DYNAMIC COMPUTER MODELS TO IDENTIFY THE OPTIMAL SYSTEM AND MANAGEMENT OF POPULATION STRUCTURE FOR SELF-CONTAINED MEAT SHEEP CROSSBREEDING ENTERPRISES

HESHMATOLLAH ASKARI-HEMMAT

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at the University of New England
Armidale, NSW 2351
AUSTRALIA

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TO MY FATHER

In the name of the Most High God

Foreword

The study presented in this thesis is original and was initiated by the author while in receipt of the Ministry of Culture and Higher Education of Iran postgraduate scholarship, and under supervision of Professor B.P. Kinghorn.

I certify that this thesis has not been submitted for any degree and is not currently being submitted for any degree.

Any help received in preparation of this thesis and all sources used have been acknowledged in this thesis.

H. Askari-Hemmat *September, 1997*

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Summary

Two deterministic computer models for the choice of the crossing system possessing optimum design flock structures, for self-contained meat sheep crossbreeding enterprises were developed, using Microsoft Excel's Solver software. Both of the models use a dynamic strategy for optimization of the flock structures for a time period of 10 years.

There are two breeds of sheep and up to three flocks considered in each model. Also, the initial total number of the ewes in the flocks to commence the crossing system with, is an optional input parameter which should be determined by the breeder. At any time for a given set of the input data, the computer models search all options to determine the optimal structure of the flocks under a detailed year-by-year scheme. The models predict the relevant parameters while applying the standard cash flow discounting method (optional), and propose either a rotational crossing, a terminal-rotation crossing, a single two way crossing, or a combination of these systems. Meanwhile, the flock structures, and most of the important phenotypic, genotypic and economic parameters are displayed diagrammatically for a clear understanding of the simulation modeling.

The input data which are almost comprehensive should be given to the models by the breeder, being as follows: weaning rate of the ewes, weaning rate of the maidens, slaughter weight of the lambs, body weight of the culling ewes, ewe replacement rate, greasy fleece weight of the ewes, greasy fleece weight of the hoggets, greasy fleece weight of the yearlings, clean fleece weight : greasy fleece weight ratio (= yield), fibre diameter, ewe mortality, weaning to hogget mortality, weaning to slaughter mortality, costs of husbandry per ewe per year, costs of feed per ewe per year, costs of feed and husbandry per slaughter lamb, costs of feed and husbandry from birth to yearling, costs of feed and husbandry from yearling to hogget, costs of marketing per ewe, costs of wool harvesting and marketing, price of 1 kilogram of clean wool of 21 microns in diameter, extra price (negative and/or positive) per 1 kilogram of clean fleece for each micron deviating from 21 microns, price of the purebred replacement hoggets and that of the purebred ewes for the two initial years of the crossing system, price of the ewes per kilogram body weight, price per kilogram live weight of the lambs, discount factor, total number of the ewes for commencement of the system, and finally, heterosis for the most important traits in the reciprocal crosses.

The computer models predict the following cases, being offered in the year-by-year diagrams: ***Phenotypic parameters****, most important of which being: slaughter weight of the lambs, body weight of the ewes, greasy fleece weight, fibre diameter, weaning rate, and ewe replacement rate.* ***Genetic parameters****, i.e., degree of heterozygosity, breed difference, gene proportion of the breed (usually) superior in meat production, for the ewes and hoggets, and also gene proportion of each breed for the slaughter lambs.* ***Management parameters*** *include: number of the ewes in the flocks, number and source of the migrant hoggets as replacements, number of the slaughter lambs, number of the salvage animals (implicitly) and number of the losses.* ***Economic consequences*** *for the proposed system, e.g., the cumulative discounted net profit, applying the standard cash-*

flow discounting method (optional) for each economic year, as well as other economical aspects.

*One of the models is designed for a **stable** flocks' size regime and the other for a **variable** one, both using the data attributed to the Australian Merino (M) and Border Leicester (BL) sheep breeds. In the former, the flocks' size is stable in all years of crossing and in the latter, it is allowed to vary from one year to another. In a comparison of the models running with same input data, the model with a stable regime proposed a terminal-rotation crossing, and that having the variable one, a combination rotational crossing system including some sub-systems of rotational crossing.*

The initial number of the ewes in the variable model was held constant and only this number for the other model changed until a cumulative discounted net profit, equivalent to that for the variable model was gained in the final year of crossing. The stable model resulted in a remarkably higher average cumulative discounted net profit per ewe, i.e., 20.21% more benefit per ewe, compared with the variable model, owing to a 20.25% smaller cumulative number of the ewes in the former, acknowledging that the ewe and hogget costs are among the main economic components affecting the whole optimized population structure. Further, the crossing system suggested by the stable model, helps produce more desirable meat, by means of less variations in the meat quality in subsequent years of crossbreeding due to less variations in the BL's gene contribution.

It was concluded that the variable model would be more suitable where a lower amount of the initial investment and also limited resources are available to the breeder at the commencement of the crossing system. Another conclusion in this regard is that, if there are no limitations in terms of provision of the required husbandry facilities, and also if the delay in acquiring a notable amount of profit until the final two years of crossing is admissible, the variable model is more desirable though there will be a smaller profit gained per ewe raised. The argument was given in the text.

Also, the standard cash flow discounting method had no effect on the flock structures, when equal numbers of the ewes were used for the commencement of the systems in with- and in without cash flow discounting procedures, using same models at a time. However, trend of the annual net profit changed, when cash flow discounting method was applied.

Conversely, when setting the proposed systems for equal cumulative net profit gained through different initial numbers of the ewes, in both with- and without cash flow discounting procedures, the whole flock structures had some minor changes. In other words, (only) the cumulative number of the lambs sold was affected (but dramatically) in a reverse direction, from a 0.5% larger number, to a 7% smaller one in the stable model in comparison with that in the other one, in a without- and in a with cash flow discounting manner, respectively.

In the same status as above, in the stable model, the average cumulative net profit per ewe remained almost proportionately higher, in accordance with the cumulative number of the ewes which was held proportionately lower when discounting was applied, although the initial number of the ewes for commencing the system did not change proportionately from the with- to without cash flow discounting procedure. There was

16% difference between the changes occurred (from 500, the initial number of the ewes) in this number in same economical circumstances applied to both models.

A further conclusion is that, the cumulative number of the ewes, as well as the average cumulative net profit gained per ewe are important factors in optimization of flock structures with optimal profitability, as they changed almost proportionately, in the different conditions applied.

Finally, the models allowed little variations in the flock structures from optimality, e.g., small proportions of the female lambs and/or hogget ewes could be sold with negligible effect on the optimal profitability of the proposed crossing system.

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