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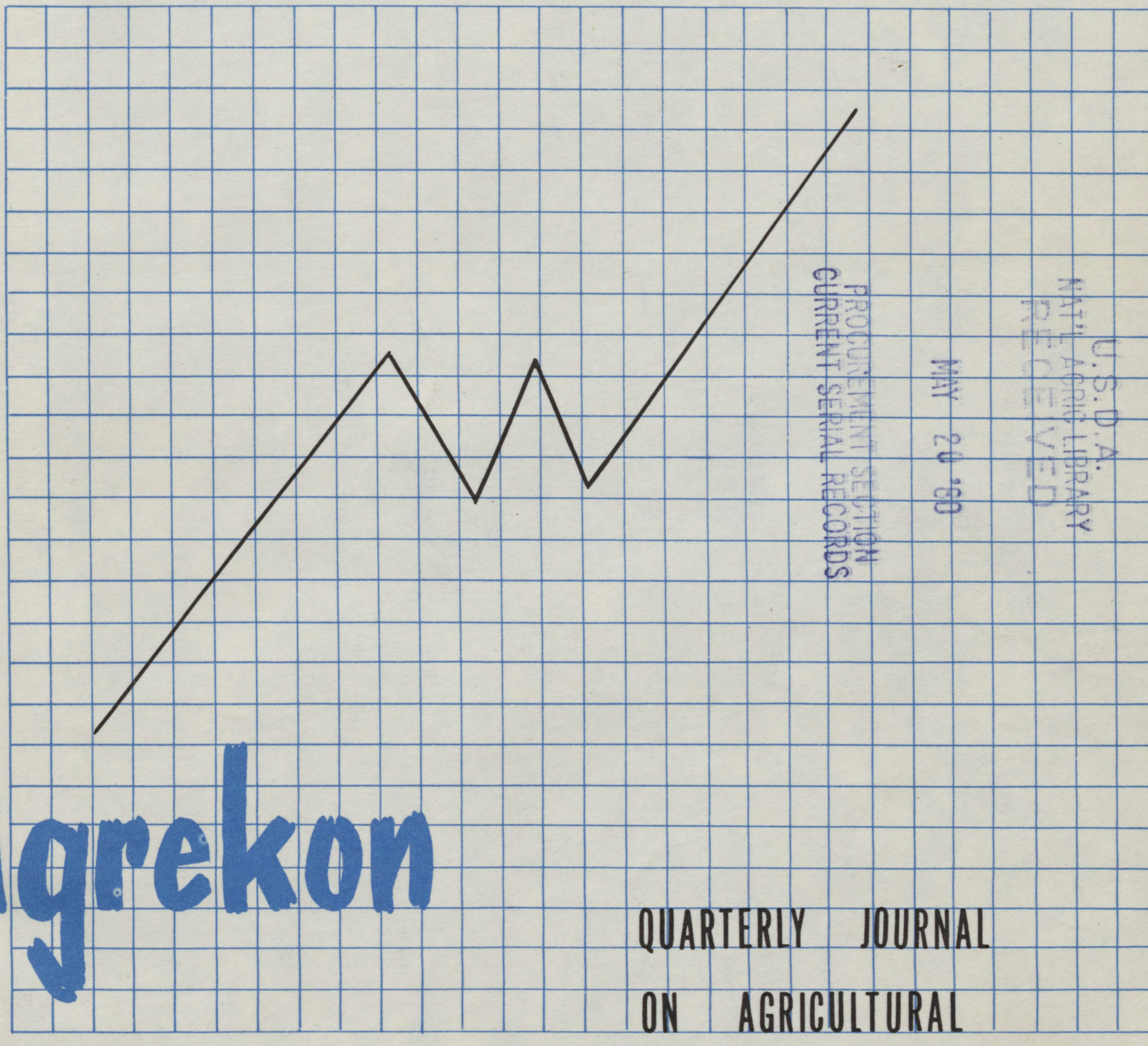

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DEMAND FOR IMPROVED QUALITY PROTEIN MAIZE IN MONOGASTRIC ANIMAL RATIONS*

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1. INTRODUCTION

Shortages of fish-meal in world markets in recent years (1976/77) caused prices to increase which threatened local pig and poultry producers as these industries were totally reliant on fish-meal as a source of protein. This moved the Government to secure an annual allocation of fish-meal to these industries at the old price of R227 per ton which was well below the export price of R425 per ton (S.A. Poultry Association, 1977).

