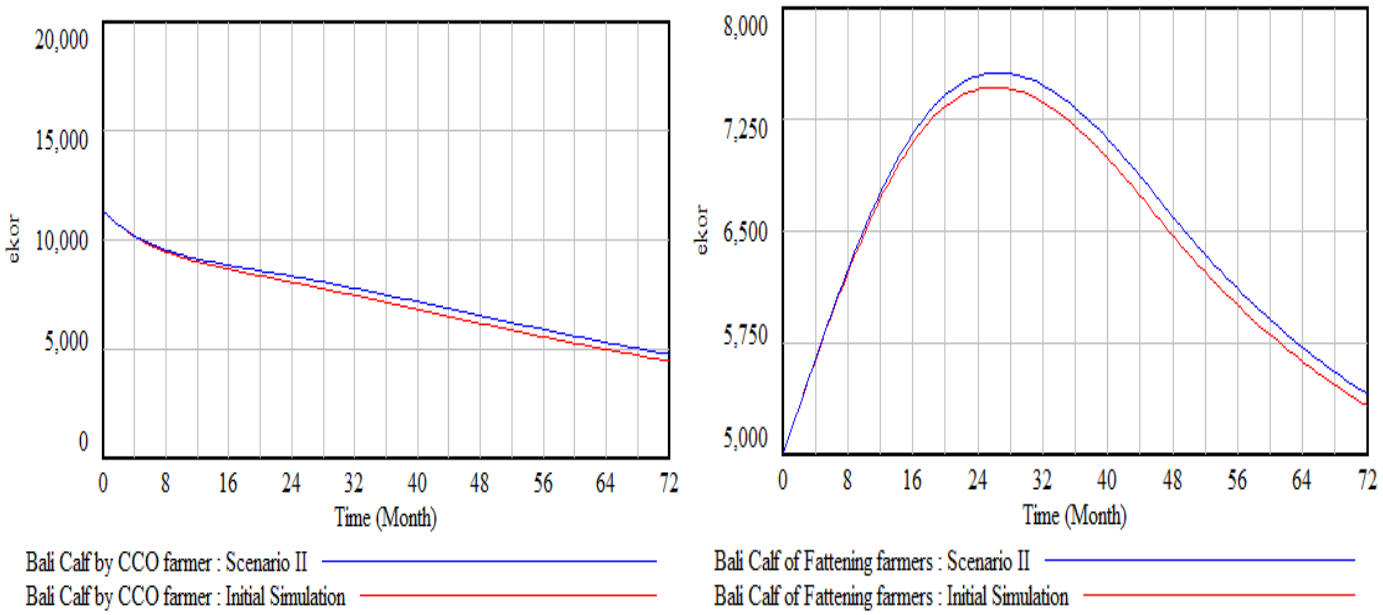

Figure 9. Cattle young females and young male breeders and fattening scenario simulation results to reduce mortality.

the 1% level only reduces the mortality rate from 6.5 to 6.1%. However, the 2% level of supplementation reduces the mortality rate from 6.5 to 0%.

Jelantik et al. (2010), using supplements consisting of the following local feeds: natural grass straw (10%), rice bran (26%), corn flour (35%), lamtoro leaf meal (15%), and fish meal (14%). Administration of calves resulted in a mortality rate of 1.0% on average and was not affected by month of birth, number of groups or districts. The month of birth varies from March to September, but is mostly concentrated in the months of June and July (55%). All types of local feed, except fish meal are quite widely available at the farmer level at a relatively cheap price so that farmers can easily adopt the feed technology. Fish meal can be obtained from several local markets.

The use of supplements in Bali cattle will add to the farmer's expenditure structure. Therefore the structure of adding supplements for Bali calves, feeder, and adult females is added to the farmer cash sub-model. The price of the supplement used is assumed to be IDR 1,000 per kg.

The simulation results (Figure 9) show that 2% supplementary feeding for calves and feeder of Bali cattle (scenario II) is quite effective in increasing the productivity of Bali cattle. This is shown by an increase in the population of heifers by 2.64%, and by 11.77% for feeders in the breeding business from the initial simulation. While the population increase in cattle fattening was relatively small, namely both heifers as much as 2.64% and feeders 1.70%.

The results of scenario II simulation show that partially all policies implemented to reduce mortality are able to reduce production risk by 9.59% in breeding and 19.07% in fattening businesses (Figure 10). The existence of efforts to reduce mortality is a policy that is quite effective in reducing the number of dead cows. If in the initial simulation, the average risk of loss experienced by seed breeders in Kupang Regency is IDR 26,147,000,000 per year, after applying scenario II, the average risk of loss is reduced to IDR 23,484,266,667 per year. In the fattening business the average risk of loss for farmers in Kupang Regency is IDR 13,179,398,333 per year in the initial simulation and after the application of scenario II, the risk of loss decreased to IDR10,472,366,667 per year. This condition can only be done if breeders in Kupang Regency have the willingness to implement supplementation for their cows. There is needs to continuously educate and counsel breeders about the importance of changing traditional management which only provides limited feed.

