

**SOCIAL SCIENCES & HUMANITIES**Journal homepage: <http://www.pertanika.upm.edu.my/>**Analysis of Malaysian Beef Industry in Peninsular Malaysia under Different Importation Policies Scenarios and Rate Management Systems****Zainalabidin Mohamed*, Anahita Hosseini and Nitty Hirawaty Kamarulzaman***Department of Agribusiness and Information Systems, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia***ABSTRACT**

In Malaysia, the production of fresh beef is inadequate to meet the people's demand. The major problem is that the beef sub sector of Malaysia has remained uncommercialized due to low productivity and the private sector has been silent on the beef sub sector development. Malaysia imported 75-80% of her beef requirement from different parts of the world in order to meet the domestic demand. Thus drastic policies need to be formulated to terminate dependency on others while developing beef industry domestically as an import substitution strategy. Thus the objective of this study is to develop a beef production system modeling for policy analysis via a model known as the Vintage approach simulation matrix model (VASIMM). VASIMM has the ability to determine the effect of the importation of the breeding stock policy and calculate the benefit and cost of implementing such policy to the government in the long run. The VASIMM method uses aggregate data to bring the new breeding stock into the model. Among the data feasible include reports that derive the reproduction of existing breeding stocks, determine the culling rate, and derive a theoretical slaughter system based on different rates of calving, replacement, mortality, and slaughter in the past. In addition, the method is able to determine reduction rates for system simulation, simulate final results of female and male breeding stocks, iv) female and male calves, ,rate of slaughter, and production of beef from beef cattle, dairy cattle, and buffalo . The ex-ante simulation analysis was developed by examining different policy variables, and report issues on mortality, slaughter, and calving rate, importation of female

breeding stocks, and importation of animal for slaughter, in 9 different Policy Scenarios. Result from these 9 Scenarios indicate that only Scenario 3 is economically applicable in the long run which can fulfill the targeted level of self-sufficiency (40%) by 2020.

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INTRODUCTION

The Malaysian agriculture sector plays an important role in the country's economic development, functioning as a food supplier, employment provider, export earner and provider of raw materials for the agro-based industries. The share of the agriculture in the country's economy, in terms of GDP, was reduced from 29.0% in 1970 to 7.7% in 2007. The agriculture share of employment and export earnings has also declined from 55.7% and 55.0% in 1970 to 12.2% and 8.6% in 2007 respectively. During the 8MP, the agriculture sector recorded an average annual growth rate of 3.0% exceeding the target of 2.0% for the 8MP. During the 9MP period (2006-2010), the agriculture sector is expected to become the third engine of growth to the economy. The agriculture sector is expected to grow at a higher average annual rate of 5.0% during the 9MP. With the inclusion of agro-based industry, the growth rate is expected to be 5.2% (Government of Malaysia, 2006). The agricultural value added grew at an average rate of 3.0% per annum during the 8MP Period, higher than the targeted rate of 2.0%. The value added in the agricultural sector is estimated to improve from RM 18,662 million in 2000 to RM 27,517 million in 2010. The value added for food commodities is also expected to increase from RM 7,629 Million in 2000 to RM 11,996 Million in 2010. state why is this sector important to the economy..eg, Thus, the value added from

the said market is a significant contributor to the GDP.

Livestock industry in Malaysia

The Malaysian livestock industry is an important and integral component of the agricultural sector. It provides gainful employment and produces useful animal protein food for the population. In 2005, the livestock industry alone contributed 0.8% to the GDP and around 9.6% to the value added in agriculture (Government of Malaysia, 2006). In fact, the livestock sector is the largest food industry in Malaysia in terms of output value at the total value of RM 6,992 million in 2006. On the other hand, the state of the ruminant industry paints a fairly depressing picture. The ruminant industry is not well developed and it has had little growth in meat production. (what exactly does ruminant industry refer to).

Currently, more than 90.0% of the ruminant population in Malaysia is still in the hand of small farm holders. This group of farmers do not grow pastures for animals traditionally compared to the larger commercial and government farms where there are proper infrastructures and established pastures. However they produce only 5.0% of the total ruminant in Malaysia. The policy objectives of provide full termNAP3 for the livestock sector are to increase production of all livestock products, raise the nutritional status of the human population and provide rural employment.

