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SYSTEM MODELLING OF BEEF AVAILABILITY IN IKN BUFFER AREAS USING SYSTEM DYNAMICS

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ABSTRACT

There are definitely several of pros and cons when relocating the country's capital from Jakarta to IKN. One of them has to do with the food security. As one of the IKN buffer areas, Balikpapan, has experienced issues with food security, particularly with regard to the supply of beef. The amount of imported beef in 2016-2019 shows a prediction that the amount of imported beef will continue to increase drastically yearly while the amount of local beef tends to decrease. The government of Balikpapan predicts that there will be an increase in the migrant population of up to 20.000 people each year due to the IKN, which can lead to an increase in demand for beef. Factors affecting the availability of beef in Balikpapan are local and imported beef availability, consumption, scarcity, and population demographics. This research was conducted using a system simulation approach with the system dynamic method to describe a complex system regarding the availability of beef in Balikpapan. Based on the scenario that has been developed, an effective policy that can be implemented to maintain the availability of beef in Balikpapan is to increase the cattle feed fraction by 15% and increase the arrival rate of imported beef by 10%. However, there is a need for an intervention policy from the government to increase local beef production, which is predicted to decrease, and minimize the amount of imported beef which dominates in fulfilling the beef consumption needs of the people of Balikpapan.

Keywords: Beef, IKN Buffer Areas, System Dynamics, Consumption, and Availability.

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1. INTRODUCTION

Meat is essential to meeting nutritional needs, especially animal protein. Meat can be obtained from slaughtering livestock such as cows, buffaloes, goats, horses, and other types of livestock (Zeng et, 2019). Beef is a type of meat consumed by people worldwide, including the Balikpapan. Beef, which is a type of ruminant meat, is one of eleven staple food ingredients based on Presidential Regulation of the Republic of Indonesia (PERPRES) No. 125 of 2022 concerning the Implementation of Government Food Reserves, which the government must maintain its availability to avoid food crises, price spikes, or other problems (Nugraheny, 2022). Based on data from the Livestock and Animal Health Office of East Kalimantan Province, beef consumption for Balikpapan in 2020 was 3500.38 tons, while beef production for Balikpapan in 2020 was only 1692.49 tons. The amount of local beef production in Balikpapan only fulfills 48.35% of the community's demand. In 2019 and 2018, Balikpapan experienced a similar situation where beef production could only satisfy 30.58% and 48.43% of the public's demand, respectively. Because beef production in Balikpapan has not met public consumption, imported beef is Needed to meet the demand for beef imported from other countries.

Figure 1 and 2 shows beef availability from local and imported beef production. There is no significant change in local beef production where the graph tends to be linear for the availability of local beef. However, there was a significant change or increase in the availability of imported beef from 2016-2019. However, in 2020 there was a decrease in the amount of imported beef due to the Covid-19 pandemic, which led to import restrictions during the pandemic (Rohmi et, 2021) (Pamungkas et, 2021). It can be seen in the 2017 chart that the amount of imported beef was 1159 tons, then increased to 2108 tons in 2018, and increased again by 3609 tons, which is a rapid increase in the amount of imported beef. The graph shows the quantity of beef imported between 2016 and 2020 under normal conditions, and it is projected that up to the next ten years, a considerable amount of imported beef may occur, while the amount of local beef will be constant. Excessive imports can harm the country's economy, affecting the rupiah exchange rate against the US dollar. The value of the rupiah currency will weaken due to dependence on imports. An excessive number of imported products can also lead to intense competition with imported products which can threaten the sustainability of the domestic industry. It can certainly affect the balance of the economy and the ability of a country to produce goods and services. In addition, inappropriate import policies can affect the domestic industrial market and impact declining national production levels (Sedyaningrum et, 2016)

