UNIVERSITI PUTRA MALAYSIA

ANALYSIS OF PERFORMANCE OF BEEF SUB-SECTOR IN PENINSULAR MALAYSIA

ANAHITA HOSSEINI MATIN

FP 2009 5

ANALYSIS OF PERFORMANCE OF BEEF SUB-SECTOR IN PENINSULAR MALAYSIA

By

ANAHITA HOSSEINI MATIN

© COPYRIGHT UPM

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

August 2009

Dedication

To

My Father, Mother, and Brother

Heavenly Angels of my life

For their forever unconditional love, support, encouragement and patience through all these years of my life, no matter how wild I have acted or how huge I have made mistakes.

I am always proud to be your daughter.

© COPYRIGHT UPM

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

ANALYSIS OF PERFORMANCE OF BEEF SUB-SECTOR IN PENINSULAR MALAYSIA

By

ANAHITA HOSSEINI MATIN

August 2009

Chairman: Associate Professor Zainal Abidin Mohamed, PhD

Faculty : Agriculture

Food production is not keeping pace with food demand. Growth in food production is consistently falling behind population growth making food shortages a recurrent problem. On the other hand, global financial crisis necessitates that world countries reach certain level of self-sufficiency in producing basic commodities. In Malaysia, the production of fresh beef is not enough to answer the people's need, either as food security reasons or to increase self-sufficiency level for the country. 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. The objectives of this study is to develop a Model for beef policy analysis in order to investigate the future trend of beef self sufficiency level in Malaysia via biological and mathematical simulation beef model, to

© COPYRIGHT UPM

develop a beef production system modeling for policy analysis, to predict the beef supply trend in future plans, and to analyze the benefit/cost of implementing alternative policy in increasing beef production in Malaysia.

Vintage approach simulation matrix model (VASIMM) was used to analyze the objectives of the study. The VASIMM method uses aggregate data on bringing the new breeding stock into the model, reproduction of existing breeding stocks, and culling rate, to derive a theoretical slaughter system based on different rates of calving, replacement, mortality, and slaughter in the past, as reduction rates to system simulation, and simulate the final results of female breeding stocks, male breeding stocks, female calves, male calves, slaughter, and production of beef cattle, dairy cattle, and buffalo. The ex-post simulation analysis was applied for 1960-2006 period, and the model was validated using RMSE, RMSPE, and U-Theil inequality coefficient, as the base model of ex-ante simulation model. The ex-ante simulation analysis was developed by examining different policy variables, such as mortality, slaughter, and calving rate, importation of female breeding stocks, and importation of animal for slaughter, in 9 different Scenarios. Scenario 1 depicts the current situation of fresh beef production in Malaysia without any breeding stock importation. Scenario 2 assumes that all management variables (mortality rate, slaughter rate, etc) are the same as in Scenario 1, but there are 10,000 heads of female breeding stock importation. In Scenario 3, apart from the importation of female breeding stock, the management is also improved. Scenario 4 investigates the poor management system of the industry while Scenario 5 analyzes the effects of importing 10,000 heads of

© COPYRIGHT UPM

beef cattle and buffalo for slaughter under the current situation. Scenarios 6, 7, and 8 are similar to Scenarios 2, 3, and 4 respectively, but the importation of beef cattle and buffalo for slaughter is added to each of them. Lastly, Scenario 9 investigates what changes in the current situation of fresh beef production would be if 50,000 heads of female breeding stock are imported in 2010, 2011, and 2012.

Amongst these 9 Scenarios, only Scenario 3 is economically applicable in long run, and can fulfill the targeted level of self-sufficiency (40%) by 2020. The results of positive Net Present Worth (NPW) and 45% level of self sufficiency under the following conditions of 3-4% mortality rate, 5-10% slaughter rate, 75-78% calving rate, importation of 10,000 heads Beef cattle, 500 heads Dairy cattle, and 500 heads Buffalo female breeding stock/year by 2010, respectively, indicate that under Scenario 3, in long run Malaysia can be independent on fresh beef importation. While, the negative value of NPW and low level of self sufficiency in Scenario 1, 2 , 4, 5, and 8 makes these Scenarios inapplicable. In Scenarios 6, 7 and 9, although the level of self sufficiency in beef production will be reached to the target and even exceed the target, the negative value of NPW depicts that Scenario 6, 7 and 9 are not economically feasible.