As stated earlier, in terms of Gross Domestic Product (GDP), livestock industry

is expected to contribute about 9.0% to agriculture value added which is equivalent to total production value of more than RM 2,483 million in 2010. The sector value added grew steadily at an annual average of 4.0-6.0% over the period of 2005-2010. In the 8MP, the value added for the livestock as food commodities, grew at a rate of 6.6% per annum and its contribution to GDP for agriculture was 8.14%. In 9MP it is targeted that the livestock industry will continue to contribute about 9.0% to the GDP for agriculture.

In 1960, the production of beef, mutton, pork and poultry were recorded at 11,570, 1,280, 38,450, 21,273 metric tons, but increased to 26,513, 1,556, 168,356, 944,840 metric tons in 2006, respectively. In 2006, beef production (2.3%) was lower than poultry (82.9%) and pork (14.8%), but it was slightly higher than mutton production (0.1%). The beef production trend shows fluctuations from 1960 to 1996, but in general, the beef production depicts an increasing trend from 1990 to 2006. In spite of the rising beef production, it could only cover about 20% of the domestic demand.

The trend of consumption for all meat is increasing over the years. The quantity of consumption of beef, mutton, pork and poultry in Peninsular Malaysia in 1960 were 14,030, 3,380, 30,170, and 23,636 MT, respectively, whilst in 2006, their consumption were 136,056, 17,150, 155,884 and 721,230 MT, respectively. Beef consumption increased steadily from 1990 to 2006 and it is higher than mutton, but lower than poultry and pork. In 2006, beef

consumption growth was 13.2% which is higher than mutton (1.7%) and lower than poultry (70.0%) and pork (15.1%). Beef consumption increased from 14,030 MT in 1960 to 136,056 MT in 2006.

In 2006, the self-sufficiency level (SSL) of beef (22.11%) and mutton (9.07%) were lower compared to pork (108%) and poultry (131%). Although, the beef production grew steadily from 1960–2006, the self-sufficiency rate in beef decreased from 82% in 1960 to 22% in 2006 and even with given priority in the livestock development plans over the years, it was unable to meet the local demand. The rapid decrease in self-sufficiency level could possibly be attributed to lack of efficiency in the performance of the beef and mutton subsectors.

Thus, there is a need to formulate a policy to enhance sufficient beef production in order to prevent Malaysian dependency on imported meat and livestock. The implementation of this provision will not only attain the goal of the livestock industry to meet the local demand, but it could also be a response to the food security issues. The low performance of the beef animals along with strong competition from other agricultural activities especially palm oil on one side and cheaper prices of imported beef on the other side, make beef cattle rearing a costly business to operate locally. Besides this, the consumption of beef is subjected to the price of its competitors such as fish, poultry, mutton and pork. The fish and chicken are close substitutes to beef and in terms of elasticity as it is considered to be very elastic.

Therefore, the main purpose of this study is to develop a model for beef policy analysis in order to formulate a policy implication for local fresh beef production and the future trend of beef self sufficiency level in Malaysia via biological and mathematical simulation beef model.

Under NAP3, it was expected for the Malaysian beef sub- sector to fulfill 30% of self-sufficiency by the year 2010. The production of fresh beef, mutton and milk are expected to increase for the domestic market. Private sector led commercial production was actively encouraged to adopt modern approaches and farming on large-scale basis. Smallholder livestock activities with potential would continue to be transformed into larger commercial operations to improve efficiency.

The main problem facing the local beef industry is the slow growth rate of the local beef supply in relation to the growth rate of its demand. Even though the efforts have been made by the government to boost the industry through consecutive Malaysian plans, the slow growth rate of the beef supply still persists. At present, the level of support given to the ruminant sector is still too small to yield any measurable impact . Beef consumption is expected to increase in the near future. With the Malay population (the major consumers of beef) growing at an annual rate of 3.1% which is substantially in excess of the national average of 2.5%, the demand for beef is anticipated to increase .