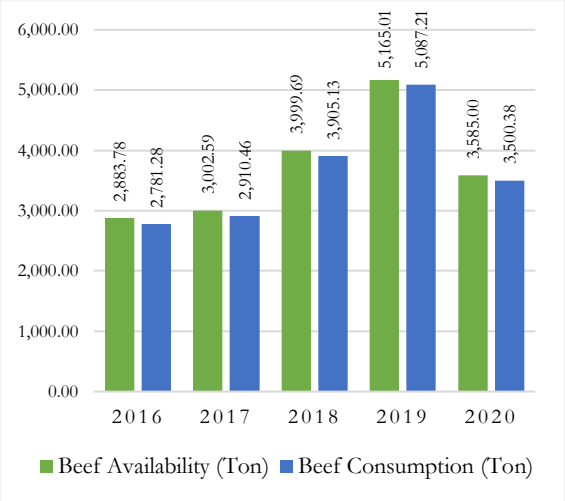

Figure 1. Beef Availability and Consumption in Balikpapan

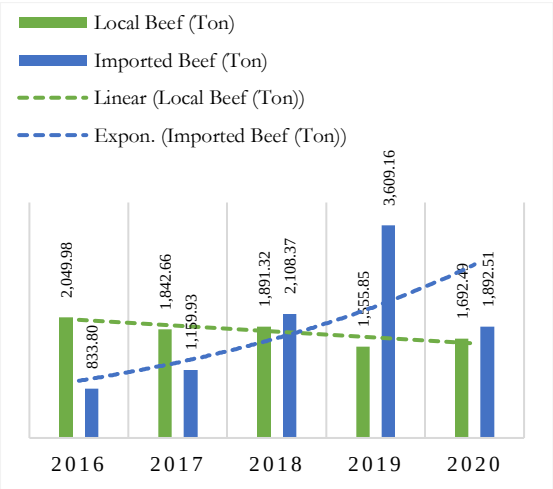

Figure 2. Local Beef and Imported Beef in Balikpapan

Department of Population and Civil Registry of Balikpapan, the population in 2022 will increase by 8,000 people in just six months. This does not rule out the possibility that the population of Balikpapan will also increase in the next few years given the ongoing construction of the IKN (Indonesia's new capital city), where the Head of the Population and Civil Registry Service for Balikpapan predicts that there will be an increase of up to 20,000 people each year (Angelina, 2022). As the population increases, societal consumption, such as protein consumption, will also increase due to population growth, population movement, and industrial growth due to the existence of the IKN (Min et, 2015).

The Head of the Office for Women's Empowerment, Child Protection, and Family Planning (identified as DP3AKB) reports that approximately 1436 children under the age of five are severely malnourished. This number may increase due to the continued risk of stunting in pregnant women, which affects around 700 individuals. In 2021, the stunting rate will reach 17% and increase in 2022 to 19%, while the national stunting rate target is 14%. To reduce the risk of stunting in infants or pregnant women, is to increase consumption of foods that are nutritious and rich in animal protein, such as eggs, beef, chicken, and other proteins (Heri, 2023). Therefore, it is necessary to know the availability of protein, especially beef, for the residents of Balikpapan for the next few years and how efforts can be made to meet the availability of beef with a system simulation approach (Odoemena et, 2020)

Previous study conducted by Susanto regarding designing palm kernel shell supply chains using a dynamic system approach, based on the analysis, the proposed supply chain model can ensure a consistent supply of palm kernel shells to the end customer. The model can maintain a minimum of 95% customer production level, even if the generation rate of palm kernel shell reduces at the source and other consumption rates increase (Susanto et, 2022). Sulistyono also conducted research on proposing an electric motorcycle adoption-diffusion model in Indonesia using a system dynamics approach. According to his research, the electric motorcycle market share is expected to increase from 2021 to 2030. In order to speed up the process of adopting electric scooters, policies are being developed that include retail price subsidies and electricity price scenarios (Sulistyono et, 2021). Studies on rice availability in Balikpapan have shown that a dynamic system has been developed to predict rice availability. This system considers the production subsystem, the consumption subsystem, and the distribution subsystem. It uses several variables to create a model that projects rice availability which resulted in an increase in the procurement and procurement of rice from Bulog and distributors (Abdallah et, 2024). There are also some other researches using system dynamic approach which concern about availability such as by Jamaluddin about rice availability in West Java (Jamaludin et, 2021), maintaining water availability in Lake Toba by Sihotang (Sihotang et, 2016), predict land availability and population growth in Bengkulu by Lestari (Lestari et, 2020), and analyze the recommended startegy for water supply in Sentul City Area by Baskoro (Baskoro et, 2021). After reviewing these studies on system dynamics, it can be concluded that this method is efficient in analyzing current systems and predicting their future outcomes.

This research was carried out using a system simulation approach with the system dynamic method so that it can describe a complex system based on variables that mutually influence the availability of beef in IKN buffer areas especially Balikpapan and can provide alternative policy recommendations that are effective in maintaining the availability of beef in Balikpapan. Based on the problems mentioned, this research is expected to be one of the contributions of ideas in meeting the availability of beef in Balikpapan for the next few years with a system dynamic approach.

2. METHODS

In order to research the availability and consumption of beef in the Balikpapan, it is crucial to observe and identify existing problems in the research objects. This will help determine the formulation of the issues and research objectives to be addressed. The data collected in this study are primary data and secondary data. The primary data used in this study were the fraction of cattle feed, the weight of the cattle, the success rate fraction of the birth rate success program, and the cattle vaccination fraction. Meanwhile, secondary data was obtained from

other sources. Secondary data used in this study were cattle population, beef production, beef consumption, total population, average income, and others. Primary and secondary data were collected through observation, interviews, and data requests with related parties such as the Balikpapan food agriculture and fisheries service department, Balikpapan slaughterhouses, markets, and distributors. The model building start with a conceptual model as a causal loop diagram to illustrate a system of causal relationships between variables that influence each other—furthermore, make a simulation model in the form of stock and flow diagrams based on the causal loop diagram that was made before by entering values for each variable (Sterman, 2000) (Law, 2015). Verification is done by comparing the simulation model with the actual system by observing the running of the simulation model (Pattiapon, 2015). If the model can run without any errors, then the model can be said to have been verified. The STELLA 9.1.3 software tool, which is useful for examining faults in the model developed or the consistency of the system model, is utilized in this verification procedure. If the model is not verified, then the model will be generated again. Validation is done by comparing the simulated output and the actual output. If the simulation model's output matches the actual output, then the model can be said to have been validated. If the model is not validated, the model will be generated again (Alhamri et, 2017). By comparing the output of the actual with the output of the simulation results using the statistical test method, specifically the Paired Sample T-Test aided by SPSS software, the model validation process employed the statistical test method. Several alternative scenario recommendations are developed to maximize the objectives to be achieved in the research (Daellenbach et, 2005). Scenario design is made through three values: pessimistic (reducing value from the existing value), existing, and optimistic (adding value from the existing value) of the decision variable (Mahananto et, 2020). Conduct analysis and discussion on research starting from system identification, model building with causal loop diagrams and stock and flow diagrams, preparation of several alternative scenarios, and selection of recommended scenarios. Lastly, conclude the results and answer the objectives set in the study.