This policy measure detracts from the urgency of developing other local sources of protein and means foreign earnings are lost. With independence in South-West Africa, South Africa will have to import fish-meal at world market prices. Research concerning the development of other sources of protein should thus receive high priority in South Africa.

Dr H. Gevers, Summer Grain Subcentre, Pietermaritzburg had success in breeding a high lysine and improved quality protein maize[1] (hereafter called HLM) which has been successfully tested by Prof. G.V. Quicke of the University of Natal.

The purpose of this paper is to study the economic feasibility of introducing this new cultivar into animal rations, and to determine its potential demand for livestock consumption. The study thus concentrates on determining the potential consumption of HLM and the range of prices at which it would be economically feasible to include it in rations.

2. THE MODEL

The study was confined to monogastric animal rations (pigs and poultry) because ruminants (cattle) produce their own amino acids. Minimum cost rations were generated by linear programming procedures for each of nine pig and poultry rations. The following rations were studied: broiler starter, broiler finisher, broiler withdrawal, layer mash, pig grower 5-15 kg, pig grower 20-40 kg, pig grower 60-100 kg, non-lactating gilts and sows and lactating gilts and sows. The following raw materials were considered for inclusion in rations: normal maize, grain sorghum, bran, lucerne, groundnuts, sunflower, cotton, fish-meal, soya-bean, high quality protein maize (HLM), lime, monocalcium, lysine and methionine. Specifications for rations and raw materials were obtained from the Department of Animal and Poultry Science, University of Natal. Information was also obtained by private communication from the Pig Section at Irene. Minimum and/or maximum specifications were laid down for ME, protein, calcium, available phosphorus, lysine, methionine, total sulphur amino acids, tryptophan and arginine. The feed composition matrix of the model includes the ingredients (say percentages amino acids, ME, etc) of raw materials (normal maize, grain sorghum etc). The cost of raw materials was taken as prices prevailing during 1977/78.

3. RESULTS

The extent to which HLM would be included in minimum cost pig and poultry rations was studied by parametrically increasing the price of HLM. Information contained in the post optimal analysis of the linear programme solution was used for this purpose. A stepped demand function for HLM was derived as portrayed in Fig. 1, showing percentages of HLM included in rations at various prices[2]. The percentages in each ration were multiplied by the total consumption of that ration in order to arrive at the estimated national animal con-

* The assistance of T. Bookless, a graduate student, is gratefully acknowledged especially for running the computer programmes on which Figures 2 and 3 are based

FIG. 1 - Stepped demand function for HLM maize if the local price of fish-meal is equal to the world price

