A BEEF FATTENING DECISION SUPPORT SYSTEM

SHANMUGAVELU S.¹, WAN ZAHARI M.², WONG H.K.¹ AND MARDHATI M.¹

¹ Malaysian Agricultural Research and Development Institute, MARDI, Serdang, Selangor.

² Universiti Malaysia Kelantan, Pengkalan Chepa, Kota Bharu, Kelantan. shan@mardi.gov.my

ABSTRACT. A beef feedlot production decision support system (DSS) was developed based on Microsoft® Excel. The DSS comprises of three modules i) an ingredient database ii) a least-cost ration formulation module and iii) beef growth simulation module. The program uses empirical equations developed for tropical beef to simulate nutrient requirements and daily body weight gains based on the formulated feed ration. The formulated least cost ration can be pasted automatically the growth model to evaluate into performance and economic viability. The growth model calculates nutrient available and computes body weight gain on a daily basis, summates weight gain and stops at the targeted body weight. The data output include i) days to reach target body weight, ii) cumulative feed consumed, iii) anticipated average daily gain, iv) total cost of feed (concentrates and grass), and v) gross profit per cattle. If a portion of the feed is fed as grass, then the model also computes the pasture land required in hectares, based on the forage species chosen. It is anticipated that the developed model can assist cattle entrepreneurs and farmers in the development of the beef cattle industry in Malaysia.

INTRODUCTION

Beef is an important commodity in Malaysia with a per-capita consumption of 5.6 kg. However, only 28% of this requirement is produced locally (DVS, 2010). The main factor that contributes to the low self sufficiency level is the high cost of local beef production. For example, the average cost of local beef for 2010 was RM15.85 compared to RM9.20 for imported beef from India (DVS, 2010). The lack of cheap feed and the inefficient use of available feed resources contribute significantly to the higher cost of production as feed generally comprises 60-70% to the total production cost. Many local beef producers do not have access to information on nutrient values of available feed resources nor the ability to efficiently utilise the resources. This paper describes a beef fattening decision support system that can help improve the efficiency of a beef production enterprise.

MATERIALS & METHODS

A Microsoft[®] Excel based software was developed based on cited publications (NRC, 2000; Leonard, 1982) and beef growth data collected from research conducted in MARDI. The model comprises



Figure 1. Model algorithm

of three modules i) an ingredient database ii) a least-cost ration formulation module and iii) beef growth simulation module. The ingredient data base comprises of nutrient content information of local feed resources. The least cost module utilizes the linear optimization module inbuilt in Microsoft® Excel 2007 for Windows. The beef growth simulation uses empirical equations developed for tropical beef based on research data to simulate nutrient requirements and daily body weight gains. The nutrient requirements for the beef production module are based on Department of Standards Malaysia (Standards Malaysia) (unpublished). Microsoft® Excel 2007 Visual Basic for Application was employed for the beef daily growth simulation module. The program algorithm is shown in Figure 1. Other features incorporated into the model include the options to evaluate two different feed formulations and their growth rate predictions.

RESULTS AND DISCUSSION

The captions of the beef fattening decision support system are shown in Figures 2, 3, 4, 5, 6, 7 and 8 with simple user friendly



Figure 2. Main Screen

legendant	Annual Col	Contig	Tanget body weight (kg)	20	Sec. 14	Arquited	Total Intake	per by head
for the	36.00	4.76	Final ad	20.0	-	26.28	31.15/44	7.45 8.14
PONE (Hy)	25.00	4.34	Event to barged with	915	108	1000.990	2011.1.12	49.79 %
NEPHE	27.00	4.34			CP C	478.67	894.40	11.30 %
bighterst meal (imported)	1.00	1.01	Cam head case (800)	3.0	(Fat		494.05 g	10.40 %
Crepria missat	10.00	4.04	Contraction of the second second	100	Ca	17.30	38.47.8	0.84%
Adapter	3.00	4.85	Anticipated ADG (kg)	0.57	Phon	10.63	10.04 g	0.00%
Deg	.2.90	1.71			Ca P Ratio		3.15	1.21
Let .	1.00	4.36			10000	0.000	1015-101 No. 6	S
CaCO3 (Lineatorie)	110	0.17	Calculated Intakes		Individua	Animal E	conomic Data	L
rk Mee	4.94	2.80						
Mohammere	4.00	0.01	Fed as fed (Fresh)	Amount (hg)	Cattle pers	Name price (F	(MAg)	6.53
Distant Rice	0.00	4.75	Concentrate	4.50	Sale price			. F 34
Roybeast Halls	4.04		Gravet		I wat of the	dei cattis (iit	n .	547 107
Causinia	4.90	8.78			Freed Cost	(IAA)		10.0
FOUR Comparisons	100.000		Citit intake		Total grass	funited (bg.	CAR .	
HESH GRUSS (hg/ding)			Concentrate	4.33	Group profil	in while (Real)		CAPT AN
Bracharia decumberts	4.00	0.017	Grans	0.00	0.000000	100 ACC 100 A	00	
Forest Child (% / Repl	3.66	4.11	Total CRIE (rigi)	4.33	Herd Eco	shomic Dat		
Programman of various		1000	% Budy weight	2.11				
Concentration (No.	194 04	4.33			Tutal manuf	test of califier		14.00
Fresh Grees/Forege (%)	6.00	0.00	Cost of Concentrates	3.30	Total Hand	Gross Prufit	100	43,999,36
fund feed	100.000	4.15	Cost of gross	8.85	Courses prod	County State		14,367.107
			Total load continue (1981)	2.28		of required d		