METHODOLOGY

The self-sufficiency level of beef in Malaysia has been declining over the last few decades

. Although efforts have been made to increase beef production, it still cannot cope with the increasing population and demand for beef and beef products. Having adopted a system approach as a method to analyze the beef enterprise, simulation has been chosen as a technique for the beef production system analysis in solving the beef productions issues. Such a technique is used to test the effect of beef production decision-making and government policy options on the behavior of the system model. Simulation has also been selected because it offers the greatest potential with the understanding and solving the model of the process involved in the production of beef. Therefore, in this research the system simulation analysis via vintage approach is used for analyzing a beef enterprise.

Simulation defines a technique that involves setting up a model of the real situation and then performing experiment on the model (Naylor *et al.*, 1966). A simulation model is a mathematical model that calculates the impact of uncertain inputs and decisions we make on outcomes that we care about, such as profit and loss, investment returns, environmental consequences, and the like (Meier *et. al*, 1969).

Model Specification (The Formulation of a Mathematical Model)

This study developed a simulation model for beef in Peninsular Malaysia using a vintage approach simulation matrix model (VASIMM). This model is considered to be more efficient, since it allows a separate analysis on the beef population,

beef production, self-sufficiency level of beef and investment cost in enhancing beef production . In this study, the system being considered is both biological and economical. It is biological because it involves beef cattle, dairy cattle and buffalo population life cycle and their production process. On the other hand, it is economical because it includes the economic framework of supply and demand embodied in beef production decisions as presented in the Fig.1.

Consequently, Smit (1984) used the following deduction method, which we adapt as slaughter system in equations (1) and (2).

$$r_k = r_{k-1} - (100 - \rho) / k$$

for $K= 1, \dots, k$ (years) (1)

$$P_k = \delta^{\delta/k}$$
 (2)

Where,

r_k = percentage of original animal population remaining after k years

p_k = percentage of remaining animal population deducted in year k

ρ = total remaining percentage to be reached after k years

k = number of years for constant annual decrease in percentage not yet deducted

δ = the rate of change of slaughter or culled or death animal

Fig.1 illustrates that the distribution of vintage in each year was derived using rates, such as mortality, slaughter and calving. For instance, X_1 female breeding stock entered to the system in 1960, and therefore to be assumed in year one in 1960, $Z\%$ was deducted resulting in mortality and slaughter rate, and as can be seen, x_1 breeding stocks will be available in year 1961 (year 2), and x_1 will also be available in 1962 (year 3),

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	...
1961	X_1										
1962	X_2	x_1									
1963	X_3	x_2	x_1								
1964	X_4	x_3	x_2	x_1							
1965	X_5	x_4	x_3	x_2	x_1						
1966	X_6	x_5	x_4	x_3	x_2	x_1					
1967	X_7	x_6	x_5	x_4	x_3	x_2	x_1				
1968	X_8	x_7	x_6	x_5	x_4	x_3	x_2	x_1			
1969	X_9	x_8	x_7	x_6	x_5	x_4	x_3	x_2	x_1		
1970	X_{10}	x_9	x_8	x_7	x_6	x_5	x_4	x_3	x_2	x_1	
1971	X_{11}	x_{10}	x_9	x_8	x_7	x_6	x_5	x_4	x_3	x_2	
.
.
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Fig. 1: The Flow Diagram of Distribution of Vintage Approach

1963, etc. The number of x will be lesser than the previous years, due to deducted rate of slaughter and mortality. For 1961, X_2 new breeding stock will be entered into the system, while x_1 which is the deducted number of breeding stocks in 1960 also exists in the system. Again, X_2 will be deducted by $Z\%$ of rates of mortality and slaughter, and x_2 amount of breeding stock will go to year 1962.

In the last column of the matrix, the vintage distribution of the total simulated value in terms of number of breeding stocks can be obtained by adding up the deducted values in each column in front of each year, for example, the total number of breeding stocks in the year 1971 can be calculated like this: $X_{11} + x_{10} + x_9 + x_8 + x_7 + x_6 + x_5 + x_4 + x_3 + x_2$. At the same time calving rate will be inducted into the vintage to generate steers and heifers which will go into the male/female breeding stock less than 3 years old. Steers that reach 3 years old will be put back into the $FBS > 3$ years old, given specific replacement rate.