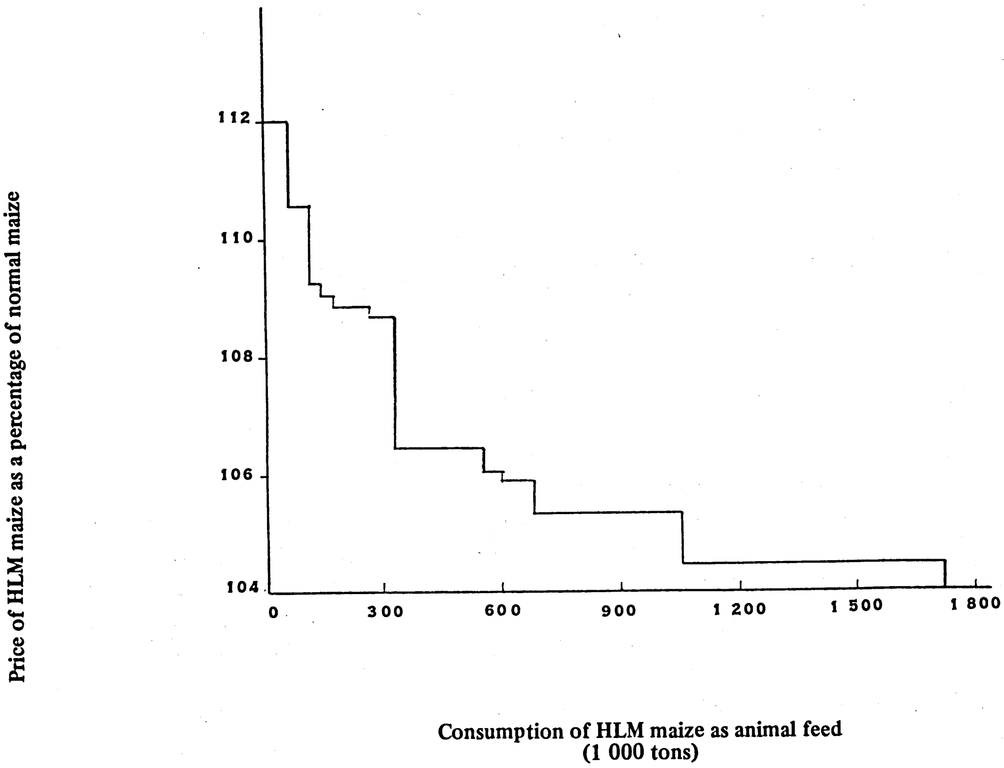


FIG. 2 - Stepped demand function for HLM if the price of fish-meal is "subsidised"