3. FINDINGS AND DISCUSSION

3.1. Findings

Causal Loop Diagram

The following is a causal loop diagram of each beef availability system submodel in Balikpapan. Blue arrows with positive polarity indicate a positive relationship, while red arrows with negative polarity indicate a negative relationship. The beef availability sub-model consists of the amount of local beef and the amount of imported beef. Local beef production is obtained from the cattle reared in Balikpapan population through a birth program for productive female cattle carried out by breeders and then fattening the cattle by providing feed to the cows. Vaccination in cattle will slow down the rate of cattle slaughter because there is a time interval when cattle must be incubated and cannot be slaughtered. Imported beef is beef imported from abroad to the Balikpapan to meet the demand for beef consumption in the Balikpapan. Beef stock will increase if availability increases but will decrease if consumption increases.

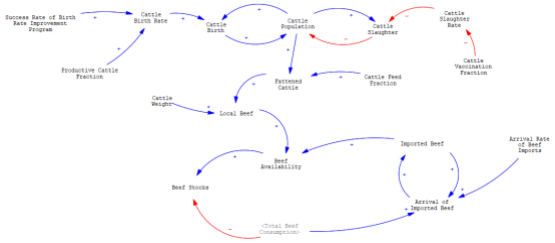

Figure 3. Causal Loop Diagram of Beef Availability Sub-model

The consumption sub-model describes total beef consumption, the sum of the annual or regular beef consumption, and beef consumption on holidays. The need for protein consumption and beef consumption per capita will increase the fulfillment of beef consumption, which is positively related to beef consumption. The more the population of Balikpapan, the higher the demand for beef consumption. The more significant expenditure on meat commodities issued by the population indicates an increase in beef consumption. The increasing price of fresh or local beef indicates decreased beef consumption.

The scarcity sub-model describes beef consumption by the people of Balikpapan during religious holidays (Hari Raya), especially the Muslim population, where the demand for beef commodities will increase compared to regular days. Expenditure on meat consumption, fulfillment of meat consumption, and an increasing population will increase beef consumption in Hari Raya. The demand for beef on public holidays, which is higher than normal conditions, indicates that beef consumption also increases. An increase in the price of fresh beef on holidays indicates a decrease in beef consumption on holidays. In contrast, an increase in the price of frozen or imported beef on holidays indicates an increase in beef consumption on holidays.

The population demographic sub-model describes changes in the total population of Balikpapan from time to time which is influenced by births, deaths, and migration of residents from or to Balikpapan, due to IKN and anything else. The birth rate will increase the number of population births, leading to an increase in the population of Balikpapan. The death rate will increase the number of deaths in the population, reducing the population of Balikpapan. Migration will cause an increase in population due to the arrival of residents from outside the area to Balikpapan. In contrast, emigration will cause a decrease in population due to the departure of Balikpapan residents outside Balikpapan.

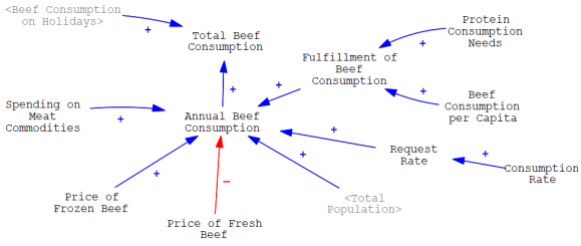

Figure 4. Causal Loop Diagram of Beef Consumptions Submodel

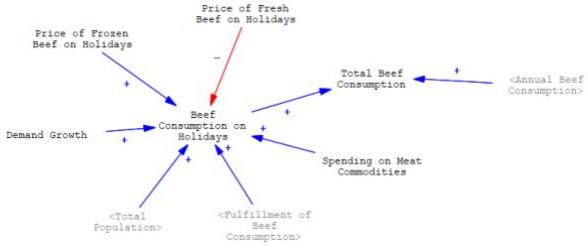

Figure 5. Causal Loop Diagram of Beef Scarcity Submodel

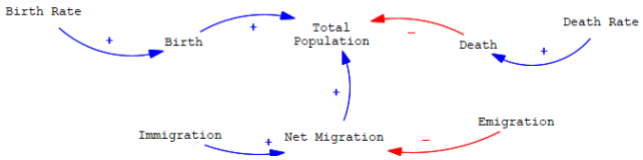

Figure 6. Causal Loop Diagram of Population Demographics Submodel

Stock Flow Diagram

The next step is making stock and flow diagrams based on the causal loop diagram. Several variables in the causal loop diagram are transformed into stock (level) and flow (rate). The variables of cattle population, amount of imported beef, annual beef consumption, and population are stocks because the numbers can increase or decrease in future periods. The variables of cattle birth, cattle slaughter, arrival of imported beef, demand rate, birth, death, and net migration are flows in and out of stock, where the variables in flow (rate) will affect the amount of stock (level). In the stock population of cattle, what will cause an increase in the population of cattle is the birth rate of cattle, and what will cause a decrease in the population of cattle is the rate of slaughtering cattle. In the stock of annual beef consumption, the rate of demand will cause an increase in annual beef consumption. In the stock of imported beef, what will cause an increase in the amount of imported beef is the arrival rate of imported beef. In the population stock, what will cause the population to increase is the birth rate and net migration, and what will cause the population to decrease is the death rate.

