

# The Economics of Grassland Development and Improvement in New Zealand<sup>1</sup>

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New Zealanders are faced with the need for expanding their economy to maintain or possibly to increase the living standard of their rapidly-growing population. Grassland is the basis of their major export industries and has the potential for substantial physical expansion. This article deals with the economics of grassland development and improvement in New Zealand in the recent past and the immediate future. "Development" refers here to opening up new grassland and "improvement" refers to increasing the productivity of existing grassland. In actual practice, these two ways of producing more grass cannot always be separated.

## Background

New Zealand is a grassland

farming country. Its 90,000 farms, mostly of family size, include about 31 million acres of grazing land and only about 1 million acres in harvested crops, the major portion of which is used for livestock feeding. These grasslands carried 39 million sheep, nearly 2 million milking cows, and 4 million other cattle in 1955 (6).<sup>2</sup>

New Zealand is the world's largest exporter of dairy produce, the second largest exporter of wool, and a large exporter of lamb. Farm products provided more than 90 percent of the value of exports of New Zealand in 1954-55 (6).

New Zealand has a temperate climate. In the pastured areas the average annual rainfall varies from 20 to more than 100 inches. but it is more or less evenly spread. Except for occasional, comparatively short periods, droughts are the exception. Some pastures need drainage while others in the drier sec-

tions can profitably be irrigated.

Most of the country is mountainous and steep; only about 20 percent of the land is flat and rolling. Soils vary greatly in fertility; most of New Zealand's high soil fertility is man-made.

Good New Zealand pastures consist of mixtures of grasses and legumes. Perennial ryegrass and white clover are basic to most good pastures; however, many other pasture seeds are added or substituted in the seed mixture, depending on climate, soil, location, and purpose of the pasture. Most pastures require phosphate fertilization for optimum growth of the legumes and some also need lime, potash, or trace elements. Nitrogen is generally provided by the legumes and rarely given in the form of commercial fertilizer.

In many sections of the country pasture growth never ceases, although grass production varies greatly during the different seasons of the year. Livestock graze throughout the year. Generally, no concentrates are fed and no stall-feeding is done.

The mountainous and high country is used mainly for the production of wool and the raising of sheep replacements. The carrying capacity of much of this land is now low. Beef cattle are used primarily to eat off surplus pasture growth left by sheep and to crush invading fern and shrubs. The better, low-lying lands are used intensively, for

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<sup>2</sup> Numbers in parenthesis refer to Literature Cited.

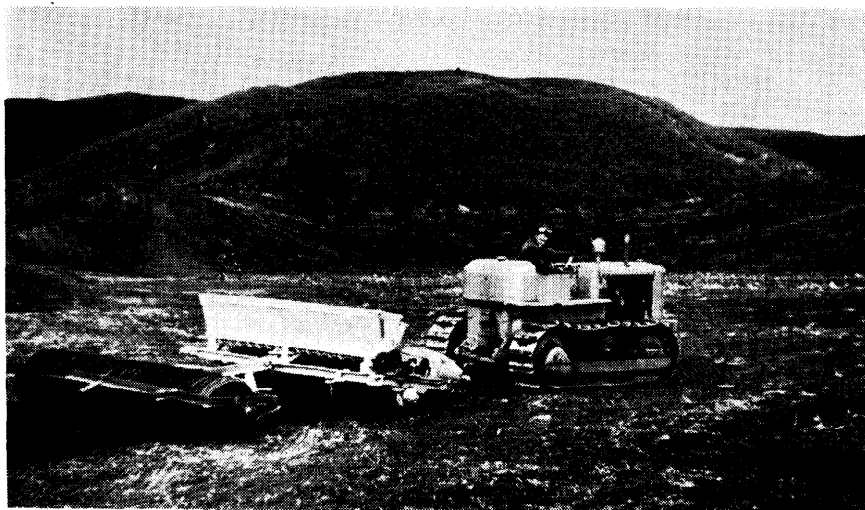


FIGURE 1. Grass seeding on formerly cobalt deficient land near Rotorua, New Zealand. The cobalt-deficient condition is remedied by applying 300 pounds per acre of cobaltized superphosphate at seeding time, 300 pounds 4 to 6 months after seeding, and 200 to 300 pounds annually thereafter. Note original fern and brush vegetation in the background.

dairying, lamb production, and for finishing of sheep and cattle.

#### Pasture Development and Improvement

It has been estimated that another 2¼ million acres of now unoccupied land are suitable for pasture development in New Zealand (1). This total includes land which has never been improved or which has totally reverted to fern, brush, or forest.