Scenario III: Pressing the sales of productive female of Bali cattle at the breeder level in Kupang Regency

The actual behavior shows that the sales of productive female of Bali cattle at the level of breeders are relatively high, reaching 84%. According to Krova et al. (2019), farmers only sell cattle because there is a large amount of cash needed. This happens because the purpose of the actual cattle business is as savings for farmers. This is one of the global market behaviors created by corporations that are full of mechanisms and standardization that make it difficult for local producers, thus forcing local producers to sell productive cows to meet the needs of consumers who are unable to reach these standardized products (Setiawan et al., 2018). One solution that can be made is to save productive female Bali cows from being

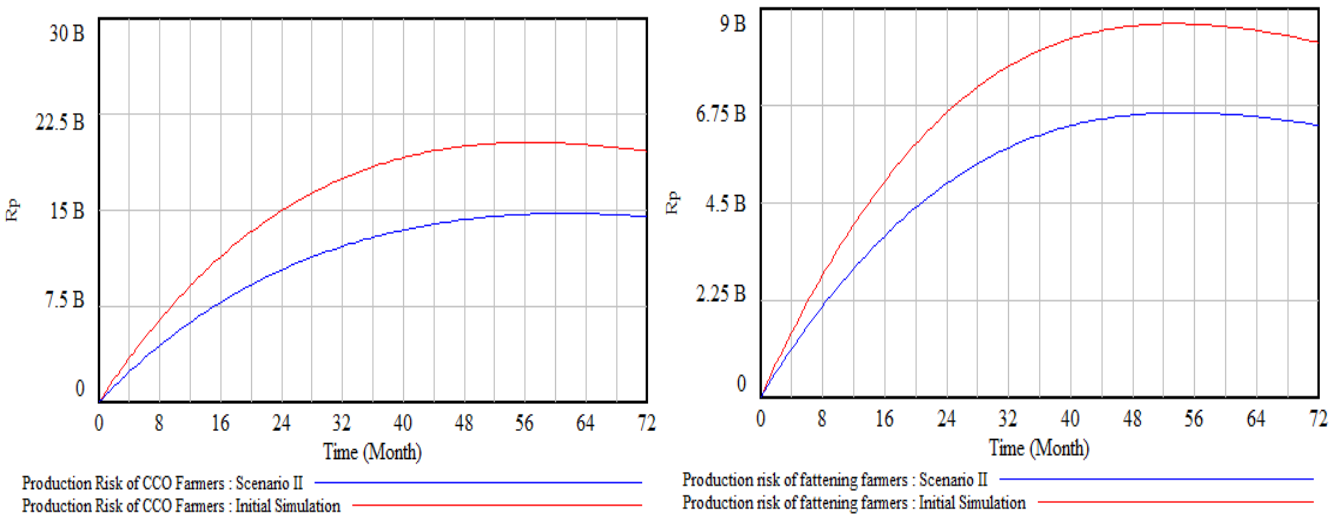

Figure 10. Risk behavior of Bali cattle production from simulation results of Scenario II.

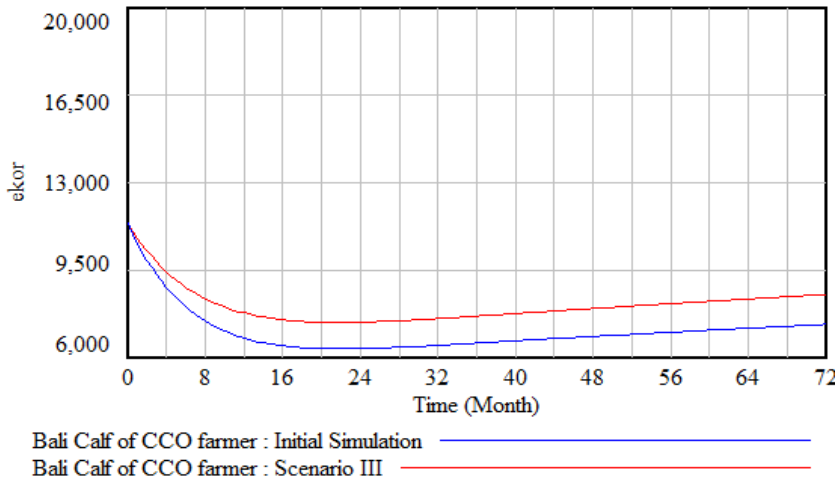

Figure 11. Population behavior of young bulls from the simulation results of suppressing productive female cattle sales.

slaughtered. This can be done by delaying sales and involving financial institutions in providing the loans needed by farmers. The existence of this policy can prevent the sale of productive females to traders as well as the slaughter of them in slaughterhouses and non slaughterhouses.