The simulated results indicate that Malaysia can boost its fresh beef production by increasing importation of female breeding stock, and improving the management system by reducing the rate of mortality and slaughter, and

© COPYRIGHT UPM

increasing the rate of calving, so that Malaysia would be independent on beef production in the near future.

© COPYRIGHT UPM

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

ANALISA PRESTASI SUBSEKTOR DAGING LEMBU DI SEMENANJUNG MALAYSIA

Oleh

ANAHITA HOSSEINI MATIN

Ogos 2009

Pengerusi: Profesor Madya Zainal Abidin Mohamed, PhD

Fakultie: Pertanian

Pengeluaran makanan sentiasa tidak dapat memenuhi tahap permintaan terhadapnya. Pertumbuhan dalam pengeluaran makanan selama ini masih jauh lebih rendah berbanding pertumbuhan penduduk menjadikan isu kekurangan makanan suatu masalah berlanjutan. Krisis kewangan global pula memaksa negara-negara di dunia memiliki suatu tahap sara diri tertentu bagi komoditi-komoditi asas yang dikeluarkan. Di Malaysia, pengeluaran daging lembu segar masih lagi tidak mencukupi bagi menampung keperluan penduduk. Tahap sara diri komoditi ini adalah rendah memandangkan industri daging lembu negara tidak dijalankan secara komersil. Terdapat dua faktor yang menyumbang kepada masalah ini iaitu daya produktiviti yang rendah dan kurangnya penglibatan sektor swasta dalam aktiviti pembangunannya. Tujuan utama kajian ini dilakukan adalah bagi membentuk satu model analisa dasar daging lembu yang membolehkan tahap sara diri komoditi ini pada masa hadapan dapat dibuat melalui kaedah

© COPYRIGHT UPM

simulasi matematik dan biologi. Selain itu, kajian ini dibuat untuk membina satu model sistem pengeluaran daging lembu, membuat unjuran corak bekalan daging lembu pada masa hadapan, serta membuat analisa kos dan faedah bagi suatu polisi alternatif baru bertujuan meningkatkan pengeluaran daging lembu.

Dalam kajian ini, model yang dikenali dengan nama *Vintage Approach Simulation Matrix* (VASIMM) digunakan. Model ini membolehkan semua data tentang stok baka baru, pembiakan stok baka sedia ada, dan kadar *culling* dikumpulkan untuk menghasilkan satu sistem penyembelihan teoritikal dengan mengambil kira kadar kelahiran anak-anak lembu, kadar penggantian, kadar kematian, dan kadar penyembelihan pada masa lalu. Analisa simulasi *ex-post* bagi tempoh 1960 hingga 2006 dilakukan dan model ini disahkan melalui kaedah *RMSE, RMSPE*, dan *U-Theil Inequality Coefficient* sebagai model asas bagi model simulasi *ex-ante*. Analisa simulasi *ex-ante* diperkembangkan dengan pelbagai pembolehubah seperti kadar kematian, penyembelihan, dan kelahiran anak lembu, jumlah stok baka lembu betina yang diimport, dan jumlah lembu import untuk disembelih bagi sembilan situasi berlainan (Scenario 1 hingga 9).

Senario 1 menunjukkan keadaan semasa bagi pengeluaran daging lembu segar di Malaysia dengan tiada sebarang import stok pembiakan dilakukan. Senario 2 membuat andaian bahawa semua pembolehubah pengurusan (kadar kematian, kadar penyembelihan dan lain-lain) adalah sama seperti Senario 1, tetapi terdapat import stok baka lembu betina sebanyak 10,000

© COPYRIGHT UPM

ekor. Dalam Senario 3, selain daripada import stok baka lembu betina, tahap pengurusan juga dipertingkatkan. Senario 4 menyelidiki keadaan pengurusan yang lemah bagi industri ini manakala Senario 5 pula mengkaji kesan pengimportan 10,000 ekor lembu dan kerbau bagi tujuan penyembelihan dalam keadaan sekarang. Senario 6, 7, dan 8 adalah sama seperti Senario 2, 3, dan 4 masing-masing tetapi terdapat import lembu dan kerbau yang dibuat bagi setiap satunya. Akhir sekali, Senario 9 menyiasat perubahan yang akan berlaku terhadap industri pengeluaran daging lembu segar sekiranya 50, 000 ekor baka lembu betina diimport pada tahun 2010, 2011, dan 2012.

