

NEW ZEALAND AGRICULTURE
AND OIL PRICE INCREASES

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THE AGRICULTURAL ECONOMICS RESEARCH UNIT

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1. INTRODUCTION*

This paper is based on the assumptions that world oil resources are finite and that world oil production will peak sometime in the 1980s or 1990s (Hughes & Mesarovic 1978 : 139). Such a scenario is now widely accepted and is robust to alternative assumptions on oil prices and reserves.

Increases in the real world price of oil are therefore likely to occur. Because of New Zealand's almost complete dependence on imported oil for liquid fuel purposes and New Zealand's continuing balance of payments problems, the situation could become serious for New Zealand resulting in policies designed to reduce use of oil-based fuels, such as substantial domestic fuel price increases, or government regulation of fuel use, such as rationing.

This paper attempts to give an indication of the implications that an oil price rise could have for New Zealand agriculture. A large part of the paper is concerned with transport, since the transport industry is the largest user of liquid fuels in New Zealand. The paper concentrates on the effects of fuel price rises as opposed to physical

* This paper is based on two unpublished papers produced by the authors over the past 12 months. The first paper by P.D. Chudleigh and S.L. Young was 'Rural and Agricultural Impacts', presented to a seminar entitled "Transport 1984 : Planning Implications of the Energy Crisis", organised by the Commission for the Environment and the Ministries of Energy and Transport, and held in May 1978.

The second paper by P.D. Chudleigh and W.A.N. Brown was entitled 'Agricultural Viewpoint' and was presented to a general symposium on "Oil : Australian and New Zealand Responses to Dwindling Resources", at the Australian and New Zealand Association for the Advancement of Science, held at Auckland in January, 1979.

2.

rationing of liquid fuels. In describing the potential effects of fuel price rises, particular attention has been given to how farm costs and farm product prices may be affected by fuel price increases. Most attention is given to effects on and responses from the farm production sector of agriculture, although some consideration is also given to the agricultural freight and product processing sectors. Some brief comments are also made on the demand for transport in rural areas so that equitable fuel pricing or rationing systems can be devised and implemented if, and when, necessary.

2. THE IMPORTANCE OF OIL IN AGRICULTURE

It is not a simple task to establish the 'importance' of a substance like oil to New Zealand agriculture. The main difficulty lies in the fact that oil is but one source of energy (although a very important source) used in the production of many agricultural inputs (e.g. fertiliser, insecticides). On the other hand, a number of inputs to agriculture are derived directly from an oil base. The most important of these latter inputs are the petroleum fuels on which agriculture has relied in the past for transport of inputs and outputs, for motive and tillage power on farms, and for allowing the more remote farming areas to maintain acceptable levels of social interaction.

2.1 Liquid Fuels and Farm Costs

One available indicator of the importance of oil to the farm sector is the proportion of farm costs made up by the direct use of petroleum fuel. The Australian Bureau of Agricultural Economics has recently produced figures based on three years 1973/74 to 1975/76 showing farm fuel costs as a proportion of total farm expenditure. Some of these figures are presented in Table 1. Fuel made up between 6-11 per cent of cash costs on farms depending on the type of farming system. For example, the figure was higher for wheat-growing farms than for farms concerned mainly with grazing. However, it is interesting to note that the reverse is the situation when fuel costs are viewed as a proportion of total farm costs (i.e. including depreciation and imputed interest costs). This is probably partly due to the much higher investment in capital plant necessary on wheat-growing farms.

TABLE 1
Fuel Used by Farmers as Proportion of
Total Farm Costs in Australia

Grazing Industries	<u>Three Year Average 1974/76</u>	
	% Cash Costs	% Total Farm Costs
Pastoral Zone - mainly grazing	6.5	5.2
Wheat-Sheep Zone - mainly grazing	8.9	7.1
High Rainfall Zone - mainly grazing	6.6	5.4
Wheatgrowing Farms	10.3	3.5

Source: Compiled from Table 1 in Partridge, L. (1977).
"A Note on the Importance of Petroleum Products as a
Cost to the Australian Wheat and Grazing Industries
and the Impact of Recent Price Increases", Quarterly
Review of Agricultural Economics, Vol 30 (4), p.333.

In New Zealand similar information is not specific but it can be estimated that petroleum products made up around 5 per cent of total cash expenditure (excluding interest charges) on New Zealand sheep and beef farms over the 1974/75 and 1975/76 seasons.¹ This compares with the 6-9 per cent for Australian grazing farms. The higher figures for Australia are probably due to the larger sizes and longer distances associated with Australian farms compared with those in New Zealand, and the generally more extensive type of grazing operation in Australia (meaning lower levels of inputs other than fuel).

¹ Source: N. W. Taylor (Pers Comm), 1979; New Zealand Meat and Wool Boards' Economic Service, Sheep-Beef Farm Survey, 1974/75 and 1975/76.

On New Zealand wheatgrowing farms fuel makes up about 10 per cent of total cash costs involved in producing wheat.² However, if fuel costs are taken as a proportion of total farm costs, this figure drops substantially.

For New Zealand factory supply dairy farms the proportion of cash expenditure (excluding interest charges) made up by fuel costs is probably around 4-5 per cent. For town supply farms the proportion could be slightly more due to the greater degree of fodder conservation practised on town supply farms allowing them to produce milk all year.