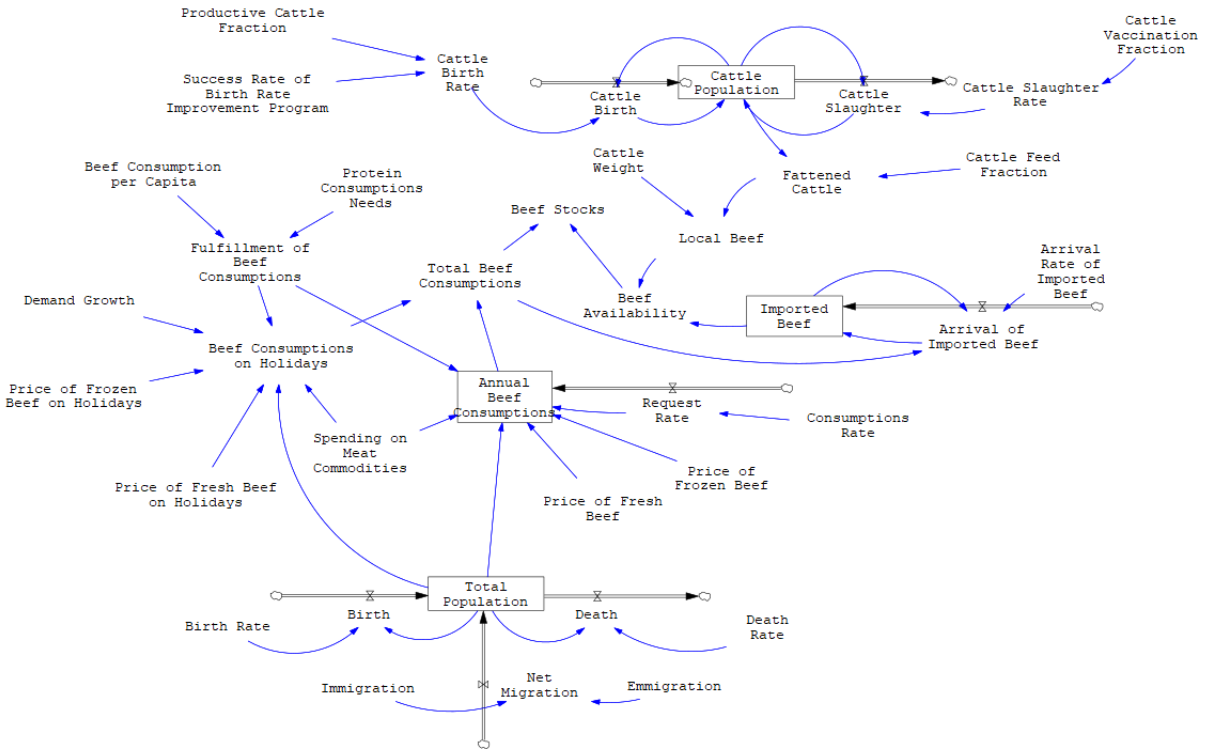

Figure 7. Stock and Flow Diagram of Beef Availability Model

Verification

Verification is done to determine whether the model can be run without debugging or error (Sulistyono et, 2021). The figure below shows that the model has been verified and can be run without error.

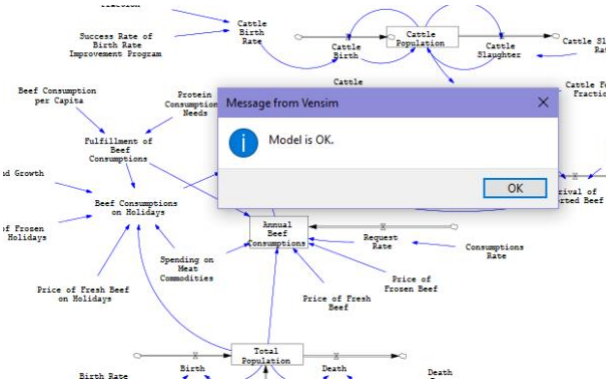

Figure 8. Verification Model

The model that has been built is validated to find out whether the model has described actual conditions or has not described actual conditions. The model is valid if the error value between the simulated and actual data does not exceed 5% (Alhamri et, 2017). The following is data validation on beef availability model variables.

The table above shows that the error value is 17.25% for beef consumption and 54.95% for beef availability variables. In 2020, there needs to be more clarity between the simulation and actual data. However, the error value in the simulation data for 2017-2019 is below 3%, the error value in validating local beef production data is 1.688%, beef availability is 1.154%, and beef consumption is 0.7227%, as shown in the table below. The simulated data can be considered valid since the error value is below 5%.