The system simulation model includes cow-calf operation model with four major components of the system which includes I: population distribution component, II: slaughter and beef production component and III: beef production and consumption component and IV: management decision-making component. The three physical components have been shown to involve beef population life cycle, beef production and beef-self-sufficiency level. Financial component has been shown to involve management decision. The simulation

model is designed to be useful in analyzing various management policies to increase beef production. These four components represent realistic simulation of the system behavior through time.

Beef Population Distribution Component

Female Breeding Stock (FBS)

Equation (3) determines the current female breeding stock (FBS) level using the previous level, slaughtered female breeding stock (SFBS) and Mortality of female breeding stock (MFBS). The rates of slaughter female breeding stock (S_1) and death of female breeding stock (M_1) are also used in this equation.

$$FBS_{(t+Dt)} = \int_t^{t+Dt} [FBS_t - SFBS_t - MFBS_t] dt \tag{3}$$

Where,

- Dt = Increment of time
- $FBS_{(t+Dt)}$ = Current number of female breeding stock for each age
- FBS_t = Previous number of female breeding stock for each age
- $SFBS_t$ = Previous number of slaughtered female breeding stock for each age
- $MFBS_t$ = Previous number of death female breeding stock for each age

The following equations define the structure of the system:

$$SFBS_t = S_1 \times FBS_t \tag{4}$$

Where,

- S_1 = Slaughter rate for each age

Total slaughter female breeding stock is generated by multiplying previous number of female breeding stock at annual slaughter rate (S_1).

$$MFBS_t = M_1 \times FBS_t \quad (5)$$

Where,
 M_1 = Mortality rate

Total number of death of female breeding stock is generated by multiplying previous number of female breeding stock at annual mortality rate (M_1).

The equation:

$$TFBS_{(t+Dt)} = \sum_{Dt=1}^n FBS_{i(t+Dt)} \quad (6)$$

Where,
 $Dt = 3, 4, \dots, 10$ (years)

The reason that Dt is 1 to 10 years is that, the productive age of a cow is normally 10 years, so after this time the breeding stocks will be culled.

$TFBS_{(t+Dt)}$ = Total simulated female breeding stock of different ages in a current year

The grand total number of female breeding stock is the sum of three sources of beef, dairy and buffalo for the current year.

The rest of population components such as male breeding stock, female breeding stock, male calves and female calves would be calculated as such.

Slaughter

The total slaughtered (SLT) number is calculated from the sum of number of slaughter breeding stock (male and female), calf-crop (male and female) of beef cattle, dairy cattle and buffalo.

Equation (7) determines the slaughtered female breeding stock, male breeding stock, female calves, and male calves, for beef cattle, dairy cattle and buffalo population combined.

The equation:

$$SL_{(t+Dt)} = SFBS_{(t+Dt)} + SMBS_{(t+Dt)} + SFC_{(t+Dt)} + SMC_{(t+Dt)} \quad (7)$$

Where,

$SL_{(t+Dt)}$ = Current number of beef population (beef /dairy/buffalo) come to slaughter

$SFBS_{(t+Dt)}$ = Current number of slaughtered female breeding stock

$SMBS_{(t+Dt)}$ = Current number of slaughtered male breeding stock

$SFC_{(t+Dt)}$ = Current number of slaughtered female calves

$SMC_{(t+Dt)}$ = Current number of slaughtered male calves

From VASIMM model, total slaughter is the sum of slaughtered beef cattle, dairy cattle and buffalo.

The following equations define the structure of the system:

$$SFBS_{(t+Dt)} = S_1 \times FBS_{(t+Dt)} \quad (8)$$

Where,

$FBS_{(t+Dt)}$ = Number of female breeding stock
 S_1 = Slaughter rate

The total number of slaughtered female breeding stock is generated by multiplying number of female breeding stock at annual slaughter rate (S_1).

$$SMBS_{(t+Dt)} = S_2 \times MBS_{(t+Dt)} \quad (9)$$

Where,

$MBS_{(t+Dt)}$ = Number of male breeding stock
 S_2 = Slaughter rate

The total number of slaughtered male breeding stock is generated by multiplying number of male breeding stock at annual slaughter rate (S_2).

$$SFC_{(t+Dt)} = S_3 \times FC_{(t+Dt)} \quad (10)$$

Where,

$FC_{(t+Dt)}$ = Number of male breeding stock
 S_3 = Slaughter rate

The total number of slaughtered female calves is generated by multiplying number of female calves at annual slaughter rate (S_3).

$$SMC_{(t+Dt)} = S_4 \times MC_{(t+Dt)} \quad (11)$$

Where,

$MC_{(t+Dt)}$ = Number of male breeding stock
 S_4 = Slaughter rate

The number of slaughtered male calves is generated by multiplying number of male calves at annual slaughter rate (S_4).

