Future meat consumption: potential greenhouse gas emissions from meat production in Malaysia

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FUTURE MEAT CONSUMPTION: POTENTIAL GREENHOUSE GAS EMISSIONS FROM MEAT PRODUCTION IN MALAYSIA

by

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ABSTRACT

This study shows that there is mounting meat consumption which is to be met by higher meat production. As the result, higher gas emission of CO_2 is expected from increasing meat production. This is led by poultry and beef production which is likely to produce most of the greenhouse gas emissions from meat production in Malaysia. It is crucial to incorporate environmental consideration into livestock policy in National Agricultural Policy 4 and Tenth Malaysian Plan.

Keywords: *Meat, consumption, production, gas emission.*

JEL code: Q11, Q50

1.0 INTRODUCTION

The ultimate intention in Malaysian agri-food policies is to increase agri-food production, for self-sufficiency and trade. However, the policies tend to hold the grip on the economic impact of the industry rather than the profound environmental impacts caused by agricultural activities. One of the myriad impacts is greenhouse gas emissions from meat production. A recent study by Steinfeld *et al.* (2006) found that the production of meat contributes between 4.6 and 7.1 billion tonnes of greenhouse gases each year, which represents between 15% and 24% of total current greenhouse gas production.

At aggregate level, the domestic meat consumption pattern is like those described by Keyzer *et al.* (2005) as per capita total meat consumption has increased over the years, at a very high rate. Relatively, beef consumption has increased faster than other major meat products (poultry, pork, and mutton) at the fast track of economic growth after 1997/98. This leads to the question of what would be the future meat consumption at disaggregate level.

The consumer-driven meat sector is well spelt in the National Agricultural Policy 3. While the demand is mounting, beef and mutton are still self-insufficient at large in domestic market. The unfulfilled demand is expected to see a boost in beef and mutton production.

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Coupled with all-time high poultry and pork production, it is essential to investigate possible greenhouse emission from meat production in Malaysia. Hence, this study intends to (1) forecast for future meat consumption and production, and (2) generate potential future greenhouse gas emissions from meat production in Malaysia.

2.0 DATA AND ESTIMATION PROCEDURES

Time-series data of beef, pork, mutton, and pork consumption and self-sufficiency level are obtained from various issues of Agriculture Statistical Handbook (1960-2008). Several series of data namely 1960-2008, 1970-2008, 1980-2008, and 1990-2008 are analyzed via simple linear regressions from managerial economics perspective. This is to choose the best series which produce the least residuals. The simple linear regression can be expressed as:

$$\log(Q_i) = \beta_{0i} + \beta_{1i} TT$$

where Q is consumption (quantity) of ith meat product and TT is time trend in the data series.

The forecast can then be done by plugging the continuous time trend up to 2020 into the estimated linear regression. However, the projection is not meant to be deterministic. Stochastically, the projection is shift upward and downward based on the average percentage of residuals in the observations.

In order to obtain forecast of meat production, information of future self-sufficiency level for the major meat products are needed. Table 1 presents the calculated meat self-sufficiency level in Malaysia, which was estimated by adding average annual growth of 1.5, -0.38, 0.5, and 0.2 to the base (2008) of self-sufficiency level in beef, pork, mutton, and poultry respectively. It is noteworthy that self-sufficiency level in beef, mutton, and poultry are aligned with the target in Ninth Malaysian Plan, whereas pork performs negatively.

Table 1: Meat self-sufficiency level in Malaysia

Year	Beef	Pork	Mutton	Poultry
2008 (base)	25.88	96.60	9.15	121.58
2010	28.88	95.85	10.15	121.98
2015	36.38	93.96	12.65	122.98
2020	43.88	92.07	15.15	123.98

Forecast for meat production is then yielded by multiplying the forecasted meat consumption with the forecasted self-sufficiency level. Then, the forecasted meat production is transformed into greenhouse CO_2 quantity by using the estimates as shown in Table 2.