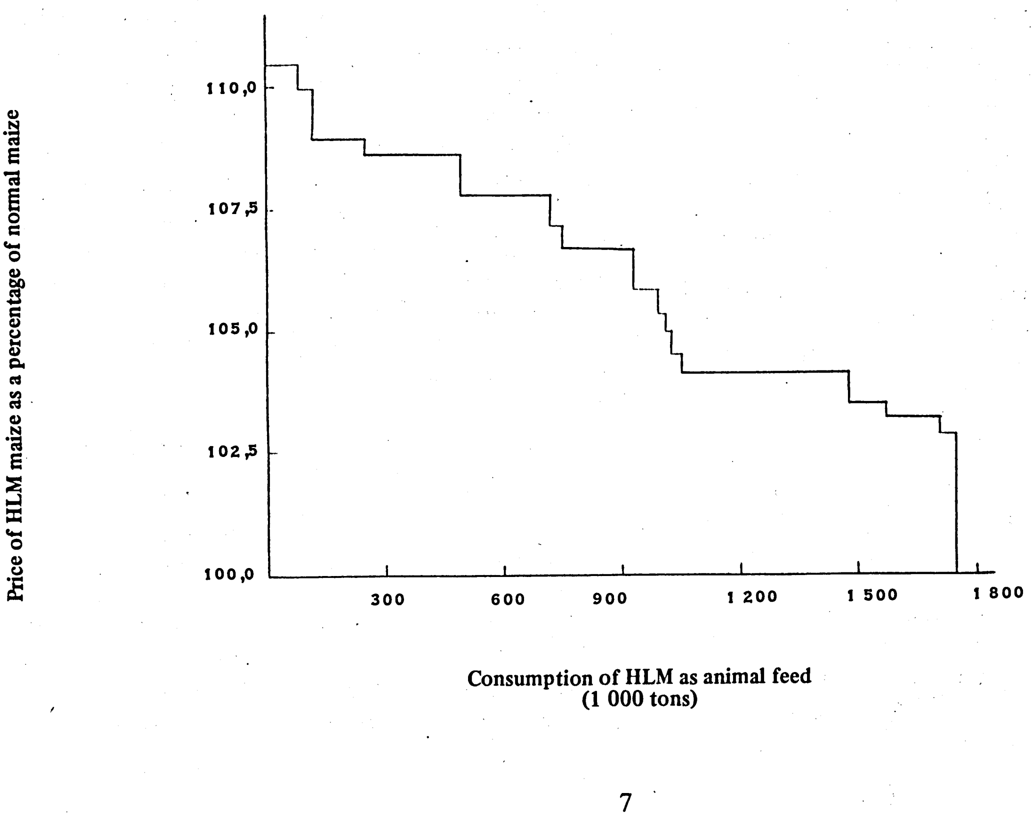
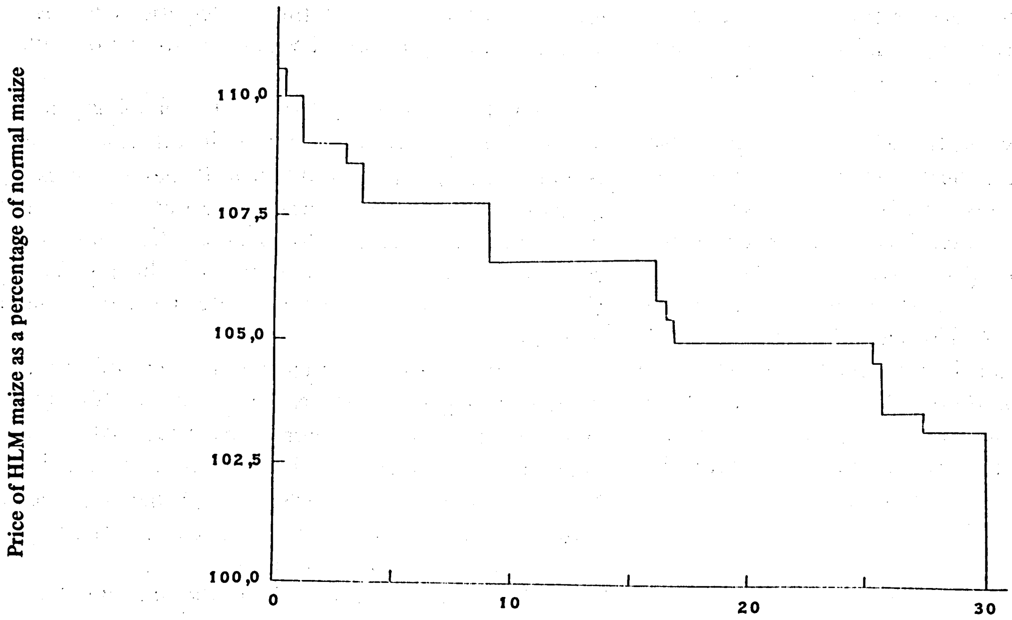


FIG. 3 - Fish-meal displaced (saved) by HLM maize at different prices of HLM



sumption.

According to Fig. 1, should the price of HLM be higher than 12,1 % above the price of normal maize, then HLM would not be considered in animal rations. This calculation assumes that the domestic price of fish-meal is equal to the world price while all other raw materials including soya-beans are available at prices prevailing during 1977/78. If the price of HLM is between 6,3 % and 8,6 % above the price of normal maize then the consumption of HLM is estimated at 300 000 tons. Consumption of HLM is estimated to increase substantially if the price is reduced below the level of 6,3 % above that of normal maize (Fig. 1).

The increased consumption as portrayed in Fig. 1 arises from the substitution of HLM for other raw materials in minimum cost rations. The inclusion of HLM in rations means a lower feed cost which would stimulate the total consumption of animal feed. Fig. 1 may underrate the responsiveness of HLM consumption to price changes because in the derivation of Fig. 1 the total consumption of animal feed was assumed constant.