An area of over a million acres of virgin pumice land in the center of the North Island is now being developed along the following lines: Where mechanized ground equipment can be used, the brush is crushed with a tractor-drawn roller and burned. The land is then plowed, disced, harrowed, and rolled both before and after sowing. In this area a typical seed mixture per acre consists of 20 to 25 pounds of perennial ryegrass, 8 to 10 pounds of cocksfoot, and 2 pounds each of white and red clover. At seeding time 300 pounds per acre of cobaltized superphosphate are applied. Another 300 pounds are applied 4 to 6 months after sowing and 200 to 300 pounds annually thereafter. Young pastures are con-

solidated by rotational stocking with sheep, and fern and brush regrowth is prevented by heavy seasonal stocking with both sheep and cattle. Where the land is too steep for mechanized ground equipment, the brush is burned and the land is fertilized and seeded from the air.

About 10 million of the 31 million acres of pasture in New Zealand were sown after cultivation, mostly on flat and rolling land. Some farmers have improved this type of pasture as

much as is now economically justified, and a few have even gone beyond this point. These high-producing pastures may carry one cow and more or 8 to 10 sheep per acre. Other pastures could profitably be improved by seeding superior strains of grasses and legumes or special-purpose grasses, such as early- and late-growing species. Some pastures need additional fertilization, subdivision fencing, drainage, or irrigation. These practices would allow better stock management and heavier stocking on a permanent basis.

Another 8 million acres of pasture, primarily on the North Island, were originally surface-sown into the ashes of the burned forest. Much of the land sown by this method is unplowable hill country with low natural fertility. Good species of grasses and clovers were originally sown. However, once the fertility created by the ashes was used up, less desirable grasses and weeds took over, the soil began to erode, the carrying capacity declined, and much of the land reverted to fern and brush. This pasture deterioration is reversible under good management based on fertilization,



FIGURE 2. Formerly cobalt deficient land two years after seeding. This is a government development project in the "station stage". The cattle are "agricultural implements" used to crush and eat off roughage, fern and brush left by the sheep.

reseeding with suitable legumes and grasses, subdivision fencing, adequate stocking with cattle during crucial periods, and rotational grazing.

About 13 million acres, mostly in the lower rainfall, hilly, and mountainous areas of the South Island, are in native grasses, primarily tussock species (11). Many of these grasslands are lacking in legumes. Some are suffering from the consequences of overstocking and a formerly heavy population of rabbits. Others are still infested with rabbits. Many of these pastures can be improved by the introduction of suitable legumes, the addition or substitution of other grass species, fertilization, rabbit control, fencing, water and soil conservation practices, and stock control.

From the end of World War II to 1957, improvement and development of grassland in New Zealand along the lines just discussed proceeded at a high rate. A good indication of the amount of improvement done was the increase in the area fertilized from 3.6 million acres in 1945 (8) to 9.2 million acres in 1957 (7). New grasslands were developed at the estimated annual rate of 150,000 acres during the mid-50's (1). This new grassland did not add to the total grassland acreage, because marginal hill country was reverting to brush, and

because land was being set aside for soil conservation or National Parks, or was used for urban development.

Six major factors primarily brought about the high rate of grassland improvement and development after World War II. These were:

1. Technical advances
2. High farm incomes and availability of credit
3. A favorable income tax law
4. Subsidies
5. Direct grassland development by the state
6. Profitability

#### Technical Advances

During the post-war period, technical advances were ready for exploitation. Some mineral deficiency problems in soils were solved, new or improved equipment and methods of establishing and managing pastures were developed, better seeds were available, and know-how of drainage and irrigation methods increased.

Two examples may illustrate the importance of recent technical advancements to grass producers.

1. The above-mentioned virgin pumice lands in the center of the North Island had been lying unused because pasture animals there suffered from an unexplained

disease called bush sickness. With the addition of 5 ounces of cobalt per acre, the animals were kept healthy. As a result the area is now becoming one of New Zealand's high-producing pastoral districts.

2. Before 1949, more production of grass in hill country was held back because the land was inaccessible to machinery. Bringing in fertilizer and seed by pack-horse and distributing these by hand had become prohibitive with the increase in the cost of labor. The use of airplanes to seed and fertilize this type of land overcame the obstacle. In 1957, almost 4 million acres—over 40 percent of all grassland fertilized in New Zealand—were topdressed from the air (7). Other uses of airplanes on New Zealand ranches now include dropping of posts and fence wire from the air, spraying and dusting, and distribution of poison bait against rabbits. There are now an estimated 12,000 farm airstrips all over New Zealand.