The various types of petroleum products used by Australian farms are detailed in Table 2. A similar situation applies in New Zealand with petrol making up around 60 per cent of total fuel expenditure.

The proportion of fuel used in different farm activities varies substantially according to the farm type concerned. In the case of mixed cropping farms in Canterbury, a breakdown of fuel use from a survey of 20 farms is given in Table 3.

The overall conclusion that can be drawn from these figures is that petroleum products contribute directly to only a small proportion of total costs facing farmers.

But direct petroleum product inputs are not the only oil based inputs to agriculture. Based on estimates by Pearson and Corbett (1976) and Brown and Pearson (1977), it is probable that direct consumption of oil based fuels makes up only 35-40 per cent of the total energy input to New Zealand agriculture. This figure is probably higher for cropping farms; for example, results of a recent survey of mixed cropping farms in Canterbury showed that as much as 58 per cent of total energy inputs was in the form of fuels

² Source: Davey, L.E. (1978) pers. comm.

TABLE 2
Types of Petroleum Products
Used on Australian Farms

	Petrol	Diesel	Kerosene	Oil/ Grease	Other
	(% expenditure)				
Pastoral Zone	61	29	2	5	2
Wheat-Sheep Zone	52	38	1	6	5
High Rainfall Zone	63	23	2	7	6

Source: Compiled from Partridge, L. (1977), op.cit.

TABLE 3
Breakdown of Fuel Use on Mixed Cropping Farms,
Canterbury, New Zealand

	% Fuel Use
Cultivation	27
Non-Specific Tractor Activities ^a	23
Transport ^b	33
Haymaking	8
Harvesting	6
Stationary Plant	3

Notes: a. All tractor functions except cultivation, haymaking, and powering stationary plant.

b. Covers fuel used by trucks, utilities, bikes and farm cars.

Source: McChesney I.G., Bubb, J.W., and Pearson, R.G. (1978) "Energy Use on Canterbury Mixed Cropping Farms", Joint Centre for Environmental Sciences, Occasional Paper No. 5, Lincoln College.

and oils, that is, direct energy inputs.

It is important to bear in mind, therefore, that the price of oil will affect farmers' costs not only through direct inputs of fuels but also through the extra costs involved in the production and transport of various other inputs.

2.2 Transport and Agriculture

New Zealand agriculture relies heavily upon transport systems to provide inputs to farms and to convey products to markets. An agricultural industry made up of over 60,000 independent production units dispersed throughout New Zealand must generate a large demand for transport, both in terms of private car kilometres as well as freight tonnes transported.

Most inputs and outputs to and from production units travel by road as few farms have direct access to rail sidings. One step away from the farm, a proportion of goods such as fertiliser, lime, wool, grain and meat moves by rail. However, road predominates in agricultural transport since the major bulky commodities including practically all livestock, milk, and a significant proportion of fertiliser, grain and wool are carried by road. This generalisation is supported by a transport use survey undertaken by the Agricultural Economics Research Unit (AERU) in 1975 in Ashburton County.³ It was found that road transport operators accounted for 81 per cent of the tonnage transported on and off farms, with rail transport accounting for 10 per cent (with road transport to and from terminals), farm transport 6 per cent, leg power (droving) 1 per cent, and unknown modes 2 per cent. Other things being equal, it would appear that the current trend towards closure of branch lines of railways and the relaxation

³ Ambler, T.I. (1975). "Use Made of Transport by Farmers: A Pilot Survey with Findings Relating to Ashburton County", AERU Discussion Paper No.30, Lincoln College.

of road-rail competition may tilt the agricultural freight sector even more towards road.

Air transport is important for agriculture in the form of aerial topdressing of fertiliser and lime (about 50 per cent of fertiliser is spread by air). Weedicides, insecticides, seeds, and animal poisons are the other major agricultural inputs applied by air. With respect to export markets, air transport is essential in the development and maintenance of markets for fruit and vegetables including mushrooms, fresh vegetables etc. But although it has increased in importance over the past few years, air transport accounted for a total of only \$24 million of the value of New Zealand's agricultural exports in the year ending June 1976.

Coastal shipping is not highly significant for agriculture although substantial amounts of wheat usually move from South Island to North Island by this mode. On the other hand deep water shipping is critical to NZ's major export industries; practically all export products are carried by this means as well as NZ's principal imported inputs into agriculture such as phosphate and farm machinery.

How important are transport costs in the supply of inputs to and marketing of New Zealand's agricultural products? A major proportion of New Zealand's agricultural production is exported and it is this sector that is given most attention here.

2.3 Transport and Agricultural Inputs

Transport costs associated with inputs can be divided into direct and indirect costs; for example, transport of sheep drenches to farms from stock and station suppliers could be considered a direct transport cost to farmers and the transport of raw materials to the plant where the drench is made and distribution to agents can be considered as an indirect transport cost faced by farmers. A similar concept can be used with respect to products.