Antara kesemua sembilan situasi ini, didapati hanya Scenario 3 dapat digunakan dalam jangka masa panjang dan mampu mencapai tahap sara diri yang disasarkan pada tahun 2020 iaitu 40%. Nilai Semasa Bersih (*NPW*) NPW bagi Scenario 3 adalah positif dan tahap sara diri yang dicapai adalah 45%. Keadaan-keadaan yang terlibat bagi Scenario 3 adalah: kadar kematian (3-4%), kadar penyembelihan (5-10%), kadar kelahiran anak lembu (75-78%), bilangan baka lembu pedaging import setahun (10,000 ekor), bilangan baka lembu tenusu import setahun (500 ekor), dan bilangan baka kerbau *FBS* setahun (500 ekor). Keputusan yang dicapai ini membolehkan negara Malaysia tidak lagi perlu bergantung pada daging lembu import segar dalam jangka masa panjang. Lima lagi situasi (Scenario 1, 2, 4, 5, dan 8) tidak dapat diterima kerana kesemuanya menghasilkan nilai NPW yang negatif dan tahap sara diri yang rendah. Sementara itu, Scenario 6, 7 dan 9 pula menghasilkan tahap sara diri yang lebih tinggi daripada yang

© COPYRIGHT UPM

disasarkan. Namun begitu, nilai NPW yang dicapai oleh kedua-duanya adalah negatif.

Berdasarkan pada keputusan-keputusan simulasi yang dibuat, negara Malaysia mampu meningkatkan pengeluaran daging lembu segar dengan menambahkan jumlah import stok baka lembu betina. Sistem pengurusan juga mesti diperbaiki bagi mengurangkan kadar kematian dan kadar penyembelihan lembu manakala kadar kelahiran anak lembu pula perlu ditingkatkan. Sekiranya semua ini dapat dicapai, negara Malaysia pasti mampu mengeluarkan daging lembu sendiri dengan secukupnya pada masa akan datang.

© COPYRIGHT UPM

ACKNOWLEDGEMENTS

My utmost thanks go to Allah almighty who gave me the will-power, strength, and ability to complete this challenging task. The following thesis, while an individual work, benefited from the insights and direction of several people.

First, I would like to express my profound gratitude and sincere appreciation to my supervisor, Associate Professor Dr. Zainal Abidin Mohamed for his motivation, guidance, inspiration and useful suggestions throughout the period of this research by providing timely and instructive comments and evaluation at every stage of the thesis process, allowing me to complete this thesis on schedule. I am grateful for his constructive criticisms and his comments on this study and his invaluable contribution and direction in preparing this thesis which enriched this study. Without his tireless assistance, leadership, and confidence in my abilities, this project would not have been possible. Working beside him was extremely demanding and challenging, and helped me significantly to get my best intellectual shape. Prof, your help and your personal knowledge enabled this research to see the light of the day. I should say confidently that this kind of supervisor is definitely the types of mentors, advisors, friends, and gurus that every graduate student should be lucky enough to have.

In addition to technical and instrumental assistance above, I received equally the invaluable support and friendship from him and his wife during my crises moments and understanding when things did not go too smoothly which is a

© COPYRIGHT UPM

precious gift to my life. Prof you made feel as if I have a real second father in Malaysia and you treated me like your own daughter. If I thank you a million times, this would not be enough.

My sincere appreciation is also extended to my graduate committee members, Associate Prof. Dr. Mohd Mansor bin Ismail, and Dr. Nitty Hirawaty Kamarulzaman, for their constant interest, constructive criticisms and recommendations for this study which have greatly improved this work.

Grateful acknowledgement is also expressed to Dr. Abdullahi Farahi Ahmad who help me in my estimation section via E-views software and also so many other fruitful and outstanding guidance. I am grateful for his assistance and constructive comments.

My deepest gratitude goes to my parents for their unconditional love and sacrifices, and my younger brother for his love and support who deserve much of the credit for my completion of this degree. I appreciate their patience, understanding, encouragement and faith in me for sending me to Malaysia. To my father and mother, thank you for being such an inspiring role model, even in the most disappointing moments you two said “Stay and Win. Never allow life to defeat you”. I do not know how to express my appreciation for all your support and for allowing me to follow my dreams. I only hope I can be as good of a parent as you have been to two of us. Mom ,dad, Thank you for letting your young chick stands on her own two feet and challenge the life by herself. I tried my best not to let you down, and my flat 4 GPA and this

© COPYRIGHT UPM

thesis are the only gifts I can grant you, however, I know that nothing can be equal to the sacrifices you made for me such as the anxiety and deep sadness you have while I am not beside you.