#### High Farm Incomes and Availability of Credit

Another major factor contributing to grassland improvement



FIGURE 3. Results of two methods of controlling gorse (*Ulex europaeus*). The pictures were taken on adjoining fields. *Left*: Old method—the gorse was burned, but the pasture received no further treatment. *Right*: New method—the gorse infested land was bulldozed, cultivated, reseeded, fertilized, and sprayed where necessary.

and development was the high level of farm prices and farm incomes during this period. With 1952=100 as a base, the index of New Zealand export prices of pastoral and dairy produce rose from 50 in 1945 to 75 in 1949 and averaged 113 from 1950 to 1956 (6).

The index of New Zealand gross farm income from pastoral produce, with 1938-39 as a base, increased from 141 in 1945-46 to an average of 475 for the years 1949-50 through 1955-56 (7). As a consequence of their high incomes, many farmers could finance some or all of their developments out of current earnings. To those who could not, fairly easy credit was available at reasonable cost from both private and state lending institutions. Farmers lacking adequate customary security for a loan, could apply for assistance under the terms of the Marginal Lands Act of 1950, which was enacted especially for this purpose.

#### A Favorable Income Tax Law

Improvement and development of grassland proceeded at a high rate partly because the income tax law in New Zealand encourages such practices. Tax rates increase at the rate of 1¼ percent for every \$280 of increase in taxable income. The exchange rate used in this article is \$2.80=£ (N. Z.) 1. The maximum income and social security tax rate of 67½ percent applies to incomes of about \$10,000 or more above exemptions. All costs of clearing and cultivating land, seeding to grass, and fertilizing are deductible expenses in the year in which these costs are incurred. Costs of controlling weed and animal pests are also deductible. Capital improvement costs for drainage and irrigation, erosion control, rabbit-proofed fences, construction of access roads and airstrips are deductible up to \$840 per year.

Unlike the United States, cap-



FIGURE 4. Where the land is too steep and rough for the operation of power machinery, the airplane is used for fertilizing and seeding. This New Zealand farmer looks over his land, all of which has just been fertilized by air.

ital gains are not taxable in New Zealand. A farmer who improves his grasslands may pay little income taxes for years. When he sells his land he pays no tax on the profit of the sale. However, he must delay the sale for 5 years from the date he acquired the land; otherwise he is required to pay income tax on all previously allowed deductions (9).

#### Subsidies and Direct Grassland Development by the State

Subsidies for grassland improvements came from several sources, either from public funds or from reserve and stabilization funds held by quasi-public organizations of the farming industry. Transportation of lime and fertilizers, importation of fertilizers, control of rabbits and wild pigs, and soil conservation work were subsidized during part or all of the period under consideration (5).

Government departments developed unimproved or totally reverted land at the rate of 60,000 acres per year in the mid-1950's. These departments develop land in large blocks averaging from 3,000 to 6,000 acres. Each block is operated as one ranch for several years and then

subdivided into individual holdings and settled. The development work is usually done by private contractors operating with modern equipment. Governmental development is financed partly from public appropriations and partly from the sale of pastoral products raised on the land blocks under development and from the sale and rental of the developed individual holdings.

The major land development agency of the government is the Department of Lands and Survey. For several years in the mid-50's, it developed 50,000 acres of crown lands annually (2).

Most of the grassland development and improvement on Maori lands is being done by another government department, the Maori Affairs Department. Mostly because of plural land ownership, Maori land development has been slow. During the last two decades, however, the activities of the Maori Affairs Department have improved the situation. With the approval of the Maori owners, this department may take over lands temporarily for development purposes. After completing the grassland development and sub-