In an analysis of data reported by the New Zealand Meat and Wool Boards' Economic Service from their annual survey of expenditure on sheep and beef farms throughout New Zealand, the cost category 'railage and cartage' estimates farmers' expenditure on direct transport activities for farm inputs and outputs. From the 1976/77 survey 'railage and cartage' made up between 3.9 and 7.2 per cent of total cash costs (excluding interest charges) for the various farm classes, and averaged 5.4 per cent overall. Such railage and cartage proportions are most likely underestimates since data are mostly assembled from farm accounts where input transport costs are often inseparable from material costs, and outward transport costs are often deducted from gross revenues from sale of produce and therefore do not always appear separately in the farm accounts. A preliminary analysis of transport costs incurred by Ashburton County farmers⁴ has estimated that railage and cartage made up 7.4 per cent of aggregate farm expenditure in 1974/75 compared with the estimate of 4.2 per cent of cash costs obtained from the Economic Service Survey for the class of farm predominating in Ashburton County for the same year. If greater accuracy of these figures is considered important, this area clearly requires a greater research effort. Since tonnages moving to and from farms are approximately the same,⁵ it has been assumed in this paper that direct transport costs associated with inputs to farms make up some 3.5 per cent of cash expenditure on farms.

It has also been assumed that indirect off-farm transport costs faced by farmers make up some 10 per cent of the cost of material inputs to farming up to the supply depot. These material inputs account for about 35 per cent of aggregate farm expenditure;

⁴ Ambler, T.I., op. cit.

⁵ Ambler, T.I., op. cit.

thus indirect transport costs incurred by the sheep and wool farm are estimated at a further 3.5 per cent of cash expenditure on farms.

Therefore, a very approximate estimate of the proportion of cash expenditure on sheep and beef farms associated with transport up to the farm gate (i. e. transport costs associated with inputs) is 3.5 + 3.5 or 7 per cent.

2.4 Transport and Agricultural Outputs

Transport is a major component of farm gate to consumer costs for New Zealand's agricultural export products. Table 4 shows the importance of transport costs in relation to total post farm gate transport, processing and marketing costs and in relation to farm gate prices for meat and wool.

Because overseas prices for New Zealand exports are set irrespective of New Zealand production and marketing costs (that is, farmers are price takers for their products), any increase in transport costs will not automatically be passed on to ensure correspondingly higher prices for products sold overseas. It can therefore be assumed that increases in transport costs will result in lowered New Zealand farm gate prices. Of course to gauge the final effect of a global increase in transport charges on New Zealand farm gate prices, the transport component of production and marketing costs for similar or substitute products in competing producer regions would need to be taken into account as well as agricultural and trade policies in overseas markets.

However, given fixed overseas prices for New Zealand products and given that increases in transport costs reduce farm gate prices, Table 4 demonstrates that farm gate prices would be very sensitive to increases in transport costs. This is especially so for meat. The ratio of farm gate price to transport costs for wool is much higher than for meat and hence farm gate prices for wool would be less affected by an increase in transport costs.

TABLE 4
Processing and Marketing Costs and Farm Gate Prices
as Components of Overseas Prices

	Overseas Prices	Total Farm Gate to Market Cost	Transport Component of Farm Gate to Market Costs	Farm Gate Price
Greasy wool (1)				
1975/76 (c/kg)	184	37	23	147
1976/77 (c/kg)	251	45	-	206
Carcass Lamb (2)				
1975/76 (\$/carcass)	21	12	4	9
1976/77 (\$/carcass)	24	14	-	10
Carcass Mutton (3)				
1975/76 (\$/carcass)	15	10	5	5
1976/77 (\$/carcass)	21	12	-	9
Cartoned Beef (4)				
1975/76 (\$/carcass)	150	66	28	84
1976/77 (\$/carcass)	147	72	-	75

(1) Based on greasy wool sold at auction and shipped to Bradford, U.K.

(2) Based on carcass lamb shipped to the Smithfield Market, London.

(3) Based on carcass mutton shipped to Japanese ports.

(4) Based on cartoned beef shipped to New York.

Source: Handbook, New Zealand Wool Marketing Corporation,
1975/76, 1976/77.
New Zealand Meat Producer (various issues).

It is significant to note that sea freight makes up around 75 per cent of costs of transport from farm gate to market for the products appearing in Table 4 (79 per cent in the case of wool, 74 per cent in the case of lamb, 82 per cent for mutton, and 76 per cent for beef).

2.5 Transport and Processing Costs and Liquid Fuel Prices

In the road transport sector, the ratio of fuel and oil costs to total costs of operating a truck, including overheads, depend to a large extent on the truck type and its level of utilisation. It is estimated that liquid fuel costs currently contribute about 15 per cent⁶ of the total costs of rural road transport, where total costs include depreciation allowances but not a return on capital invested. The other internal transport mode, railways, has a much lower fuel cost : total cost ratio.

In ocean shipping, it has been calculated that whereas in 1971 fuel costs made up only about 10 per cent of total costs including loading and stowing and overheads for a containership carrying 1250 containers on long ocean hauls, in 1974 they made up 25 per cent of costs.⁷ Other information suggests that the proportion is less. In this paper an estimate of 20 per cent has been used.

With respect to processing costs, fuel costs are not very high relative to total costs. For example, in meat processing plants fuel and power together only contribute about 5 per cent of operating costs. Other marketing activities such as handling and administration incur little or no fuel costs.

⁶ Using Road Transport Association National Cost Index for October, 1977.