The simulation results of scenario III show that implementing a policy of saving productive females or returning productive females to breeders has resulted in an increase in the population of heifers by 51.41% and feeders by 18.37% at the breeder level. Figure 11 shows that a reduction in the sales of productive female cattle at the farmer level will lead to an increase in the overall population although it still shows a downward trend.

Scenario IV: Increasing calving rate, adding feed supplements and suppressing sales of productive females

Policy IV is a combination of policies to increase the calving rate, reduce the mortality rate of Bali cattle, and reduce the number of sales of productive females in Kupang Regency which are carried out simultaneously. The three policies that are implemented simultaneously will have an effect on the increase in the population of the wild (young males) and profits (Table 3).

Table 3 shows that the simultaneous test results show an increase in both feeder cattle population and breeders' profits compared to the previous partial test results in

Table 3. Simultaneous test results on the future population of breeding and fattening business.

Simultaneous test combination	Population of Feeders	
	Breeding Business	Fattening Business
Simultaneous test I	11,482.43 ekor (50.70%)	3.552.06 (31.96%)
Simultaneous test II	13,338.62 ekor (55.20%)	6,193.94 (47.32%)

Inform ation:Simultaneous Test I = Combination between Scenarios I A (Calving rate = 75%), II (suppressing mortality with feed supplements = 2%) and III (sales figure = 50%). Simultaneous Test II = Combination between Scenarios I B (Calving rate = 80%), II (suppressing mortality with feed supplements = 2%) and III (sales figure = 50%). (Source: Primary data processed, 2020).

policy scenarios I, II and III. The results of the first simultaneous test in the breeding business showed that the population of Bali calves increased by 50.70% and the profit increased by 34.34%. The results of the second simultaneous test in the breeding business showed that the feeder cattle population increased more than the result of the first simultaneous test, namely 55.20%, while the profit increased by 47.32%.

The behavior of the simulation results above shows that efforts to increase the supply of feeder of Bali cattle are more effective if policies I, II, and III are carried out simultaneously. The results of the second simultaneous test on breeding and fattening businesses showed an increase in some of the observed variables, namely: feeder population and profit compared to simultaneous test I. These results indicate to both breeders and government that efforts to increase feeder of Bali cattle supply in Kupang Regency are only can be done through policy IV, namely applying a combination of the AI Scenario (calving rate = 80%), II (reducing mortality with feed supplements = 2%) and III (sales figure = 50%). Implementing this policy will also increase farmer profits at a higher level. When the farmer receives a higher profit, the farmer has an incentive to apply innovation and technology. In addition, it is hoped that it can increase access to various social and economic activities as an indicator of its welfare.

However, it is well known that this effort is not easy to do. Socialization and extension efforts are not enough but must be accompanied by more intensive assistance and interaction with stakeholders. In order to achieve this goal, cooperation between breeders, government, universities, and other institutions is very important in the management of Bali cattle production in Kupang Regency.

Conclusion and Recommendations

Based on the results and discussion above, several conclusions as follows were made:

1. The interaction between actors in the management of actual feeder cattle supply in Kupang Regency is still limited to the marketing of beef products for both local and domestic markets.
2. The dynamics of the actual Bali cattle supply management system at the farmer level in Kupang Regency shows that the behavior of the Bali cattle population structure, including feeders, tends to decrease due to the low calving rate (70%), high mortality rate (35%), and the greatest influence is sales of productive female of Bali cattle are high (84%).
3. Several policies that can be intervened to increase the supply of feeder Bali cattle as well as the benefits of breeders are implementing various efforts to increase the calving rate by up to 80%, reduce the mortality rate with 2% feed supplementation, and reduce the sales of productive female Bali cattle by 50% simultaneously.

Based on the above conclusions, the following can be recommended:

1. The government, in this case the Animal Husbandry Service, must coordinate with various parties, such as: universities, private institutions, and other institutions to increase the intensity of their output and outcome-based services to breeders.
2. In order for innovation and technology to be applied by breeders in improving various parameters in the supply management of feeder Bali cattle, breeders need to get assistance in several business periods so that they are able to independently innovate and applied technology to realize the expected outcomes.
3. It is necessary to immediately establish a savings and loan cooperative at the farmer level with an extensive information system to market the livestock owned by member breeders with a relatively strong bargaining position so that the price of cattle that occurs at the farmer level is a negotiated price, not a price that is taken for granted.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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