EFFECTS OF CROSSBREEDING AND SELECTION ON THE PRODUCTIVITY AND PROFITABILITY OF THE NEW ZEALAND DAIRY INDUSTRY

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ABSTRACT

This aim of this thesis was to evaluate some effects of crossbreeding on the New Zealand dairy industry. The study started with a review of crossbreeding parameters, followed by the development of two models.

A farm model was developed to evaluate the productivity and profitability (net income per hectare) of mating strategies involving the main breeds farmed in New Zealand; Holstein-Friesian (F), Jersey (J) and Ayrshire (A). Under current production costs and values for milk and beef, dairy herds using rotational crossbreeding systems had higher net income per hectare than straightbred herds. The ranking of mating strategies on profitability altered with changes in the relative values of fat and protein (1:4, 1:2.2 and 4:1) but rotational FJ and FJA herds had higher net incomes than straightbred herds across three values for the fat to protein ratio and two values for meat (current and 50% higher than current).

An industry model was constructed to evaluate the effects of mating strategies on the rate of genetic gain and the productivity (yields of milk, fat and protein) of the dairy industry over 25 yr. The mating strategies simulated were upgrading to F (UPGF), upgrading to J (UPGJ), upgrading to A (UPGA), rotational crossbreeding using two or three breeds, and use of best bulls (UBB) irrespective of breed. Upgrading to either J or F increased the number of potential bull mothers from 0.27 million to 2.03 and 2.15 million and resulted in genetic gains of 0.27 genetic SD/yr, for both options. Rotational FJ decreased the number of potential bull mothers to 0.17 million and resulted in a genetic gain of 0.24 genetic SD/yr. Upgrading to F and UPGJ resulted in divergent averages of live weight and yields of milk, fat and protein per cow. On the basis of production per hectare, UPGF resulted in lower stocking rate, higher milk yield, and less fat and protein than UPGJ. Effects of the rotational FJ strategy on live weight per cow, and yields of milk per cow and per hectare, were slightly different from the average values for UPGJ and UPGF, due to the effects of heterosis.

The farm and industry models were combined to calculate industry profit for the different mating strategies for 25 yr. Industry yields of standardised whole milk powder, butter and casein were calculated from industry yields of milk and its components. Profitability was calculated as income from dairy products and salvage animals less on-farm costs of production and off-farm costs of milk collection, manufacture and marketing. The ranking of the different mating strategies was affected by the value for butter. When marginal butter sales (above the total industry yield in the base year) were worth only NZ$0.45/kg, UPGF resulted in the highest industry net income (NZ$1119 million) followed by straightbreeding (NZ$1086 million) and rotational FJ (NZ$1076 million). However, if the marginal value of butter production was assumed to be equal to the average base value, then UPGJ resulted in the highest industry net income (NZ$1185 million) followed by rotational FJ (NZ$1177 million) and UBB (NZ$1173 million). Despite the widely different mating strategies used for 25 yr, the largest difference in net income was only 10%.

Rotational crossbreeding systems can increase the profitability of commercial herds, but wide implementation of crossbreeding in the dairy industry reduces the number of active cows (bull mothers) and therefore penalises the rate of genetic gain of the entire population. Future values of dairy products have a major impact on the relative value of breeds and are therefore important to any decisions about mating strategies.

If I take the wings of the morning,
and dwell in the uttermost parts of the sea;
Even there shall thy hand lead me,
and thy right hand shall hold me.

Psalms 139:9-10.

Dedicated to Silvia

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