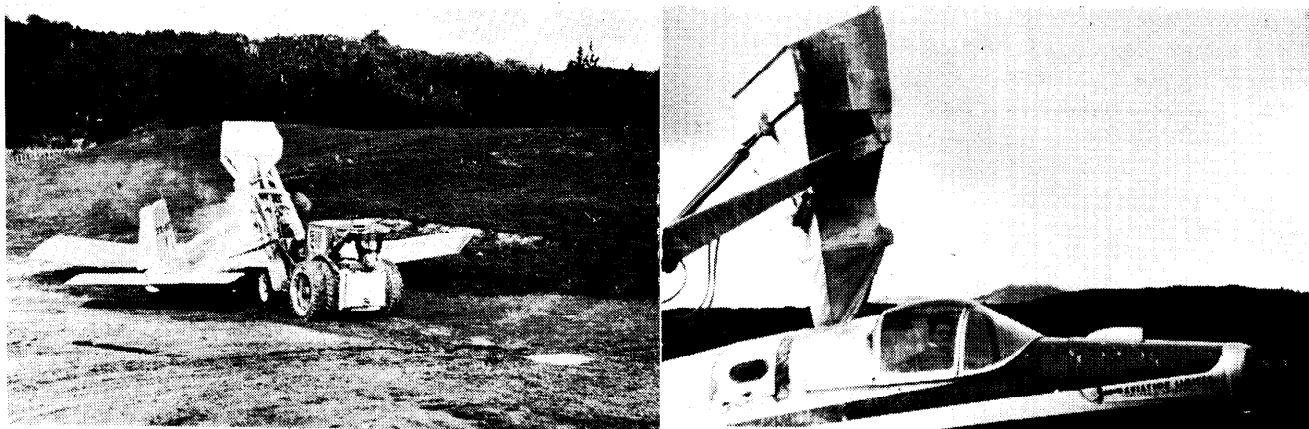


FIGURE 5. *Left*: Mechanical loading of fertilizer into a plane in New Zealand. Efficient operation demands minimum time on the ground for the plane. The loading operation takes 50 seconds or less. *Right*: Close-up of the mechanical loading of fertilizer into the plane.

division, the department returns the land to Maori settlers. During the mid-50's, the department seeded lands under its control at the rate of 10,000 acres annually (4).

#### Profitability

Up to 1957, the relationship between marginal returns and costs of grassland development and improvement, at the then existing level of improvement intensity, was favorable on many farms. For example, pastures on a typical hill-country sheep ranch were oversown with some grass and clover seed and twice fertilized by airplane with 224 pounds of superphosphate per acre. The carrying capacity of these pastures increased from one sheep per acre before the improvement program started, to two sheep per acre after its completion. The annual net return from oversowing and fertilizing during the three-year improvement period was estimated at \$1.27 per acre above the annual improvement cost of \$3.53 per acre (10).

During the fiscal year 1957-58 New Zealand prices for most pastoral produce declined. Export receipts for these products declined by about 20 percent or an estimated \$142 million from the preceding year (12). Farm costs are not expected to decline

much, primarily because of New Zealand's rather inflexible wage structure and its dependence on imports for much of its capital equipment and supplies.

Past shifts in the rate of grassland improvement in response to changes in return-cost relationships may be indicative of future trends. In the 4 years preceding the 1930-35 depression, when fertilizer prices were low compared to prices of pastoral produce, fertilizer consumption increased by 80 percent. During the depression, fertilizer prices did not fall much, despite the introduction of a small subsidy. With a less favorable relation between fertilizer and pastoral product prices, average fertilizer consumption in the years 1930-31 to 1934-35 was 27 percent lower than during 1929-30 (3).

If the less favorable price-cost relationship which existed in pastoral agriculture in 1957-58 continues, the rate of grassland development and improvement on private farms can be expected to drop. In the past, even during the period of high produce prices, some expansion of grass production was pushed beyond the level where marginal returns equalled marginal costs, both on the intensive and on the extensive margin. For example, dairy farmers in some high-producing areas applied as much as

5 cwt. of phosphate fertilizer per year, when 2 cwt. would probably have been more profitable. Grassland development on some poor hill country, which was marginal before, will now become unprofitable. The improved competitive position of crops such as wheat and the urging of farm and government leaders toward more diversification may also have the effect of diverting resources away from grassland development and improvement (13).

The future rate of grassland development by the government will depend mainly on the level of receipts from the sale of pastoral produce and on the level of public appropriations. The latter will be affected by the financial condition of the Dominion and by the economics and politics of developing grasslands rather than other sectors of the economy. If funds available for government development of grassland should be cut, labor and capital could be saved by continuing to hold developed lands temporarily in the block or station stage rather than by subdividing them into family-sized units. In view of the continuing over-employment situation in the country, any freed manpower could easily be absorbed elsewhere in the economy.

### Summary

A combination of favorable factors brought about a high rate of grassland development and improvement in New Zealand during the period from the end of World War II to 1957. New techniques and know-how in developing and improving pastures were exploited to the extent that in most cases additional returns from expanding grass production exceeded additional costs. High farm incomes often provided the capital needed for the increase in grass production. The government encouraged farmers to expand production by making available credit, by a favorable income tax law, and by outright subsidies. In addition, the government was itself in the business of developing and improving pastures on a large scale.

With the decline in prices of most pastoral products during

the fiscal year 1957-58, the expansion of grass production has become less profitable on pastures with a high improvement potential and unprofitable on pastures with a low improvement potential. Unless the return-cost relationships become more favorable, it is reasonable to expect some decline in the over-all rate of grassland development and improvement in New Zealand.

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