Figure 3. Growth simulation module

modules. The model enables the user to alter feed ingredients and test different feed combinations based on costs and nutrient requirements and allows the comparison of two types of formulations (Figure 5). The user has the option to alter, add and make changes to the feed ingredient database including the use of grass as a proportion

Noredeal.	Der Chi	Cruster In	-	Page 1	TON	14	C Film	107	No.	NUME.	Did young	Cowi Million	State State	Marie Marie
Services gram	88.29	23.46	1.41	-	64.00	8.94	29.40			0.74	april a state			
lainen Rosa	01.00									0.00		0.75	0.00	40.0
0x00u-0.0m4(store)	83.68	1.00	28.49	0.89	4.00					0.99		9,47	0.00	. 6.0
Carsana	21.68									0.89		0.78	1.08	40.0
Colorett anuthalian	99.00									0.00			0.00	- P.I
Cocioex australia	00.00									0.89		1.1	0.08	- 31
Cognis milear	87.18	21.70			66.10		12.00	43	58	0.98		0.95	0.09	40.1
Céré	87.79	8.30	0.28		87.20	8.26	3.90		81	12.68		0.84	1.08	40.1
Con Silaps	23.96	8.20	4.58	0.29	78.00	3.40	33.80		63	5.99			1.08	100.0
(PO cOnvex Pairs (N))	00.00											2,45	0.00	10.0
009	107.00	6.00	22.09	10.00	9.00							8,40	1.09	
mark tilset	01.00											2,80	0.09	40.0
Groundrall Dailet	00.00											0.85	0.08	30.0
Merchand Brone Merch (MBAC)	83.66											5.94	0.04	40.0
Nomened .	72.00	6.00	1.08	0.71	72.00	0.10	0.00			10.87		0.85	1.09	20.0
CIPH MY	01.00	4.70			26.10		38.00	68	79	0.64		0.30	1.09	30.0
CAPIF for and	20.40	4.79			54.+0		54.50	64	78	6.44		0.96	1.04	36.5
Aug Barrier	81.68	\$4.50	8.84	0.64	94.60	15.66			1.0	18.07		4.94	0.04	80.0
PICARE WINUT	81.18	\$1,70	0.76	0.56	48.00	12.00	17.00			0.08		0.90	1.08	40.0
Rice Wat	80.08	84,70	0.04	170	61.00	15.80	12.80	18	28	7.78		0.75	0.09	40.0
Side Hadro	01.00	3.30	0.10	0.06	12.00	6.08	42.80	39		1.41			0.00	40.0
flos sites	10.00	4.79	1.14	0.78	48.75	1.00	29.40			P.81		0.54	1.00	100.0
full.	93.04											0.95	0.09	0.0
Diam Mary	00.00											3.36	0.08	10.5
Conterior I rivella	01.00	12.10	4.63	0.10	64.00	2.10	39.00	- 48	94	9.87		0.44	1.08	36.0
DELOSAR MAR (IMPORTS)	91.44	40.00	- 242	0.01	84.00	1.00	710	- 10	- 53	12.68		1.01	175	- 211
Declarate result discut	10.44	-										1,70	0.00	40.0
Unit	00.00	108.00	0.00	0.00	4.00					0.89		8,70	0.00	3.5
vit tilen	81.00	1100.000										2.80	1.04	
10 1 Path and	10.00					84.00						3.00	122	2.2
NO. 2 Fally and	03.00		1.00			84.00						3.30	1.00	
10.3 Pally and	03.00		122			84.70						1.30	1.08	- 22
Sunited a maturials (young)	18.78	21.00	1.00	1.00	48.10	1.10	18.00			6.76	10000	8.017	1.08	100.00
oniges cannas (no.2)	14.14												100	
Bracharia desurctions	17.00	11.00		0.00	67.40	1.16	39.90			1.14	10000	6.017	1.08	100.00
Bracharia netitianeta	18.48	54.00	1.44		40.40			41		111	18505	8.417		150.50
Chimoletia manounata (nounci)	18.79	21.00	1.20	2.00	48.10	4.16	13.20			4.79	18000	6.017	1.00	100.00
Landinana Inusini aginata (returing)	10.10	40.40	1.00		23.40	176	8.40			4.00	18000	6.017	1.08	
	24.79	20.40		4.64	79.00	1.06	5.80		- 1	10.48	13000	6.417	1.00	+445-545
Aprilation and (Marganes) (earlies)	23.18			0.54	232					7.16	18000			100.00
Pankovin-maximum (Suimeat)		10.40	0.49			1.80	55.80		- 22			4.017		
Pendandum purpunsum Pageer	21.00	6.00	2.48	0.20	44.00	1.90	40.00			0.59	28000	-0.011		100.00