My deepest appreciation and love, also goes to Ali who stuck by me through the good and the bad times. It was comforting to know that I had his unconditional love and support during this period. Ali, you will never know how much your love and friendship means to me. Words can not express the love and appreciation I feel for you. Thanks for everything.

I would like to express my gratitude to each and every one of the members of agriculture faculty, and staff in the Department of Agribusiness and Information System that made these years very rewarding in knowledge, experience, and friendship. There are a number of lecturers whom I took part in their classes and those whom I was lucky enough to receive their general advice both technical and life matters. Thanks are addressed to Prof. Ghazali, Prof. Ariff, Prof. Zubaidi, Prof. Eddy, Prof. Mad Nasir, Dr. Law, Dr.Zaleha, Dr. Amin, Dr. Norsida, and Dr. Ismail.

During my research, I was able to interact with many great people whom have bestowed me with their friendship and advice for which I am extremely grateful. They have shared with me their true friendship, trust in one another, and faith, including, my classmates, my dearest friends (M. Nicksiar, M. Mahmoodi, Dr. Golnaz Rezaee, Dr. Majid Sanaei, Pooya, Roya, Mahzad, Azadeh, Leila, Ila, Intan, Zuri, Shinta, Lina, Anita, Shri Dewi, and many other

© COPYRIGHT UPM

fellows). All those people have created an affectionate environment that I will never forget. I am very fortunate for having had the chance to meet excellent friends at UPM. A very special thank you is extended to my childhood forever friends Mitra, Paria and Neda and my so-called daddy Dr. Kamran Fekri, for their invaluable friendship and love.

Last, but not certainly least, I would like to express my special thanks to all the people I have met in Malaysia with light hearted hours of entertainment they provided for me during my stay. These people have shared their lives and knowledge with me, allowing me to gain a better understanding of the life itself. They have enlarged my horizon and have helped me to be a more open-minded person.

© COPYRIGHT UPM

I certify that an Examination Committee met on August 2009 to conduct the final examination of Anahita Hosseini Matin on her Master of Science thesis entitled “Analysis of Performance of Beef Sub-Sector in Peninsular Malaysia” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Ismail Abd. Latif, PhD
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Abdullahi Farah Ahmed, PhD
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Norsida Man, PhD
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Abu Hassan Md. Isa, PhD
Professor
Faculty of Economics and Business
Universiti Malaysia Sarawak
(External Examiner)

_____

HASANAH MOHD GHAZALI , PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

© COPYRIGHT UPM

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Zainal Abidin Mohamed, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Mohd Mansor Ismail, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Nitty Hirawaty Kamarulzaman, PhD
Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

_____

HASANAH MOHD GHAZALI, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 16 October 2009

© COPYRIGHT UPM

TABLE OF CONTENTS

		Page
DEDICATION		ii
ABSTRACT		iii
ABSTRAK		vi
ACKNOWLEDGEMENTS		x
APPROVAL		xiv
DECLARATION		xvi
LIST OF TABLES		xix
LIST OF FIGURES		xxiii
LIST OF ABBREVIATIONS		xxviii
CHAPTER		
1	**INTRODUCTION**	1.1
	1.1 Agriculture Sector in Malaysia	1.1
	1.2 Livestock Industry in Malaysia	1.7
	1.2.1 The Importance of Livestock Industry in Malaysia	1.10
	1.2.2 Livestock Production	1.12
	1.2.3 Livestock Consumption	1.14
	1.2.4 Level of Self-Sufficiency	1.17
	1.2.5 Import of Livestock Products	1.17
	1.2.6 Cattle and Buffalo Population Trend	1.22
	1.3 The Third National Agricultural Policy 1998-2010 (NAP3)	1.25
	1.3.1 NAP3 and Livestock	1.28
	1.4 National Feedlot Corporation (NFC)	1.29
	1.5 Problem Statement	1.32
	1.6 Objectives of the Study	1.34
	1.7 Significance of the Study	1.35
2	**LITERATURE REVIEW**	2.1
	2.1 Simulation and Simulation Modeling	2.1
	2.1.1 Historical Studies on Simulation Models in The World	2.4
	2.1.2 Recent Studies on Simulation Models in The World	2.16
	2.1.3 Studies of Simulation Models in Malaysia	2.34
	2.2 Studies of Cost-Benefit Analysis in Simulation Models	2.39
	2.3 Conclusions	2.44
3	**METHODOLOGY**	3.1
	Introduction	3.1
	3.1 Conceptual Framework	3.3
	3.2 Model Specification (The Formulation of a Mathematical	3.8