⁷ Laing, E. T. "Containers and their Competitors : The Economics of Deep Sea General Cargo Shipping in the 1970s", Marine Transport Centre, University of Liverpool, January, 1975.

2.6 The Agricultural Sector and Oil Consumption in New Zealand

The farming sector in New Zealand is not a large consumer of oil based fuels. Comparison of data from Brown and Pearson (1977) and NZERDC (1977) indicates that farming consumes 4-5 per cent of total petroleum fuels used in New Zealand. Hence, in addition to the low proportion of farm costs made up by petroleum fuel, farm consumption of imported fuels is not a significant proportion of aggregate consumption. However, the agricultural sector does contribute over 70 per cent of New Zealand's export income and it is likely that, as in the U.S.A., the N.Z. farm sector would be declared an 'essential industry', with high priority for fuel supply, if physical supply restrictions eventuate. The case for such a declaration is strengthened by New Zealand's current balance of payments difficulties.

Nearly 70 per cent of N.Z. fuel consumption is associated with transport and it may be suspected that the transport of agricultural inputs and output contribute significantly in this regard. Most agricultural freight is associated with road transport which makes up about 50 per cent of N.Z. fuel consumption. The largest part (over 60 per cent) of fuel used in road transport is consumed by private cars. Trucks only contribute to about 30 per cent of fuel used in road transport which is about 15 per cent of all fuel used in New Zealand (NZERDC, 1977).

The proportion of the 15 per cent that could be directly attributed to agricultural activity would not be high. Thus, even if a wider definition of the agricultural sector is adopted, the sector is not a large contributor to domestic fuel use in New Zealand.

3. LIQUID FUEL PRICES AND FARM COSTS AND PRICES

What will be the effect of increases in liquid fuel prices on farm costs and prices? Given the preceding relationships between fuel prices and transport costs for the important transport modes serving the agricultural sector and the relevance of transport and fuel costs to the agricultural economy, it is possible to trace the effect of various increments in liquid fuel prices on the total costs faced by farmers, and farm gate prices received.

Table 6 has been constructed to show the magnitude of effects on farm costs resulting from 20, 50 and 100 per cent increases in real liquid fuel prices; Table 7 shows estimates of the effects on farm gate prices; it is stressed that the figures presented here are indicative only of the magnitudes involved, are based on costs and prices for only two years, and assume all other factors affecting costs and prices remain unchanged. Furthermore, these figures do not take account of any reaction or response from producers or transport operators to these potential effects.

Two further qualifications must be made regarding the magnitude of the effects illustrated in Tables 6 and 7.

(i) An oil price increase would be accompanied by increases in costs of agricultural activities and inputs other than transport. For example, machinery, fertiliser, insecticides etc., contain substantial energy inputs in manufacture. The effect of an increase in the oil price is likely, therefore, to increase farm costs by a greater proportion than estimated in Table 6. A similar situation would be faced by transport operators.

(ii) Prices in overseas markets would probably rise in accord with general world increases in transport costs following an oil crisis. Since New Zealand exports involve greater transport costs than competing products, the effect of price rises in our overseas markets would be likely to be less than the reductions in New Zealand farm gate realisations.

The effects of increasing energy costs in general on agriculture in producing areas competing with New Zealand would also be extremely important and are referred to later.

TABLE 6

Effect of Assumed Liquid Fuel Price Increments on Costs
of New Zealand Livestock Farmers

Assumed Fuel Price Increase (%)	Increase in total cash costs of farms from direct purchase of fuels by farmers ^a (%)	Increase in total cash costs of farms from higher input transport costs ^b (%)	Total Increase in cash costs up to Farm Gate (%)
20	1	0.2	1.2
50	2.5	0.6	3.1
100	5	1.1	6.1

a. Assumes fuel and oil purchases by farmers make up 5 per cent of total cash costs of farms.

b. Assumes transport costs of inputs make up 7 per cent of total cash costs of farms; also, assumes fuel makes up 16 per cent of total costs facing the transport sector (road + sea).

TABLE 7

Effect of Assumed Liquid Fuel Price Increments on
Farm Gate Prices of New Zealand Livestock Farmers

Assumed Fuel Price Increases (%)	Resulting Increase in Farm Gate to Market Costs ^a (%)		Resulting Reductions in Farm Gate Price (%)	
			1975/76	1976/77
20	2.6	Wool	- 0.6	- 0.6
		Lamb	- 3.5	- 3.6
		Mutton	- 5.2	- 3.5
		Beef	- 2.0	- 2.5
50	6.5	Wool	- 1.6	- 1.4
		Lamb	- 8.7	- 9.1
		Mutton	-13.0	- 8.7
		Beef	- 5.1	- 6.2
100	13.0	Wool	- 3.3	- 2.8
		Lamb	-17.3	-18.2
		Mutton	-26.0	-17.3
		Beef	-10.2	-12.5

a. Assumes that fuel constitutes an average of 13 per cent of total farm gate to market costs; this figure should vary for each product according to the fuel intensiveness of the farm gate to market activity and the composition of the farm gate to market activities; however, 13 per cent has been used in this paper for all products.