Table 1. Validation Model 2017-2020

Year	Local Beef (Ton)		Error Rate	Imported Beef (Ton)		Error Rate	Beef Consumption (Ton)		Error Rate
	Simulation	Actual		Simulation	Actual		Simulation	Actual	

2017	1849,42	1842,66	0,367%	1.160,00	1.159,93	0,006%	2987,39	2.910,46	2,643%
2018	1792,46	1891,32	5,227%	2.075,24	2.108,37	1,571%	3986,75	3.905,13	2,090%
2019	1737,25	1555,85	11,659%	3.712,60	3.609,16	2,866%	5014,68	5.087,21	1,426%
2020	1683,74	1692,49	0,517%	6.641,85	1.892,51	250,95%	6071,81	3.500,38	73,461%
Average	1765,72	1745,58	4,443%	3.397,42	2192,49	63,849%	4515,1575	3850,795	19,905%
Error Rate	**1,154%**			**54,9571%**			**17,253%**		

Simulation Result

The following is a simulation result in conditions where there is no anything policy and based on the system that is currently running. The simulation results show results for 15 years, from 2017 to 2032. The simulation results show that local beef cattle production continues to decline every year, while beef consumption continues to increase along with the increasing population of Balikpapan each year. Under these conditions, most of the beef consumption is fulfilled by the amount of imported beef which continues to increase yearly. Simulation results of the existing condition of local beef production continue to decline yearly. In 2017 the amount of local beef was 1849.42 tons, but in 2032 the amount of local beef decreased to 1156.74 tons. The amount of imported beef imported from other countries to Balikpapan City is to meet the needs for beef consumption in Balikpapan City because local beef production has not been able to meet the consumption needs of the population with an increasing amount until 2020 of 6641.85 tons, then constant for the following years. The availability of beef in existing conditions shows the amount of beef availability in Balikpapan City based on the amount of local beef production and the number of arrivals of imported beef which increases until 2020 and then tends to decrease in 2021-2032. The total beef consumption of Balikpapan City's people continues to increase yearly. In 2017 the beef consumption of the people of Balikpapan City was 2987.39 tons, then in 2032, the total beef consumption of the people of Balikpapan City increased to 21278 tons. The amount of stock of beef supplies is still available until 2020 but is experiencing a shortage, as shown by the graph, which decreases until 2032 to 13479.41 tons due to the availability of beef which cannot meet the beef consumption needs of the people of Balikpapan City. In 2017 the population was 636102 people, then it continued to increase to 955517 people in 2032. The growing number of people has led to an increase in the consumption of beef.

Table 2. Existing Simulation Result

Year	Local Beef : Existing (Ton)	Imported Beef : Existing (Ton)	Beef Availability : Eksisting (Ton)	Beef Consumption : Existing (Ton)	Beef Stoks : Existing (Ton)	Total Population : Existing (Person)
2017	1849,42	1160	3009,42	2987,39	22,03	636102
2018	1792,46	2075,24	3867,7	3986,75	-119,05	654360
2019	1737,25	3712,6	5449,85	5014,68	435,17	673012
2020	1683,74	6641,85	8325,59	6071,81	2253,78	692067
2021	1631,88	6641,85	8273,73	7158,75	1114,98	711534
2022	1581,62	6641,85	8223,47	8276,17	-52,7	731421
2023	1532,91	6641,85	8174,76	9424,71	-1249,95	751738
2024	1485,69	6641,85	8127,54	10605	-2477,46	772493

Year	Local Beef : Existing (Ton)	Imported Beef : Existing (Ton)	Beef Availability : Eksisting (Ton)	Beef Consumption : Existing (Ton)	Beef Stoks : Existing (Ton)	Total Population : Existing (Person)
2025	1439,93	6641,85	8081,78	11817,9	-3736,12	793697
2026	1395,58	6641,85	8037,43	13063,9	-5026,47	815359
2027	1352,6	6641,85	7994,45	14343,8	-6349,35	837488
2028	1310,94	6641,85	7952,79	15658,3	-7705,51	860096
2029	1270,56	6641,85	7912,41	17008,2	-9095,79	883192
2030	1231,43	6641,85	7873,28	18394,3	-10521,02	906787
2031	1193,5	6641,85	7835,35	19817,3	-11981,95	930892
2032	1156,74	6641,85	7798,59	21278	-13479,41	955517