Fresh Beef Production Component

To calculate the production of fresh beef from buffalo, the recorded number of buffalo for slaughter is multiplied by 1.20 as a correction factor for unrecorded slaughtering and by 0.181 for the meat conversion factor. The correction and conversion factors have been put forward and used by Department of Veterinary Services (DVS) for estimating the fresh beef production from cattle and buffalo (Sarmin, 1998).

The total amount is calculated from the sum of the three sources such as beef cattle, dairy cattle and buffalo for current year.

The equation:

$$\begin{aligned} PROD_{(t+Dt)} &= (SLC + SLD) \times 1.23 \times 0.114 \\ &+ (SLB \times 1.2 \times 0.181) \end{aligned} \quad (12)$$

Or

$$\begin{aligned} PROD_{(t+Dt)} &= (SLC + SLD) \times 0.14 + SLB \times 0.22 \end{aligned} \quad (12)$$

Where,

$PROD_{(t+Dt)}$ = Total fresh beef from beef, cattle and buffalo

SLC = Slaughtered beef cattle

SLD = Slaughtered dairy cattle

SLB = Slaughtered buffalo

Data Collection

The actual data from 1960-2006 on the number of beef population, slaughter, production, consumption and import of live animal and beef, and beef price have been collected from various secondary sources.

These sources are as follows:

- i. The Livestock Statistics published by the Veterinary Services Department,
- ii. The Statistical Year Book of Malaysia
- iii. Eight Malaysian Plan (2001-2005)
- iv. Ninth Malaysian Plan (2006-2010)
- v. Internet: <http://agrolink.moa.my/jph>

RESULTS AND DISCUSSION

In this study, Vintage Approach Simulation Model (VASIMM) was developed by applying different policy variables (i.e. calving, slaughter, replacement and mortality rate). The ex-post VASIMM simulation analysis was developed and verified by statistical tests (RMSE, RMSPE, and U-Theil's inequality coefficient). Nine Scenarios were defined using different policy variables, in order to examine the level of self-sufficiency under each Scenario. The Scenarios are summarized in Table 1.

Table 1 shows the range of different rates that was applied to each Scenario and the number of imported female breeding stock and cattle in each year. Scenario 1, describes the current situation of Malaysian fresh beef production without any policy intervention to increase beef production. The production and level of self-sufficiency would remain low and the Scenario would result in a loss in the long run. However, by importing female breeding stock in Scenario 2 and by applying the same rates of calving, mortality, and slaughter as like in Scenario 1, the total fresh beef production and self-

sufficiency level can be improved, but it cannot reach the optimal level expected by 2020. Therefore it is not economically feasible.

Scenario 3 discusses improvement in the management system of fresh beef production, by reducing slaughter and mortality rate, and improving calving rate. The results showed that under Scenario 3, many countries (eg) including Malaysia will be able to hit the targeted level of 40% self-sufficiency in beef production. In addition, this Scenario is economically accepted.

In Scenario 4 the impact of weak management system is examined, via the decrease in calving rate and increase in mortality and slaughter rate. The result was crystal clear, meaning that the self-sufficiency level will decrease to 10% and the production would also remain very low.

Scenario 5, Scenario 6, Scenario 7, and Scenario 8 are similar to Scenario 1, Scenario 2, Scenario 3, and Scenario 4 with the adding of imported live animals for slaughter in each scenario. The results of Scenario 5 to 8 show that none of the Scenarios are economically feasible although Scenario 6 and Scenario 7 can reach and exceed the optimal level of self-sufficiency (40.07% and 58.57%, respectively) as expected by 2020.