4. RESPONSE AND ADJUSTMENT

4.1 Farm Sector

Because direct costs of petroleum products to farms are a relatively small proportion of their total cash costs, the effect of an oil price rise on farm costs may not be very large (Table 6). If off-farm transport costs are considered, then the direct and indirect transport costs farmers pay for agricultural inputs would also increase due to an oil price rise; however, the magnitude of this effect would be quite small (Table 6). However, such estimates exclude the indirect effects of an oil price rise on the extracting, manufacturing and/or processing costs of agricultural inputs.

Although small in cash cost terms, increases in fuel prices relative to other input prices could lead to some farm level substitution between fuel and other primary inputs. For example, a lesser degree of land preparation for crops but the use of more weedicides could result. Also, there could be some substitution between intermediate farming activities requiring different fuel inputs, e.g. less haymaking and more fodder crops. Finally, there could be substitution between final farm products, e.g. less cropping and greater reliance on grazing livestock. However, such possibilities are considered unlikely unless there is a substantial price rise for oil. This may be so at least in the short term, not only because fuel constitutes a small proportion of total farm costs, but also because fuel is used in activities in which it is difficult to reduce use unless other resources, often of high capital costs, are underutilised, e.g. cultivation equipment and headers.

Whilst it may be true that farmers may keep a more watchful eye on fuel use in order to minimise their fuel bills, such action may not be as concerted as many would believe, and major changes to farming systems may not occur due to cost increases alone.

During the past five years, both New Zealand and Australian farmers have seen a decline in their terms of trade, that is, a decline in the ratio of prices received for outputs to prices paid for inputs. This is the familiar cost-price squeeze often quoted by farm industry leaders. In such times, resource use on farms is often curtailed since it may not be profitable to maintain or increase production. Inputs are reduced to cut costs. Evidence from Australia over the 1973/74 to 1975/76 period suggests that fuel prices to farmers increased over this three year period by a proportion (56 per cent) very similar to prices of all inputs overall (53 per cent).

But over this period what did farmers cut back on due to the overall cost-price squeeze? (Table 8.)

TABLE 8

Input Reductions by Australian Farmers
Over Three Year Period

	Labour	Fuel	Materials	Services
			%	
Pastoral Zone				
- mainly grazing	-36	-21	-45	-38
Wheat-Sheep Zone				
- mainly grazing	-38	-23	-23	-32
High Rainfall Zone				
- mainly grazing	-47	-28	-52	-38
Wheat Industry	-11	-14	- 1	-20

Source: Extracted from Partridge (1977), op. cit.

It appears that the input of fuel was not reduced as much as other inputs except for the wheat industry where inputs of fuel were reduced more than materials and slightly more than labour, but overall in the wheat industry fuel input reductions were similar to total input reduction. This Australian study supports the hypothesis that fuel use on farms is relatively fixed and that there is little scope for reduction.

The situation is further complicated by the fact that oil price increases would influence substantially the costs of other energy intensive inputs such as fertiliser and insecticides. For example, the prices of inputs such as fertilisers and agricultural chemicals may be altered substantially with an oil price rise, creating pressures for greater use of minimal cultivation tillage and control of pests and weeds by biological and management means. The degree to which various inputs rely on oil as opposed to alternative or renewable energy sources is an important factor but not particularly well documented. It is important therefore to expand research into the fuel and transport demands of various management methods and farm inputs to a total support energy framework.

Adjustments on the farm are more likely to originate from the farm gate price effects of an oil crisis than from farm operating cost increases per se. This is especially true for farmers producing meat for export. That this is likely, was illustrated in Table 7 where farm gate prices for meat exports are shown to be proportionately more affected by fuel price increases than costs faced by farmers in production.

Changes in costs of production and prices received for different agricultural products will clearly influence the profitability of different farm enterprises. However, apart from the fact that, of those products included in Table 7, wool seems to be affected in terms of farm gate prices less than lamb, beef, and mutton, meaningful allocation of transport costs between products is not possible without

a substantial research effort. This effort could be useful in assisting with future planning at farm and industry level.

Such research could also compare the transport and support energy 'intensiveness' of New Zealand agricultural products sold overseas with products competing in these overseas markets. Whilst most New Zealand products certainly will be more transport intensive, their total support energy 'intensiveness' may be lower than competing products. Because of New Zealand's greater use of legumes as opposed to nitrogenous fertilisers, favourable climate (allowing outside wintering of livestock), and direct harvesting of pasture and fodder by animals instead of feeding grains, New Zealand agriculture is a relatively light user of fossil fuel inputs. An idea of the relative energy inputs into farming for New Zealand, Australia, United Kingdom and the United States of America is given in Table 9.

TABLE 9

Relative Energy Inputs to Farming

Country	Estimate of Energy Input (GJ/per head of supportable population at current food production levels).
New Zealand	3
Australia	3 - 4
United Kingdom	11
United States of America	9

Source: Brown and Pearson (1977), p.27.

If oil price rises push up the cost of nitrogenous fertilisers, of harvested animal feeds and of indoor heating and lighting, the comparative advantage New Zealand now holds may be increased. Also, other products competing with traditional exports such as chicken and synthetic fibres would be likely to be more energy intensive in production than our traditional agricultural exports and hence may be affected to a greater degree.

On the other hand, a threat to the continued demand for New Zealand's animal products may come from substitute non-animal products (plant products). Much will depend on the response of consumers in terms of the future relative values they place on different foodstuffs.