Figure 4. Ingredient database

Food ingredients	Amount	Ances	Cest	- Car	tuin .	82	104	0	0		Ort	19	Conting	. Ve
South States of the	80		1.100	Mar (N)	Earth)	U.Mag	1.5	1.5	- 3-	× .	5	1.5	(88)	CONSTRAINTS
PEAC	- 4440	43	- 14.42	1.00	40.00	11.27	2440	H.SI	4.29	6.90	15.00	K .H	130	04
PORE (#5)	25.19	25.8	1.38	12	26.62			91.10	1.78	4.94	12.04	91.10	13	DN
off any	29.00	33	7,2	1.22	20.00	546	21.18	4.70	10	10			13	¢4
Soybeen meet (inpurted)	-40	4.21	1175	1.0	21.01		340	4.8	8.15	1.01	158	8.2	12	04
6.48	10	1.0	18	1.5	8.50	0.00	840	291.80	10	6.0	4.00	16.20	1.70	04
CaCOD (Lineations)	188	1.0	-1.07	1.00	1,00			1.0	214	6.01		10.50	1.0	04
YEAR	0.50	1.81	1.0	1.81	0.53			4.00	6.00	6.00		16.22	28	2.2
Can	0.00		100	1.00	225	1210		12	8.38	14		0.15		04
Set	10	1.25	1.0	12	10			1.0	101	6.00	6.00	10.30	12	04
Tolasona .	54	- 14	40	1.0	18.00	10.57	7249	5.00	1.01	2.11	4.16	75.00	10	00
Rontula	100	1.0	10	1.00	6.00	1.0	1248	338	4.0	0.01	4.04	16.20	100	04
Broken Filter	10	1.22	12	1.00	. 0.00	0.00	140	1.00	4.00	100	4.04	0.0	17	. ¢x
Student Hule	3.00	12	12	12	0.00	347	6482	0.0	4.50	4.10	210	91.32	2.00	04
Causaia	5.00	1.00	120	1.00	0.00	0.80	140	1.00	6.00	6.06	0.00	28.88	10	04
Total	160.00	18.8	41.01	1.11	1.00	1000	-	11111		-		1000	100.0	
Cantilleg (RM)		1.1.1	1.5	-	1000	1000		-				1	1	
Animal Calegory		10.00		0	- C.A.	100				-			1.1	2
RATION .	Callor	advid values	()	-		100				100				-
	Support a	Reported	10.00			1.00		1.1.1				1.	S.Comer	1
	1000	He		1	1.00	0.00	100.000			1000			1.5	
TOR (No-Calculated	\$7.95	9.0	9.8		1	Priority I		19 A.					1	
a grag	475	L/S	17			10	144			1.0		1.1	1	
CP [N	14.57	*LB	11.00		_	0	144							1.000
Circle .	1.11	3.0	5.00			0a	tare 1	100	-				1.2	1
Grint	9.72	6.57	- 6.97	1.0		6	Sare 1	1.0	-	100			1.0	
164	0.10	6.05	1.8	-		P	Sanc		-				1.1	
Call	1.86	1.0	1.0											A