The extent to which HLM can replace other raw materials, differs in various rations as is evident from Table 1. At a price of HLM between 4,0 % - 4,4 % above the price of normal maize, 73,9 % of the broiler starter ration would constitute of HLM and 77,40 % of the broiler finisher ration. If the price increases to above 4,4 % of normal maize, HLM would be excluded from the layer mash, above 6,3 % it would be excluded from pig grower rations, above 8,9 % from gilt and sow rations, above 12,1 % from broiler rations. The greatest possible demand for HLM appears to be for broiler rations and secondly in rations of gilts and sows.

The weights indicated in Table 1, are the relative percentage consumption figures of each ration in terms of the total consumption of pig and poultry rations. The percentages for individual rations are aggregated by applying these weights to arrive at the total percentage HLM in all rations given in the last column. The latter percentages were multiplied by the total pig and poultry feed consumption of 2 275 000 tons, giving consumption in tons shown in the demand function of Fig. 1.

If the price of HLM is between 0 and 4,4 % above the price of normal maize, the estimated animal consumption of HLM is 1,69 million tons while if the price increases to 6,3 % to 8,6 % above the price of normal maize, this estimate is reduced to 300 000 tons (Fig. 1). It is assumed in this calculation that soya-beans and fish-meal are available at world prices. Soya-beans were assumed unavailable in an alternative model. In this model the latter estimate of 300 000 tons increased to 1,7 million tons.

Fig. 2 is a stepped demand function for HLM if the fish-meal price is subsidised as during 1977 but assuming that soya-beans are unavailable. If the price of HLM increases to 10,5 % above the price of normal maize, then HLM disappears from rations. The reason why the stepped demand in Fig. 1 is not positioned to the right of the demand function in Fig. 2 is because soya-beans are assumed as available in least cost calculations of Fig. 1 but not in Fig. 2.

In the derivation of Fig. 2 it was observed that at a HLM price of 8,7 % above the price of normal maize, HLM appears only in broiler rations. At a marginally lower price HLM appears in pig and gilt and sow rations while if it is less than 5 % it also appears in layer mash rations.

The extent to which HLM is estimated to replace fish-meal in rations is indicated in Fig. 3 by a stepped substitution curve. In this curve it is assumed as in Fig. 2 that the fish-meal price is subsidised and that soya-beans are unavailable. If the price of HLM is equal to that of normal maize, 30 % of fish-meal included in rations would be displaced by HLM according to Fig. 3. The price elasticity between fish-meal consumption and HLM prices is + 34 at the arithmetic level in Fig. 3, which is exceptionally high. Due to certain practical considerations such as milling qualities of HLM, the substitution elasticity may be lower than estimated.

4. DISCUSSION

Figures 1 and 2 give some insight into the possible consumption of HLM at different prices. If the price of HLM is more than 10,5 % higher than the price of normal maize, very little or no HLM is estimated to be included in animal products. At a price of HLM, 5 % above that of normal maize, the animal consumption is estimated at about 1 million tons according to Fig 1 and Fig. 2 which is more than 30 % of the current animal consumption of maize.

The era of cheap fish-meal prices seems to have passed. In an effort to help livestock breeders, the Government secured an allocation of 141 000 tons of fish-meal to the local livestock industry at below export prices during 1977. The real cost of fish-meal is its opportunity cost which is the export price. Soya-beans are an important source of protein but because this product is imported, it entails a loss in foreign earnings.

In considering HLM as a raw material in minimum cost rations, it was indicated that the introduction of the new cultivar could reduce feeding costs of monogastric animals by R11,6 m. The saving in export earnings was estimated at R20,8m. In these calculations it was assumed that the price of HLM is equal to that of normal maize.