Increasing oil prices are likely to create balance of payments difficulties in most oil poor countries. Since most of the countries importing New Zealand's traditional agricultural exports do not have extensive oil reserves and/or need to import oil, marketing or market access problems for New Zealand could be accentuated. This suggests that even greater efforts should be made than currently in market development in the Middle East and other oil rich States.

A further question could be posed on the effects of oil price rises on countries competing with New Zealand for traditional markets. Countries like Argentina, with tremendous potential for competing with New Zealand in dairy products, wool and meat, has substantial oil resources herself and is also closer to the North American and European markets than New Zealand.

As mentioned earlier, transport is a major issue. What may be gained in lower energy inputs in production may be lost in the current energy intensive transport system used to transfer New Zealand's products overseas.

Sea transport is the major individual cost in farm gate to market activities for traditional exports. Also, to the modern fast container carrying ships currently in use, fuel is a major cost and

sea transport costs would be influenced therefore to a greater extent by oil price rises than other processing and marketing operations. The New Zealand agricultural sector, and indeed New Zealand governments, have not given attention to ocean shipping proportionate to its importance in terms of its costs, non-competitive structure⁸ and oil intensiveness.

So far attention has been directed towards New Zealand's export agricultural production. In relation to agricultural production for internal consumption, it is interesting to note that on-farm support energy inputs to New Zealand agriculture account for less than one-fifth of the total energy input required to put it on the household table.⁹ No doubt transport activities contribute a significant portion of the remaining 80 per cent. It could be envisaged that as transport costs increase, areas closer to major population centres may gain in comparative advantage in production of food for New Zealand consumption, and less densely populated areas may need to concentrate more on export production.

A potential response from the farming sector that is currently generating mixed reaction in New Zealand is the possibility of energy farming. Energy farming is a concept which can be viewed as a positive rather than an avoidance or negative response from the farm sector to an oil price rise. The replacement of oil based fuels by biomass based fuels appears technically sound. Variables causing most concern in evaluating energy farming proposals concerned with converting agricultural crops (or trees) to ethanol, methanol, and/or biogas are the sustainable yields that could be achieved, distances that

⁸ Chudleigh, P.D. (1977). "Shipping New Zealand's Agricultural Exports: Background and Issues", Research Report No. 85, Agricultural Economics Research Unit, Lincoln College, Canterbury.

⁹ Brown, W.A.N., and Pearson, R.G. (1977). "The Energy Requirement of Farming in New Zealand", Research Report No. 80, Agricultural Economics Research Unit, Lincoln College, Canterbury.

biomass material would have to be transported for processing, net energy gains, and the overall costs of production and distribution.

Alcohol Fuels

Ethanol from fermentation of crops such as beet, pasture or green feed, and/or methanol from gasification of cellulosic material such as wood or straw residue offer an attractive alcohol fuel extender for the internal combustion engine. Current indications from the systems study of the Energy Farming Research Group, New Zealand Energy Research and Development Committee, are that the energetics and economics of some of these options show promise; in particular, ethanol from fodder beet and methanol from straw residues and/or trees. Product prices vary from 15-20 c/litre petrol equivalent in a blend, which compares well with the cost of imported refined motor spirits in New Zealand (of 14.7 c/litre) but is considerably in excess of the ex-refinery price of New Zealand processed crude of 12.8 c/litre. Relative price movements over the next 20 years should however favour the indigenous options, with a marked impact on N.Z. agriculture. For instance, one of the scenarios suggested involves the production of over 1000 million litres of ethanol by the year 2000, which would require a beet planting area in excess of 100,000 ha, or more than the usual annual area of wheat in New Zealand. If such a programme was concentrated in the South Island, significant land use shifts would occur, the actual impact depending on whether product substitution took place on cropping or grazing land. It is likely, however, that because processing economies match assembly diseconomies in plant sizes above 150 OD TPD (oven dry tonnes per day), the number of plants involved in such a development could be around 35-40, which, if strategically sited in rural locations, could provide over 1000 direct rural employment opportunities and could even help to alleviate rural-urban drift.

Biogas

Biogas can be produced by anaerobic digestion from crops or farm wastes. The gas could be used on a small scale basis on individual farms to heat homes, sheds, greenhouses or fuel CNG (compressed natural gas) tractors, or on a regional or national scale to replace Maui gas or imported oil. While the economics of the small scale application look initially attractive, the collection and distribution costs associated with regional or national systems would tend to generate high per unit product prices. A pilot plant is currently operating at the Invermay Research Station, and this should provide more concrete data for further evaluation.

Farming for energy from a crop with end uses other than energy could be important. For example, in the Brazilian Alcohol for Fuel Programme, the major agricultural crop being used is sugar cane which in some areas has the flexibility of being converted into sugar or alcohol depending on world market prices and internal requirements.

The impact of energy farming on foreign exchange balances would also be a major consideration. Calculations carried out by Ross (1975) showed that, while costs of production of energy crops were likely to be high, foreign exchange advantages could be substantial. These initial conclusions have been confirmed by analysis at the farm level. As an example, the fodder beet-ethanol route could produce over 9000 l ha^{-1} petrol equivalent, or an import saving of \$1115. This needs to be balanced against the loss of export income from grazing ($= \$450 \text{ ha}^{-1}$) or use of foreign exchange to import wheat ($= \$660 \text{ ha}^{-1}$), but the net gains are substantial around \$2 of foreign exchange saved for every \$1 foregone by diverting resources from traditional land use patterns.