Figure 5. Least cost formulation module

Feed Analysis

of the diet. If grass is chosen as an option, the model computes the land required to cultivate the grass species chosen. The beef fattening decision support system was verified against actual beef cattle growth from studies conducted in MARDI.

recu Analysis								
FUR 1				RUN 2				
Feed logredients	Amount	Amount Agitos	Cost RM	Feed Ingredients	Amount	Amount Agiton	Cost	Gear
PKE/PKC	39.00	209.90	10.00	PKE/PKC	59.00	505.00	18.00	Analysis
PONE (by)	29.52	213,20	10.66	POME (8y)	26.19	251.90	9.07	-
OPF dy	29.00	209.00	7.00	OFF By	20.00	200.00	7.00	_
Scybean meal (Imported)	1.29	13.90	2.62	Scybean meal (Imported)	0.00	0.00	0.00	and the second second
Una	0.50	5.00	0.05	Urea	0.50	5.00	0.05	Least Cost
CaCO3 (Limestone)	1.00	10.00	0.17	CaCOD (Limestone)	1.00	10.00	0.17	
Vit Min	0.50	6.00	1.40	Vit Min	0.50	5.00	1.40	
Com	17.15	171.60	14.41	Com	2.75	27.50	2.31	(10000)
Balt	0.05	0.60	0.02	Ball	0.05	0.60	0.02	Main
Melasses	0.09	0.90	0.08	Silvingers	0.00	0.00	0.00	Menu
Fice Hulls	0.00	0.00	0.00	Rice Hulls	0.01	0.10	0.00	Noemu
Erohan Rice	0.00	0.00	0.00	Broken Rice	0.00	0.00	0.00	
Sitybean Hulls	0.00	0.00	8.00	Sleybean Halls	0.00	0.00	4.00	-
Cassara	0.00	0.00	0.00	Cassara	0.00	0.00	0.00	Marrison and St.
Total	993.20	1009.00	47,79	Total	109.00	1008.00	38.82	Full Screen
Cost/kg (SB/)			0.48	Costing (RM)	100.000		6.39	-
Calculated Composition		Dry cow		Calculated Composition	-	Day com		Difference
	Supplied	Required (Salung Max		Supplied	Required (Salona) Max	
TDN (%) - Calculated	67.75	\$7.90	57.93	TON (%) - Calculated	57.85	57.93	57.90	4.54
ME (MUlkp)	8.75	8.75	8.75	ME (MURE)	8.75	8.75	8.75	0.00
CP (%)	12.26	10.00	18.00	CP (%)	12.68	15.05	10.00	4.42
CFut (%)	8.83	3.00	6.00	CFut (%)	90.67	3.00	6.00	-5.74
Ca (Si)	0.71	0.37	0.27	Ca (%)	0.52	0.27	4.37	0.03
P (%)	9.38	0.25	0.26	P (%)	0.39	0.26	0.25	-0.01
CaP	1.87	1.42	1.42	CeP	1.74	1.42	1.42	0.12

Figure 6.	Least	cost	comparison	module
-----------	-------	------	------------	--------