Table 2: Greenhouse gas impact of 1kg of a given meat product

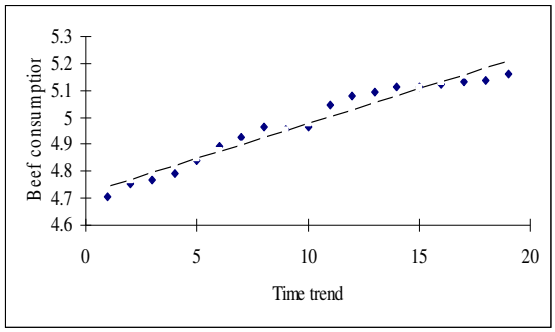
Year	Beef	Pork	Mutton	Poultry
CO_2 equivalent (kg)	36.4[i]	3.8[ii]	13.8[iii]	1.1 [iii]

Notes: [i] Koneswaran and Nierenberg (2008); [ii] Pimentel (1997), and [iii] Eshel and Martin (2006)

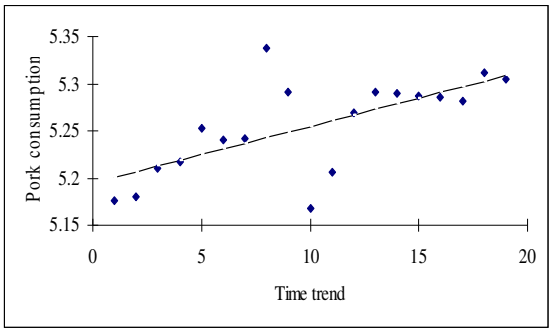
3.0 RESULTS

The best model specification was chosen based on the lowest residuals criteria in the observations. Given the lower residual values in the data series of 1990-2008, the data series was consistently the better one to use in the analysis of the major meat products in Malaysia. Graphically, they are illustrated in Figure 1. The straight lines represent predicted consumption values while having actual consumption values tabulated around them. The gap between the lines and actual consumption values is known as residuals. The average of residual is about 5 percent annually for beef, mutton, and poultry consumption. In the case of pork consumption, there are highs and lows mainly due to consumption shock in view of disease outbreak in the industry. Though so, the annual average residual is about 10 percent.

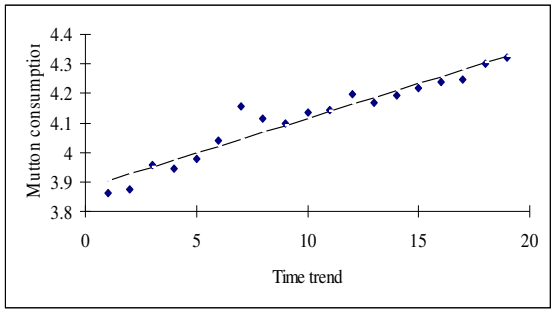
Figure 1: Plot of fit line



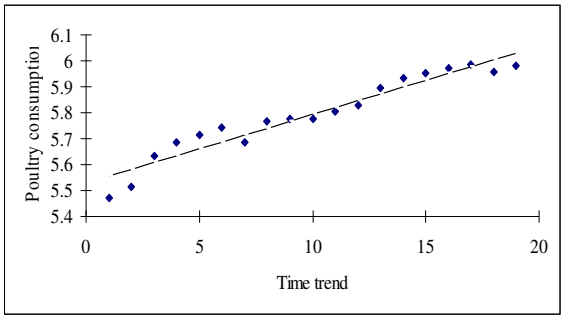
(a) Beef consumption



(b) Pork consumption



(c) Mutton consumption



(d) Poultry consumption

The empirical results of the analyses are exhibited in Table 3. The time trend is found to be positively related to meat consumption across time periods. It means meat consumption generally grows as time passes by, which perhaps imply positive impact of a combination of socio-economic variables like income, urbanization, employment, and others which are difficult to gather them all to make a good projection model.