HLM may be viewed as a new technology and its adoption may be slow initially as in the case of other technologies such as hybrid maize. It may be necessary initially to provide producers with a financial incentive in the form of a subsidy to encourage the adoption of the new cultivar. Such a subsidy could be justified on the grounds that it would promote a better resource allocation.

In the U.S.A. less than one per cent of all maize planted during the 1975 season was of the high lysine type. Soya-beans are imported by South Africa, and HLM production should thus be more profitable in South Africa than in the USA. The benefits of such a technology would be shared by producers (HLM producers), feeders and meat consumers.

The greatest benefit from the introduction of HLM is expected to be in the improvement of human diets. Protein deficiences in human diets are reason for concern and common in South Africa particularly amongst the Black population.

This research lends itself to a systems analysis approach. Most of the research so far has been undertaken by plant breeders, biochemists, nutritionists but further research is called for by economists, by millers, determining milling qualities, and by home economists, determining the tasting qualities for human consumption etc.

FOOTNOTES

1 Researchers at the Faculty of Agriculture, University of Stellenbosch, also reported success in the developing and testing of a wheat-rye hybrid called

TABLE 1 - Estimated percentage HLM maize included in animal rations at different price levels of HLM maize

Price of HLM above the price of normal maize	Broiler			Layer mash	Pig grower			Gilts and sows		Total
	Starting	Finisher	Withdrawal		5-15 kg	20-40 kg	60-100 kg	non-lactating	lactating	
Weights	7	16	7	33	2	9	20	4	2	100
4,0-4,4	73,9	77,4	80,3	73,0	81,2	68,4	75,5	70,8	75,0	74,5
4,4-5,3	73,9	77,4	13,7	0	81,2	68,4	75,5	70,8	75,0	45,2
5,3-5,9	73,9	77,4	13,7	0	0	68,4	0	70,8	75,0	28,9
5,9-6,0	73,9	77,4	13,7	0	0	28,7	0	70,8	75,0	25,4
6,0-6,3	46,6	77,4	13,7	0	0	28,7	0	70,8	75,0	23,4
6,3-8,6	46,6	13,5	13,7	0	0	28,7	0	70,8	75,0	13,2
8,6-8,7	46,6	13,5	13,7	0	0	0	0	70,8	75,0	10,6
8,7-8,9	46,6	13,5	13,7	0	0	0	0	0	75,0	8,0
8,9-9,1	46,6	13,5	13,7	0	0	0	0	0	0	6,5
9,1-10,4	46,4	13,5	0	0	0	0	0	0	0	5,5
10,4-12,1	33,3	4,0	0	0	0	0	0	0	0	3,1
12,1 and above	0	0	0	0	0	0	0	0	0	0

"Tritikali" which is high in protein and produces good yields.

2 For a discussion on step functions refer to Henry and Raunikar.

REFERENCES

GEVERS, H.O. 1972. Breeding for improved protein quality in maize. Trans. Roy. Soc. S.A., 40 (Part 2) 81-92.

HENRY, W.R. and R. RAUNIKAR. 1963. Stepped function models in King. R.A. (edited). Inter-regional competition. Department of Economics, University of North Carolina, Raleigh.

KEMM, E.H., H.O. GEVERS, G.A. SMITH and M.N. RAS. 1977. The use of South African-bred opaque-2 maize in pig growth diets. S. Afr. J. Anim. Sci. 7, 127-131.

NIEUWOUDT, W.L. 1972. Factor subsidies and certain policy implications. Agrekon 11(3): 5-8.

NIEUWOUDT, W.L. D.T.F. BOOKLESS, H.O. GEVERS and R.M. GOUS. 1978. Economic implications of opaque-2 maize in monogastric animal diets. Under review. S.A. J. of Anim. Sci.

QUICKE, G.V. and H.O. GEVERS. 1972. Higher lysine levels and improved protein quality of opaque-2 maize. S.A. Med. J. 46, 1579.

S.A. POULTRY ASSOCIATION. Poultry Bulletin. June 1977.