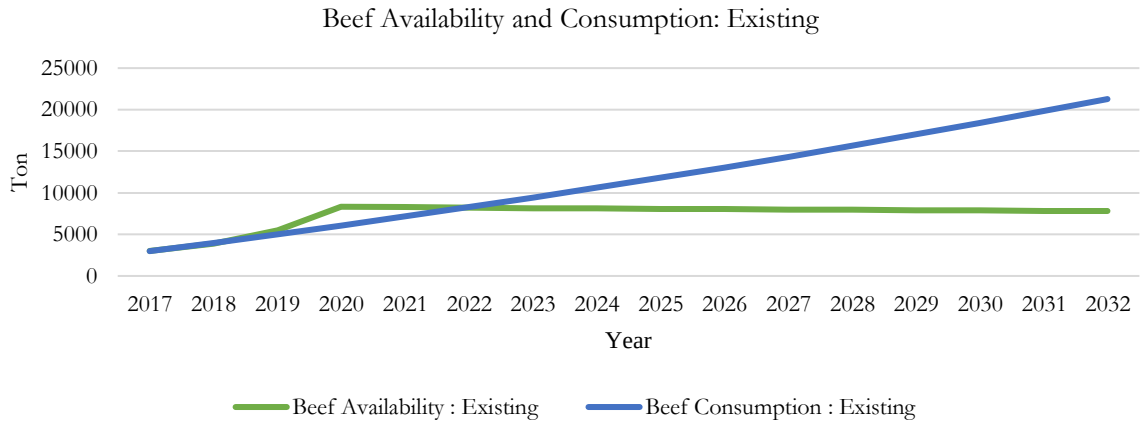

Figure 9. Existing Simulation Result of Beef Availability and Consumptions Graph

3.2. Discussion

After verifying and validating the built model, the next step is develop scenarios that effectively maintain beef availability in Balikpapan. The following scenarios as shown in Table 3, will be built in the dynamic system model of beef availability in Balikpapan. The scenario built assumes the population's birth rate increases by 2.1% per year. The increase in the birth rate is assumed to be equal to the average population birth rate from 2017-2020 based on the Balikpapan Population and Civil Registry Service Department. The number of Migration residents of Balikpapan is assumed to have increased by 20,000 people based on the results of interviews with the Head of the Office of Population and Civil Registry of Balikpapan that there has been an increase in the number of migrants by 8000 people in just six months. It is predicted that there will be an increase every year by 20,000 people due to the construction of IKN.

Scenario development to maintain the availability of beef can be done by increasing local beef production and controlling the arrival rate of imported beef. Increasing local beef production can be done by increasing the weight of the cattle by assuming an increase in the feed fraction of cattle by 15% so that the weight of the cattle is from 260 kg/each to 299 kg/each. Based on the results of interviews with the Head of the Animal Husbandry Department of the Food, Agriculture, and Fisheries Office, the cattle raised in Balikpapan come from birth programs by breeders and cattle imported from outside the area to Balikpapan. The cattle population in Balikpapan will be fattened before being slaughtered with a minimum weight of 260 kg/each. Cattle fattening can be done by feeding the cows 10-20% of the cow's weight.

Table 3. Scenario Bulidings for Beef Availability System

Scenario	Cattle Feed Fraction	Arrival Rate of Imported Beef	Population Birth Rate	Immigration (Person)
1.	-	-	+ 2,1%	+ 20000
2.	+15%	-10%	+2,1%	+20000
3.	+15%	-5%	+2,1%	+20000
4.	+15%	+5%	+2,1%	+20000
5.	+15%	+10%	+2,1%	+20000

Scenario 1 was designed with the assumption that population growth will increase the demand for beef consumption. Scenario 1 assumes that with the IKN, there will be an increase in the population's birth rate by 2.1% from 0.02852 to 0.04952 and an increase in the number of migratory residents by 20000 people from 19211 people to 39211 people. With the addition of the birth rate to 0.04952 and the number of immigrants to 39211 people, it will also increase the population to 734323 people at the end of 2032. The increase in population due to the development of the IKN has led to an increase in the birth rate and the number of immigrants or immigrants, increasing the amount of beef consumption. In scenario 1, there is an increase in beef consumption, increasing by 28.18 tons at the beginning of 2018 to 7507.1 tons at the end of 2032 compared to the existing conditions. The increase in the amount of consumption causes an increase in the amount of imported beef that must be imported due to insufficient local beef production to meet the beef consumption needs of the people of Balikpapan. The simulation results of scenario 1 with the arrival rate of imported beef of 0.789 showed there is an increase in the number of imported beef arrivals in 2022 compared to the previous year of 5240.45 tons or 11882.3 tons due to the arrival of the same amount in the previous year, not sufficient consumption of beef by the people of Balikpapan. In 2032, the amount of imported beef will reach 38028.4 tons to meet the demand for beef consumption, which is a significant increase compared to the existing conditions. Due to the increase in the number of imported beef arrivals to meet beef consumption, the supply will also increase from 2022 to 2032. In scenario 1, there is a stock that is still available due to higher availability compared to population consumption, compared to the existing conditions where in 2018 and 2022-2032, there will be a shortage of beef stock so that it cannot meet consumption needs. However, in the simulation results of scenario 1, in 2018, there was a shortage of 147,232 tons, while the availability was still sufficient in subsequent years.

Scenario 2 is designed by assuming an increase in the weight of fattened cattle on the farm, which will be slaughtered. The increase in cattle weight is carried out by assuming an increase in the feed fraction of cattle by 15% so that the weight of the cattle is from 260 kg/each to 299 kg/each and controlling the arrival rate of imported beef by reducing it by 10% or from 0.789 to 0.689. In this scenario, it is also assumed that there is an increase in the population, with the birth rate increasing by 2.1% or from 0.02852 to 0.04952 each year and the number of migrations of the population increasing by 20000 people or from 19211 people to 39211 people. In this scenario, the rate of arrival of imported beef is controlled by decreasing by 10% or to 0.689 to meet beef consumption. The availability of beef in the existing conditions and scenario 2 increased by 252.19 tons in 2017 due to the additional weight of the cattle with an increase in the fraction of cattle feed. The availability of beef decreased in 2019 and 2020 due to the reduced number of imported cattle arrivals caused by the arrival rate of imported beef which decreased by 10%. The availability of beef will increase to 20445.89 tons in 2032 due to the arrival of imported beef to meet the demand for beef consumption. In scenario 2, there is an increase in stock due to an increase in the amount of beef imported until 2032 so that it can increase the availability of beef to meet beef consumption needs. However, in 2018 and 2032, there will be a shortage of availability or stock that is not sufficient for consumption needs because the arrival of imported beef, with an arrival rate of 0.689, still needs to meet the beef consumption needs of the population.