legradient.	Amount No.	Centhy	Initial Shright (ng)	518	Sec. or other	Required	Total Intake	Amount
NE FRE	14 22	8.36	Target body weight (bg) Final of	102	-	29.20	11.00 44	per kg Rood 7. publicus
POME (Inc)	25.15	13	Days to target wit		in l	1100 100	En alla	SURAN.
OP# dy	29.33	135	toda a milar ar		6	440.32	404.34	98.135
levitore must deported	4.00	10	Cam lead east (188)	100	De 1	100.00	414,814	1445
Dea	9.65	1.12	Concernant concernant	1.16	in the second	18.01	20.01	6410
CaCO3 & investore)	1.00	10	Anticipatent ADG (b)()	101	Pan	11.40	15.10	6355
up Line	9.55	240			Car Sale		1.00	1.86
Certe	28	114			Concession of the local division of the loca			
Salt		135	Calculated Intakes		Indvidu	al Animal E	conomic Data	
Matavore	4.00	115						
Non Hulls	4.24	8.00	Fed as fed (Fresh)	Amount Red	Catle put	chane price (104.0	4.50
Destant Rick	0.00	875	Conumbula	4.85	Tale price			7.60
Southware Hullis		845	Ores	6.60	Cost of Inc	eder cattle (R	8	147.17
Cassard		8.75			Feed Con	1985	100	Filles
TOTAL Concernments	109.00	1000	Dill Intake		Fund gran	simmal (Rg.	CMI	0
HE SH GRASS (hg/log)			Concentrate	4.33	Gross prof	Initiatile (COR)	1.01	1.86.35
Decharia decumbera	922	6.617	Grass	6.60				
Network 2000 (% / High	3.0	4.13	Test (Dill (Hg)	4.38	Herd Ep	onomic Dat		
Proportion of sation		200	% Body weight	2.48		189364		11000
Concentrative (%)	100 8	4.15		- Could	oial euro	ber of cattle.	(Transfer	54.60
Fresh Grass/Foxige (%)	0.00	8.00	Croit of Coecenitrates	5.69		Gross Profit		\$4.22.68
Tutal field	108 22	4.11	Case of grant	6.80		800-0-00-FCE		21.410.16
			Total had cost day (RM)	1.67	Pasters is	red required ()	haQ.	1.00
Place only make change	a ha-cella in ULI		_	_	-			
		_	Man Ful	CRAMM	Pa	te	Paste	LENIE-CO

Figure 7. Model evaluation module

Model Analysis

Parameters	RUN 1	RUN 2	DW	
Production parameters		10.00		(3-C)
Initial Weight (kg)	141	141	0.00	CONTRACTOR OF THE OWNER.
Target body weight (kg)	100	103	0.00	Clear
Days to larget wt	65	60	5.00	
Cum feed cost (RM)	169.21	92.12	77.08	Analysis
Proportion of ration				
Concentrates (%)	100	60	60.00	Contraction of the local division of the loc
Fresh Grass/Forage (%)	0	60	-50.00	Model
Anticipated ADQ (kg)	0.60	0.65	-0.06	
Individual Animal Economic Data				1
Cattle purchase price (RM/kg)	6.50	6.50	0.00	Least-Cost
Rale price (RM/kg)	7.60	7.60	0.00	<u> </u>
Cost of feeder cattle (RM)	147.17	147.17	0.00	
Feed Cost (RM)	169.21	92.12	77.08	and the second second
fotal grass/animal (kg. DM)	0.00	142.19	-142.19	Main
Gross profiticattle (RM)	1.033.62	1,110.71	-77.08	Menu
ferd Economic Data				
fotal number of cattle	50	50	0.00	Concession of the local division of the loca
Total Herd Gross Profit (RM)	51.681.22	\$5,535.44	-3854.22	Full Screen
Gross profitimenth (RM)	23.852.87	27,767.72	-3914.85	Tun Screen
Pasture land required (ha)	0.00	2.70	-2.70	
feed Parameters				
Cost of Concentrates	2.38	1.19	1.19	
Cost of grass	0.00	0.21	-0.21	
Total feed cost/day (RM)	2.38	1.40	0.96	

Figure 8. Model analysis and economic evaluation module



Figure 9. Actual vs Predicted body weight

A sample data of predicted against actual growth rate based on the feed formulated is shown in Figure 9 with an average prediction error of 0.8 kg. The model developed can be used by the beef feedlot industry to make intelligent decisions and avoid losses in feedlot operations. It can also be used by extension agents and as a teaching tool especially in universities.

CONCLUSION

A beef feedlot production decision support system (DSS) developed based on Microsoft® Excel was observed to predict beef growth under Malaysian conditions within reasonable limits. Beef feedlot is a challenging enterprise especially with the high cost of feed ingredients and this DSS software can be utilised to optimise returns. The model can be used by feedlot operators, beef nutritionists, and also in universities as a teaching tool. However, it is emphasised that as with most DSS systems, there can be variations in any biological system. Nevertheless this software can be used as an intelligent tool to assess feedlot operations and improve economic returns.

REFERENCES

- DVS (2010). Online Livestock Statistics. Department of Veterinary Services, Malaysia. http://www.dvs.gov.my/ web/guest/perangkaan. Accessed 23 May 2011.
- NRC (2000) Nutrient Requirements of Beef Cattle. Seventh Revised Edition 1996. National Academy Press, Washington, DC, USA.
- 3. Leonard C.K. (1982). Nutrient Requirements of ruminants in developing countries. International Feedstuffs Institute, Utah State University, Logan, Utah, USA.