Table 3: Linear regression parameters

	Beef Coefficients (Std. error)	**Pork** Coefficients (Std. error)	**Mutton** Coefficients (Std. error)	**Poultry** Coefficients (Std. error)
Intercept	3.93 (0.03)***	5.19 (0.02)***	3.88 (0.02)***	5.53 (0.02)***
Time trend	0.03 (0.00)***	0.01 (0.00)***	0.02 (0.00)***	0.03 (0.00)***

Note: *** Statistically significant at 1% level of significance.

By plugging continuous time trend values into the parameters, an initial projection for the major products was obtained. In order to make it to be stochastic, projected beef, mutton, and poultry consumption was adjusted by 5 percent (as indicated by the average residual) and projected pork consumption was adjusted by 10 percent respectively. The stochastic projection of meat consumption is depicted in Table 4. The range of the projected consumption values is to indicate that the future consumption will fall within the range, which tolerates reduction and increase in the range. Meat consumption is projected to increase in future. Most strikingly is the rising beef consumption that overtakes pork consumption.

Table 4: Stochastic projection of meat consumption

Year	**Beef (M. Ton.)**		**Pork (M. Ton.)**		**Mutton (M. Ton.)**		**Poultry ('000 M. Ton.)**	
	5% lower	5% upper	10% lower	10% upper	5% lower	5% upper	5% lower	5% upper
2010	154,348	170,596	188,303	230,149	22,470	24,836	1,146,820	1,267,538
2015	206,054	227,744	201,744	246,575	29,463	32,565	1,551,582	1,714,906
2020	275,079	304,035	216,143	264,175	38,632	42,698	2,099,201	2,320,169

By multiplying the projected meat consumption with self-sufficiency level, Table 5 presents the estimated stochastic projection of local meat production. As spelt out in the self-sufficiency level in earlier session, beef production is expected to grow faster than other meat products. It is interesting to learn that poultry and pork production tends to increase at marginal rate.

Table 5: Stochastic projection of local meat production

Year	**Beef (M. Ton.)**		**Pork (M. Ton.)**		**Mutton (M. Ton.)**		**Poultry ('000 M. Ton.)**	
	5% lower	5% upper	10% lower	10% upper	5% lower	5% upper	5% lower	5% upper
2010	44,576	49,268	180,489	220,597	2,281	2,521	1,398,891	1,546,143
2015	74,962	82,853	189,558	231,682	3,726	4,118	1,908,135	2,108,991
2020	120,704	133,410	199,003	243,226	5,853	6,469	2,602,589	2,876,545

Table 6 illustrates the increasing gas emission from local meat production. Obviously, the increasing meat production has direct impact on environment, in term of gas emission - CO_2. Poultry production (in '000 metric ton) is found to cost the most severe environmental impact, with beef (in metric ton) being second.

Table 6: Stochastic projection of gas emission from local meat production

	Beef (M. Ton.)		Pork (M. Ton.)		Mutton (M. Ton.)		Poultry ('000 M. Ton.)	
Year	Low variant	High variant	Low variant	High variant	Low variant	High variant	Low variant	High variant
2010	1,622,566	1,793,355	685,858	838,269	31,478	34,790	1,538,780	1,700,757
2015	2,728,617	3,015,849	720,320	880,392	51,419	56,828	2,098,949	2,319,890
2020	4,393,626	4,856,124	756,211	924,259	80,771	89,272	2,862,848	3,164,200

4.0 CONCLUSIONS

This study follows the flow of a consumer-driven agri-food market to (1) forecast for future meat consumption and production, and (2) generate potential future greenhouse gas emissions from meat production in Malaysia. The empirical results show that there is mounting meat consumption which is to be met by higher meat production. As the result, gas emission of CO_2 are expected to increase from meat production, with other things remain unchanged. Having such indications, it is crucial to incorporate environmental consideration into livestock policy in National Agricultural Policy 4 and Tenth Malaysian Plan.

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