Scenario 3 is designed by assuming an increase in the weight of fattened cattle on the farm, which will be slaughtered. The increase in cattle weight is carried out by assuming an increase in the feed fraction of cattle by 15% so that the weight of the cattle is from 260 kg/each to 299 kg/each and controlling the arrival rate of imported beef by reducing it by 5% or from 0.789 to 0.739. In this scenario, it is also assumed that there is an increase in the population, with the birth rate increasing by 2.1% or from 0.02852 to 0.04952

each year and the number of migrations of the population increasing by 20000 people or from 19211 people to 39211 people. In this scenario, the arrival rate of imported beef is controlled by reducing it by 5% or to 0.739 to meet beef consumption. The availability of beef in the existing conditions and scenario 3 increased by 252.19 tons in 2017 due to the additional weight of the cattle with an increase in the fraction of cattle feed. The availability of beef decreased in 2020 due to the reduced number of imported cattle arrivals caused by the arrival rate of imported beef which decreased by 5%. The availability of beef will increase to 25597.49 tons in 2032 due to the arrival of imported beef to meet the demand for beef consumption. In scenario 3, there is an increase in stock due to an increase in the amount of imported beef until 2032 so that it can increase the availability of beef to meet beef consumption needs. In 2019 and 2020, there was a decrease in beef stock due to a decrease in the rate of arrival of beef, but the total stock in scenario 3 has an overall positive value, which means it can meet the needs for beef consumption.

Scenario 4 is based on the assumption that the cattle on the farm will gain weight before being slaughtered. To accomplish this, we increased the cattle feed fraction by 15%, increasing the weight for each cattle from 260 kg/each to 299 kg/each. Additionally, the arrival rate of imported beef was controlled by increasing it by 5% from 0.789 to 0.839. In this scenario, it is also assumed that there is an increase in the population, with the birth rate increasing by 2.1% or from 0.02852 to 0.04952 each year and the number of population migrations increasing by 20000 people or from 19211 people to 39211 people. In this scenario, the arrival rate of imported beef is controlled by increasing by 5% or 0.839 to meet beef consumption. The availability of beef in the existing conditions and scenario 4 increased by 252.19 tons in 2017 due to the additional weight of the cattle with an increase in the fraction of cattle feed. The availability of beef will increase until 2032 due to the increasing number of imported cattle arrivals due to the 5% increase in the arrival rate of imported beef. The availability of beef increased to 38385.09 tons or 46183.68 tons in 2032 due to the arrival of imported beef to meet the demand for beef consumption. In scenario 4, there is an increase in stock due to an increase in the amount of imported beef until 2032 so that it can increase the availability of beef to meet beef consumption needs. In 2031 there will be a stock shortage of 481.25 tons of beef where availability is higher than beef consumption, but it will increase again in 2032 with a total stock of 17398.58 tons.

Scenario 5 assumes that the weight of the fattened cattle on the farm will increase before they are slaughtered. The increase in cattle weight was carried out by assuming an increase in the feed fraction of cattle by 15% so that the weight of the cattle was from 260 kg/head to 299 kg/head and controlling the arrival rate of imported beef by increasing it by 10% or from 0.789 to 0.889. In this scenario, it is also assumed that there is an increase in the population, with the birth rate increasing by 2.1% or from 0.02852 to 0.04952 each year and the number of population migrations increasing by 20000 people or from 19211 people to 39211 people. To ensure adequate beef consumption, the arrival rate of imported beef may increase by 10% or to 0.889. The table below shows an increase in the number of imported beef arrivals each year due to increased arrival rates. The availability of beef in the existing conditions and scenario 5 increased by 252.19 tons in 2017 due to the additional weight of the cattle with an increase in the fraction of cattle feed. The availability of beef will increase until 2032 due to the increasing number of imported cattle arrivals caused by the arrival rate of imported beef which has increased by 10%. The availability of beef increased to 29215.38 tons in 2032 due to the arrival of imported beef to meet the demand for beef consumption. In scenario 5, there is an increase in stock due to an increase in the amount of imported beef until 2032 so that it can increase the availability of beef to meet beef consumption needs. The total stock in scenario 5 is favorable overall, which means it can meet the needs for beef consumption.