If the biomass for liquid fuel option is followed in New Zealand, the possibility would exist of a pricing system orientated towards price stability and long term supply contracts. If such a

system were introduced some groups of farmers could be advantaged by transferring some resources away from supply to fluctuating export markets.

4.2 Agricultural Freight Sector

In 1976 it was reported that whilst the costs of fuel, trucks and labour had increased by 250-350 per cent over the period 1968 to 1976, most transport charges to farmers had increased by only around 100 per cent.¹⁰ Reasons given were the use of trailers, larger vehicles, mechanical handling, and better work control. Some of these improvements have also reduced total fuel usage. Likewise, in the dairy industry, the rationalisation of collection routes and increases in the size of milk tankers have resulted in fuel economies over past years. So the road transport industry has demonstrated its ability to increase productivity in the past with, presumably, associated fuel savings.

A number of other suggestions for improving productivity in the road transport industry have been made over recent years:

- (i) Upgrading bridges to shorten trip distances.
- (ii) Advanced scheduling of fertiliser transport and spreading on farms.
- (iii) Increased backloading.
- (iv) Improving loading and receiving facilities to accommodate larger trucks, trailers, etc.

¹⁰ Habgood, J. (1976). "The Road Transport Operators' Present Situation, Viewpoint and Suggestions", Proceedings of a Seminar on Costs Beyond the Farm Gate, AERU Discussion Paper No.32, Lincoln College.

These suggestions may be grouped into two categories:

- (i) Those that require capital to improve aspects of the road transport system.
- (ii) Those that require co-operation and co-ordination among farmers and between farmers, road carriers, and servicing depots.

The second category appears to be low cost and, if adopted, could assist to some extent in holding down fuel use and road charges.

Two areas of apparent transport wastage have attracted much attention over recent years. The first is transporting livestock past the nearest freezing works to be killed at a more distant works. What is forgotten, however, is that the practice is probably quite rational given the current costs of transport, freezing works capacity non-utilisation and marketing considerations. However, it is likely that if transport costs increase relative to other costs, then more localised, and hence fuel conserving, transport patterns may result. The new road distance taxes may initiate greater conservation in this area also, regardless of fuel prices.

The second area of concern regarding excess transport is the aggregation/disaggregation of cargoes at specialised container ports. For example, it appears wasteful of transport resources if wool produced in parts of Southland travels to Invercargill to sale, and is then transported to Dunedin for export. Again, the reason is improved efficiency in another sector, shipping. However, in this case a significant proportion of movements are by rail so that the fuel implications are less significant. A spokesman for Wattie Industries has recently commented on this point; Watties move more than 1000 tonnes of goods per month from processing areas to non-local ports in order to service export markets.¹¹ The important

¹¹Address by Mr G.J. Wattie to Transport Users Forum, Wellington Manufacturers Association, 1977.

question is whether, in the national interest, the extra transport activity and cost within New Zealand is compensated for by the improved efficiency of the sea transport sector; due to the continuing lack of research in the most critical sea transport sector, the answer to this question may never be known.

With respect to shipping, ship speed is a critical factor determining fuel use. For example, a reduction in speed for a large container ship from 25 to 23.5 knots can save about 18 per cent of the daily fuel bill. How important is ship speed in the marketing of our agricultural products? It could be that the benefits of additional speed for our traditional exports may be outweighed by the additional costs involved.

With respect to modal changes in internal transport, recent transport policy changes may result in less rather than more agricultural products carried by rail than by road in the short to medium term even with the introduction of the new road user charges. Since rail is less fuel intensive than road, perhaps fuel price increases could reverse the trend; in turn, this would require substantial pre-planning and reinvestment by railways, greater co-operation between farmers, and much greater attention to efficient functioning of the road-rail interface in rural areas.

4.3 Product Processing Sector

Transport cost increases may influence location decisions of agricultural processing industries. If transport costs increase relative to other costs, and assuming that processing agricultural products generally reduces bulk, it may be more economic for processing plants to become smaller and move closer to production centres in order to reduce total transport requirements; regional development effects could be significant.

The call for increased processing of New Zealand's primary products has been heard increasingly over the past few years. One of the arguments for such additional processing has been the consequent reduction in transport costs, especially those of sea transport. One of the obstacles to such reductions is the way in which freight rates are set by the shipping consortia, that is, charging higher rates on higher valued products. The shipping consortia's reply to such criticisms is that any movement towards a method of rate setting on a cost of carriage basis would mean that the lower valued bulkier cargoes would have to pay more, and so may not be traded. But what is conveniently forgotten here by the shipping companies is that the total volume of cargo to be transported with increased processing will be less and so the demand for ship space less; since a major objective of shipping consortia is to keep as many ships as possible profitably employed on a trade route, this is a situation that they would clearly wish to avoid. Currently, there does not seem to be any clear method by which lower freight rates on higher valued exports can be encouraged; with freight rates set as they are it appears that there is actual discouragement on many shipping routes for developing trades in higher valued products.