© COPYRIGHT UPM

Model)
3.2.1 Beef Population Distribution Component 3.16
3.2.2 Slaughter and Beef Production Component 3.24
3.2.3 Beef Production and Consumption Component 3.28
3.2.4 Management Decision Making Component 3.29
3.3 Data Collection 3.33
3.4 Estimation Procedures 3.33
3.5 Model Validation 3.35
3.5.1 Ex-post Simulation Validation Procedure (Statistical Test) 3.36
3.6 Conclusion 3.39

4 RESULTS AND DISCUSSION 4.1
4.1 Ex-post Simulation and Validation Analysis for Beef Cattle, Dairy Cattle, and Buffalo 4.1
4.1.1 Beef Population Distribution Component 4.1
4.1.2 Dairy Cattle Population Distribution Component 4.8
4.1.3 Buffalo Population Distribution Component 4.16
4.1.4 Slaughter and Beef Production Component 4.23
4.2 Ex-ante Simulation Analysis by Applying Different Scenarios 4.29
4.2.1 Ex-ante Simulation Analysis Under Scenario1 4.31
4.2.2 Ex-ante Simulation Analysis Under Scenario 2 4.40
4.2.3 Ex-ante Simulation Analysis Under Scenario 3 4.49
4.2.4 Ex-ante Simulation Analysis Under Scenario 4 4.59
4.2.5 Ex-ante Simulation Analysis Under Scenario 5 4.68
4.2.6 Ex-ante Simulation Analysis Under Scenario 6 4.73
4.2.7 Ex-ante Simulation Analysis Under Scenario 7 4.77
4.2.8 Ex-ante simulation analysis under Scenario 8 4.82
4.2.9 Ex-ante Simulation Analysis Under Scenario 9 4.86

5 SUMMARY, CONCLUSIONS AND RECOMMENDATION 5.1
5.1 Introduction 5.1
5.2 Model Specification and Policy Implications 5.1
5.3 Limitations of the Study 5.9
5.4 Recommendations 5.10

REFERENCES R.1
APPENDICES A.1
BIODATA OF THE STUDENT B.1

© COPYRIGHT UPM

LIST OF TABLES

Table		Page
1.1	Economic Role of Agriculture Sector in Malaysia 1970- 2007 (%)	1.3
1.2	Employment and Value Added Per Worker in Agriculture and Agro-Based Industry, 2000- 2010	1.5
1.3	Value Added of Agriculture and Agro- Based Industry (2000-2010)	1.6
1.4	Self-Sufficiency Level of Beef, Mutton, Pork and Poultry, (%), 1996-2006	1.18
1.5	The Imported Livestock Population in Peninsular Malaysia, (Heads), 1990-2006	1.20
1.6	Import of Livestock 1990 – 2006	1.21
4.1	Ex-post Simulation Analysis of Beef Cattle Female Breeding Stock in Peninsular Malaysia, Heads; 1970 - 2006	4.2
4.2	Ex-post Simulation Analysis of Beef Cattle Male Breeding Stock in Peninsular Malaysia, Heads; 1970 - 2006	4.4
4.3	Ex-post Simulation Analysis of Beef Cattle Female Calves in Peninsular Malaysia, Heads; 1970 - 2006	4.6
4.4	Ex-post Simulation Analysis of Beef Cattle Male Calves in Peninsular Malaysia, Heads; 1970 - 2006	4.7
4.5	Ex-post Simulation Analysis of Dairy Cattle Female Breeding Stock in Peninsular Malaysia, Heads; 1970 - 2006	4.9
4.6	Ex-post Simulation Analysis of Dairy Cattle Male Breeding Stock in Peninsular Malaysia, Heads; 1970 - 2006	4.11
4.7	Ex-post Simulation Analysis of Dairy Cattle Female Calves in Peninsular Malaysia, Heads; 1970 - 2006	4.13
4.8	Ex-post Simulation Analysis of Dairy Cattle Male Calves in Peninsular Malaysia, Heads; 1970 - 2006	4.15
4.9	Ex-post Simulation Analysis of Buffalo Female Breeding Stock in Peninsular Malaysia, Heads; 1970 - 2006	4.17
4.10	Ex-post Simulation Analysis of Buffalo Male Breeding Stock in	4.18