Table 3. Beef Availability Scenario Simulation Result

Year	Beef Availability Scenario 1 (Ton)	Beef Availability Scenario 2 (Ton)	Beef Availability Scenario 3 (Ton)	Beef Availability Scenario 4 (Ton)	Beef Availability Scenario 5 (Ton)	Beef Consumption (Ton)
2017	3009,42	3261,61	3261,61	3261,61	3261,61	2987,39
2018	3867,7	3996,12	4054,12	4170,12	4228,12	4014,93
2019	5449,85	5283,31	5482,13	5897,18	6113,4	5124,17
2020	8325,59	7502,51	8013,72	9127,79	9732,39	6318,58
2021	8273,73	11294,51	12463,01	9068,86	9673,46	7601,81
2022	13463,9	11237,4	12405,9	15064,7	9616,35	8977,62
2023	13415,2	11182,04	12350,54	15009,34	16512,14	10450
2024	13368	17632,59	12296,89	14955,69	16458,49	12023
2025	22697,3	17580,59	20084,59	14903,69	16406,49	13700,9
2026	22653	17530,19	20034,19	25984,59	16356,09	15488,2
2027	22610	17481,35	19985,35	25935,75	29437,95	17389,6
2028	22568,3	28419,7	19938	25888,4	29390,6	19410
2029	22527,9	28373,82	33525,42	25842,52	29344,72	21554,3
2030	39260,9	28329,35	33480,95	25798,05	29300,25	23827,9
2031	39222,9	28286,25	33437,85	25754,95	29257,15	26236,2
2032	39186,2	28244,48	33396,08	46183,68	29215,38	28785,1

Based on the simulation results of various scenarios, it is assumed that in all scenarios, there will be an increase in population with an increase in the birth rate of 2.1% to or from 0.02852 to 0.04952 and an increase in the number of migrants by 20000 or from 19211 people to 39211 people, as well as an increase in the fraction of cattle feed by 15%, scenarios that can meet beef consumption are scenario 3 and scenario 5. Scenario 3 carries out a policy of reducing the arrival rate of imported beef by 5%, while scenario 5 implements a policy of increasing the arrival rate of imported beef by 10 %. Based on these two scenarios, the best scenario that can be recommended to maintain the availability of beef is scenario 5 compared to scenario 3 because the amount of beef stock in scenario 3 is higher in 2032 compared to beef stock in scenario 5 in 2032. In scenario 3, in 2032, there is a total of 32081.6 tons of imported beef, while in scenario 5, in 2032, there is a total of 27900.9 tons of imported beef, causing the total supply in scenario 3 to be higher than in scenario 5, so that the condition for consumption demand has been met then causing the stock in scenario 3 to be higher than scenario 5, so the best scenario to be chosen is a policy where consumption needs are met with a minimum amount of stock.

Thus, the best scenario that can be recommended to maintain the availability of beef is scenario 5, namely by increasing the cattle feed fraction by 15% or 260 kg/head to 299 kg/head, increasing the arrival rate of imported beef by 10% or from 0.789 to 0.889. It is assumed that there will be a population growth of 2.1% and an immigrant population of 2,000 people due to the IKN.

According to the simulation results in all scenarios, the quantity of locally produced beef decreased continuously until 2032, only reaching 1314.48 tons with an increase in the feed fraction of 15%. This maximum policy can be implemented to increase local cattle production from only 1156.74 tons in 2032 without any increase in the cattle feed scenario. As beef consumption continues to rise, the availability of local beef is decreasing, and this research was carried out by procuring imported beef. However, it can be seen that in 2032 with the best

scenario, namely scenario 5, the amount of imported beef that needs to be imported to meet the demand for beef consumption reaches 27,900.9 tons. Excessive amounts of imports, while the amount of local production continues to shrink, can cause the country's economic growth to be eroded, the trade balance to be disrupted, the country's currency to weaken due to dependence on imports, and intense competition with imported products can threaten the sustainability of the industry in the country. The government should consider implementing intervention policies such as maximizing artificial insemination programs, increasing cattle breeding, and natural mating intensification programs to reduce the reliance on imported beef. These special programs will help to increase the locally sourced beef supply, which is predicted to continue decreasing, and will ensure that the population of Balikpapan has access to enough meat for their consumption needs

4.CONCLUSION AND SUGGESTION

In each development scenario, it is assumed that population growth will occur due to the construction of the IKN with an increase in the birth rate of 2.1% and an immigrant population of 20,000 people as well as a policy to increase local beef production by increasing the fraction of cattle feed by 15%. Scenario 1 was built with the assumption of increasing population growth. Scenario 2 assumes that the policy is to decrease the arrival rate of imported beef by 10%. Scenario 3 assumes that the policy is to decrease the arrival rate of imported beef by 5%. Scenario 4 assumes that the policy is to increase the arrival rate of imported beef by 5%. Scenario 5 assumes that the policy is to increase the arrival rate of imported beef by 10%.

The recommended policy in maintaining the availability of beef in Balikpapan, assuming an increase in population due to the construction of the IKN (Indonesia's new capital city), is to increase the cattle feed fraction by 15% or 260 kg/head to 299 kg/each and increase the arrival rate of imported beef by 10%. or from 0.789 to 0.889. Suppose there is a rapid increase in the need for beef consumption due to population growth. In that case, the availability of beef in Balikpapan can be controlled by controlling the arrival rate of imported beef. Looking at the simulation results that the amount of meat is increasing rapidly, which can be detrimental to the country's economy; the government needs to plan policy interventions to increase local beef production, which is predicted to decrease and reduce the amount of imported beef which is predicted to increase to meet the demand for beef consumption residents in Balikpapan.

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