With the current dominant position of sea freight costs in marketing agricultural produce (Chudleigh, 1977), further increases in freight rates must be viewed with the utmost concern. The initiative should be taken away from the shipping companies in dictating to New Zealand exporters what type of shipping system is required and the relative rates for various cargoes they will have to pay. This would require increased co-operation between shippers and a greater research effort into sea freight rate formation.

In addition, further processing needs to be carefully analysed with respect to the economics of processing and the availability of markets for any such higher valued products. Important here are the expertise and capital required by local processing industries and their overall economies compared with overseas processing. In addition, the displacement of existing activities in overseas countries and the likely trade and access reactions need to be considered carefully.

4.4 Rural Society

In addition to the effect of an oil price increase upon rural dwellers via the agricultural economy, the direct effects on rural society with respect to private motoring should also be recognised.

Is there a case for rural societies to incur lower increases in liquid fuel prices for private motoring than in urban areas? Such a case could be made on the basis that public transport facilities are obviously less sustainable in rural than in urban areas and that any curtailment of private car usage would be far more restrictive socially in rural areas compared with urban.

What of private car usage which could be considered essential in rural areas, such as access to shopping, schooling and medical facilities? In a 1975 survey of rural women by the Sociology Department of Canterbury University,¹² it was found that rural women

¹² "The Rural Women of New Zealand - A National Survey 1975", Sociology Department, University of Canterbury, in conjunction with the Women's Division of Federated Farmers of New Zealand.

currently visit towns and larger urban centres without very much hindrance. Forty-four per cent of farm women lived within a half-hour's drive from their nearest town and most visited it weekly or more often. Even the nearest large city was visited at least once a month by most rural women, the average travelling time being just over an hour.

Half of the sample of farm women travelled less than 10 miles to a doctor but hospitals averaged a distance of over 30 miles. That there is greater transport requirement in education per rural child than for urban child is beyond doubt. However, it would be interesting to derive estimates for private fuel use for the rural or farm family compared with the urban family. One would expect fuel use to be higher for the rural family but the reverse could be true due to the size and sprawling structure of some New Zealand cities.

In the past these assumed extra transport activities (and costs) of rural living have been accepted as part and parcel of the way of life. Given substantial price rises for liquid fuels, the extra burden placed on rural dwellers could create pressure for differential pricing or rationing policies, subsidisation etc. Perhaps more constructive debate on the merits and dangers of such measures could be achieved if more accurate information were available on the demand for transport and transport use in rural areas. In this respect it is perhaps worthy of note that the Road Research Unit of the National Roads Board has recently identified the need for this kind of information and has initiated research projects accordingly.

5. SUMMARY AND CONCLUSIONS

(i) Direct petroleum fuel costs are only a small proportion of total farm costs. Also, fuel use is an essential input in many farming activities. To initiate an effective reduction in fuel use through the curtailment of certain farm activities by substitution of other inputs for fuel, or by changing product mixes, a fuel price rise may have to be quite substantial.

(ii) Because of the dependence of New Zealand on overseas markets to set prices for agricultural exports, farm gate prices for different products will be influenced directly by increases in transport and processing costs stemming from an increase in oil prices. Other things being equal, such potential farm gate price reductions could vary substantially from product to product and may alter the product mix on farms as well as exacerbating the already tight cost-price squeeze on New Zealand agriculture.

(iii) On the other hand, the existing lower energy intensiveness of New Zealand agriculture could mean that any existing comparative advantage in production may be widened even further. However, such benefits may be more than offset by the higher transport costs and it is difficult to ascertain on which side the overall advantage may accrue. In this respect ocean shipping is a key activity and the agricultural sector should ensure that appropriate research is conducted in this area. The transport intensiveness of different agricultural products needs researching further to provide input for future planning at farm and industry level. This may be best achieved in a total support energy context.

(iv) Traditional markets may have to be reappraised and possibilities for new markets in oil rich nations anticipated and explored more thoroughly.

(v) Preliminary indications from economic analyses of energy farming systems yielding liquid fuels are favourable. The implications for agriculture in this respect appear considerable.

(vi) Lowering fuel usage in the agricultural freight sector in the future may depend in part upon increased co-operation and co-ordination between farmers and road transport operators. The rationalisation of transport flows of livestock to freezing works and the encouragement of more flexible shipping systems could result from increased liquid fuel prices.

(vii) Increased processing of New Zealand's primary products should lower overall transport costs although opposition from shipping companies may exist. In this regard it is important that New Zealand exporters are encouraged to increase their knowledge of, and interest in, current and potential overseas shipping systems, particularly with respect to freight rate formation. Market access, processing costs, and environmental issues are important factors in the question of further processing.

(viii) Current trends for more agricultural products to be carried by road rather than rail may be reversed if large fuel price increases occur. Such a reversal will depend on future policies of New Zealand Railways.

(ix) More constructive debate on whether rural dwellers should be favoured in terms of fuel price differentials or quotas would follow if more information on the current relative demands for transport in rural and urban areas were available.

The overall message of this paper is that more and more information over the next decade in various fields associated with agricultural and rural transport will be required. It is important that this need is recognised now so that the appropriate research and information collation will have been carried out for the time when policy makers require it.

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