© COPYRIGHT UPM

Peninsular Malaysia, Heads; 1970 - 2006
4.11 Ex-post Simulation Analysis of Buffalo Female Calves in Peninsular Malaysia, Heads; 1970 - 2006 4.20

4.12 Ex-post Simulation Analysis of Buffalo Male Calves in Peninsular Malaysia, Heads; 1970 - 2006 4.22

4.13 Ex-post Simulation Analysis of Beef Slaughter in Peninsular Malaysia, Heads; 1970 – 2006 4.24

4.14 Ex-post Simulation Analysis of Buffalo Slaughter in Peninsular Malaysia, Heads; 1970 – 2006 4.26

4.15 Ex-post Simulation Analysis of Total Fresh Beef Production in Peninsular Malaysia, Metric Tonnes; 1970 – 2006 4.28

4.16 Assumptions of Ex-Ante simulation Analysis in Different Scenarios in Peninsular Malaysia, 2010-2020 4.30

4.17 Ex-ante Simulation Analysis for Beef Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 1 4.32

4.18 Ex-ante Simulation Analysis for Dairy Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 1 4.34

4.19 Ex-ante Simulation Analysis for Buffalo Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 1 4.35

4.20 Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 1 4.37

4.21 Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM'000, 2010-2020, Scenario 1 4.39

4.22 Ex-ante Simulation Analysis for Beef Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 2 4.41

4.23 Ex-ante Simulation Analysis for Dairy Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 2 4.43

4.24 Ex-ante Simulation Analysis for Buffalo Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 2 4.44

4.25 Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 2 4.46

4.26 Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, 4.49

© COPYRIGHT UPM

RM'000, 2010-2020, Scenario 2

4.27 Ex-ante Simulation Analysis for Beef Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 3 4.51

4.28 Ex-ante Simulation Analysis for Dairy Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 3 4.52

4.29 Ex-ante Simulation Analysis for Buffalo Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 3 4.54

4.30 Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 3 4.56

4.31 Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM'000, 2010-2020, Scenario 3 4.58

4.32 Ex-ante Simulation Analysis for Beef Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 4 4.60

4.33 Ex-ante Simulation Analysis for Dairy Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 4 4.62

4.34 Ex-ante Simulation Analysis for Buffalo Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 4 4.64

4.35 Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 4 4.65

4.36 Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM'000, 2010-2020, Scenario 4 4.67

4.37 Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 5 4.70

4.38 Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM'000, 2010-2020, Scenario 5 4.72

4.39 Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 6 4.74

4.40 Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM'000, 2010-2020, Scenario 6 4.77

4.41 Ex-ante Simulation Analysis for Slaughter, Production, and 4.79

© COPYRIGHT UPM

	Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 7	
4.42	Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM'000, 2010-2020, Scenario 7	4.81
4.43	Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 8	4.84
4.44	Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM'000, 2010-2020, Scenario 8	4.86
4.45	Ex-ante Simulation Analysis for Beef Cattle Population in Peninsular Malaysia, (Heads), 2007-2020, Scenario 9	4.88
4.46	Ex-ante Simulation Analysis for Slaughter, Production, and Consumption Component in Peninsular Malaysia, 2007-2020, Scenario 9	4.90
4.47	Cost-Benefit Analysis of Beef Production in Peninsular Malaysia, RM '000, 2010-2020, Scenario 9	4.92
5.1	The Assumptions of Ex-Ante simulation Analysis and Net Present Worth (NPW) for Different Scenarios in Peninsular Malaysia, 2010-2020	5.2
5.2	Total Fresh Beef Production Under Different Scenarios in Peninsular Malaysia, MT, 2007-2020	5.5
5.3	Level of Self-Sufficiency and Net Present Worth (NPW), Under Different Scenarios in Peninsular Malaysia, MT, 2007-2020.	5.8
A.1.1	The Production of Beef, Mutton, Pork and Poultry in Peninsular Malaysia, 1960-2006	A.1
A.1.2	The Consumption of Beef, Mutton, Pork and Poultry in Peninsular Malaysia, 1960-2006	A.2
A.3.1	Beef Cattle Population By Age and Sex in Peninsular Malaysia, (Heads), 1960-2006	A.3
A.3.2	Dairy Cattle Population By Age and Sex in Peninsular Malaysia, (Heads), 1960-2006	A.4
A.3.3	Buffalo Population By Age and Sex in Peninsular Malaysia, (Heads), 1960-2006	A.5
A.3.4	Number of Cattle and Buffalo for Slaughter in Peninsular Malaysia, (Heads), 1960-2006	A.6

© COPYRIGHT UPM