Scenario 9 examines the impact of sudden large number of importation of beef cattle female breeding stock in fresh beef production and the level of self-sufficiency. The results indicate that in spite of reaching the 40% self-sufficiency level by 2020, the Scenario is not economically feasible.

TABLE 1
The Assumptions of Ex-Ante simulation Analysis for Different Scenarios in Peninsular Malaysia, 2010-2020.

	Mortality Rate (%)	Slaughter Rate (%)	Calving Rate (%)	Replacement Rate (%)	Importation (Heads/Year) From 2010-2020
Scenario 1	5-10	10-20	70-75	80	—
Scenario 2	5-10	10-20	70-75	80	10,000 BFBS 500 DFBS 500 BUFBS
Scenario 3	3-4	5-10	75-78	80	10,000 BFBS 500 DFBS 500 BUFBS
Scenario 4	5-10	10-20	55-60	80	10,000 BFBS 500 DFBS 500 BUFBS
Scenario 5	5-10	10-20	70-75	80	10,000 Beef cattle for SL 500 Buffalo for SL
Scenario 6	5-10	10-20	70-75	80	10,000 BFBS 500 DFBS 500 BUFBS 10,000 Beef cattle for SL 500 Buffalo for SL
Scenario 7	3-4	5-10	75-78	80	10,000 BFBS 500 DFBS 500 BUFBS 10,000 Beef cattle for SL 500 Buffalo for SL
Scenario 8	5-10	10-20	55-60	80	10,000 BFBS 500 DFBS 500 BUFBS 10,000 Beef cattle for SL 500 Buffalo for SL
Scenario 9	5-10	10-20	70-75	80	50,000 BFBS only in 2010, 2011, 2012 500 DFBS 500 BUFBS

However, Scenario 9 is estimated to have the lowest negative value of NPW as compared to other Scenarios, meaning that with the improvement in management system (i.e. reducing slaughter and mortality rates), this Scenario appears to be most acceptable economically.

As stated earlier, the consumption amount of beef in terms of metric tons for

each year from 2007 to 2020 was calculated by applying the 2% increase rate of the population growth to the consumption of its previous year.

Table 2 describes the amount of fresh beef production in different Scenarios. As can be seen in all Scenarios except Scenario 4, the fresh beef production of beef has increased. The highest increase in the total

TABLE 2
Total Fresh Beef Production Under Different Scenarios in Peninsular Malaysia, MT, 2007-2020.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
2007	24,937	24,937	25,590	22,927	24,937	24,937	25,590	22,927	24,937
2008	25,920	25,920	26,707	21,869	25,920	25,920	26,707	21,869	25,920
2009	27,304	27,304	28,294	20,812	27,304	27,304	28,294	20,812	27,304
2010	26,548	26,548	30,371	18,640	28,681	28,681	32,504	20,773	32,220
2011	27,623	27,828	33,540	17,425	31,888	32,091	37,803	21,689	45,588
2012	28,272	28,871	35,665	17,246	34,667	35,266	42,061	23,642	51,655
2013	26,985	28,002	37,109	15,433	35,513	36,529	45,637	23,961	58,197
2014	29,670	31,736	43,242	16,436	40,329	42,395	53,901	27,095	55,820
2015	31,552	34,711	48,966	16,417	44,342	47,502	61,756	29,208	58,607
2016	32,712	37,162	54,387	16,711	47,634	52,085	69,309	31,634	60,812
2017	32,874	38,706	59,209	16,295	49,927	55,761	76,264	33,349	62,949
2018	31,465	38,169	61,074	15,489	50,651	57,356	80,261	34,674	65,531
2019	35,229	44,772	73,701	17,117	56,547	66,090	95,019	38,435	68,110
2020	36,648	48,484	81,698	17,917	60,098	71,935	105,147	41,368	71,833

TABLE 3
Level of Self-Sufficiency and Net Present Worth (NPW), Under Different Scenarios in Peninsular Malaysia, (%), 2007-2020.

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9
2007	17.97	17.97	18.44	16.52	17.97	17.97	18.44	16.52	18
2008	18.31	18.31	18.87	15.45	18.31	18.31	18.87	15.45	18.31
2009	18.91	18.91	19.6	14.41	18.91	18.91	19.6	14.41	18.91
2010	18.03	18.03	20.62	12.66	19.47	19.47	22.07	14.11	21.9
2011	18.39	18.53	22.33	11.6	21.23	21.36	25.17	14.44	30.35
2012	18.45	18.84	23.28	11.26	22.63	23.02	27.45	15.43	33.71
2013	17.27	17.92	23.74	9.87	22.72	23.37	29.2	15.33	37.24
2014	18.61	19.91	27.13	10.31	25.3	26.59	33.81	17	35.02
2015	19.4	21.35	30.11	10.1	27.27	29.21	37.98	17.96	36.04
2016	19.72	22.41	32.79	10.08	28.72	31.4	41.79	19.07	36.7
2017	19.43	22.88	35	9.63	29.51	32.96	45.08	19.71	37.21
2018	18.24	22.12	35.39	8.98	29.35	33.24	46.51	20.09	38
2019	20.02	25.44	41.87	9.73	32.13	37.55	53.99	21.84	38.7
2020	20.41	27.01	45.51	9.98	33.48	40.07	58.57	23.04	40.01
NPW	-1,874,176.2	-1,026,994	740,363.4	-2,345,943	-1,324,631.9	-917,157	-591,355.5	-1,625,436	-381,088
RM '000									

fresh beef production belongs to Scenario 3 and Scenario 7 with 81,698 and 105,147 metric tons production while the least is dedicated to Scenario 4 and Scenario 1 with 17,917 and 36,648 metric tons production, respectively.

Table 3 illustrates the level of self-sufficiency under different Scenarios of this study. It can be inferred that in all Scenarios, the self-sufficiency level has increased except for Scenario 4. Only Scenario 3, Scenario 6, Scenario 7 and Scenario 9 can reach the targeted levels of self sufficiency by 2020, which are 45.51%, 40.07%, 58.57% and 40.01%, respectively.

Table 3 also depicts the value of Net Present Worth (NPW) for the 9 Scenarios. The only economically acceptable Scenario would be Scenario 3 in which the value of NPW is positive (RM 740,363.4 thousand). In Scenario 6 and 9 despite the 40% level of self-sufficiency, the Scenarios are not economically feasible since the NPW is negative (RM -591,355.5 thousand and RM -381,088 thousand, respectively). Moreover, as indicated in Scenario 7 in spite of exceeding the targeted level of self-sufficiency (i.e. 58.57%) by 2020, the Scenario would not be accepted economically.

The above discussion is based on different assumptions and scenarios as a key policy or decision variables and there is no preference toward any one scenario. We can thus simulate several other scenarios that could generate results which may be either favorable or unfavorable to the targeted self-sufficiency level.

SUMMARY AND CONCLUSION

The VASIMM model used in this study is a dynamic model which represents the real system. It can be also applied for any different Scenario, based on the decision or policy variables that have been put forward, assuming that the management system is in place. The key policy variables employed as a management decision tool in the VASIMM model dynamic system are mortality rate, calving rate, culling rate, breeding stock importation rate, slaughter rate, and replacement rate. It depends on the policy makers where the industry should head from here in targeting the level of self-sufficiency and food security issues. Given the right assumption based on the real situation and effective management systems, and by improving the key policy variables, there is a possibility for Malaysian beef industry to be at least 50% or more self-sufficient in fresh beef production in the near future.

To conclude, based on the achieved results in this study, it can be understood that Malaysia would be able to reduce its dependency on beef importation if the proper policy actions are taken by the government. This study recommends the following solutions for policy makers in order to boost fresh beef production and as a result, the self-sufficiency level.

Firstly, the importation of the female breeding stock should be increased in order to save foreign exchange in importing frozen beef from other countries. On the other hand, the female breeding stock importation would increase the cattle population for slaughter

and ultimately fresh beef production. Secondly, the management system must be improved by lowering the rate of mortality and increasing calving rate. This would necessitate the improvement in training programs and level of education of farmers. Also the cattle rearing activity should be diverted to integrated farms instead of smallholders. Finally, the Government should reduce fresh beef importation, especially from the low cost countries such as India, in order to encourage local producers to enhance their production, and as a result there must be a consistent pricing policy so that the benefit gained by local producers becomes considerable.

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