

Book reviews

The Potential Effect of Two New Biotechnologies on the World Dairy Industry, by Lovell S. Jarvis. Published by Westview Press, Boulder, Co, 1996, pp. ix+153, ISBN 0-8133-8837-6.

The development of biotechnologies and their adoption by agricultural producers are expected to have very far-reaching impacts on the processes and products of agricultural industries worldwide during the next decade. In this book the author examines the potential effects of the first major biotechnologies developed, recombinant bovine somatotrophin (rbST) and multiple ovulation and embryo transfer (MOET), on world dairy industries. Both technologies are presently used by dairy industries to some extent. In the United States rbST was first approved for on-farm use at the end of 1993 although it is not yet approved for use in the European Community, Australia or New Zealand. MOET has been employed in developed countries for two decades and a number of developing countries are now using the technology at the experimental level. In this study Jarvis analyses the microeconomic impacts of rbST and MOET in both developed and developing countries with reference to the factors expected to influence adoption and profitability, estimates their likely effects on milk costs and develops simple projections which he describes as giving 'a rough indication' of the potential impacts of the technologies on world dairy markets in the medium term.

In chapter 2 the biological impacts of rbST are defined, the concerns which have been raised over its use in US dairy herds are briefly evaluated and a number of factors which will determine its adoption and profitability in both developed and undeveloped countries are examined. Jarvis uses the data from a number of papers written during the last sixteen years on the potential economic impacts of rbST, modified by more recent information on price and adoption rates, to formulate the assumptions which he uses to estimate the effects of rbST on milk output. He concludes that rbST is likely to be used in most developed countries within two decades, unless a major health problem emerges, but acknowledges that there will be considerable variation in the levels of adoption in these countries. However, he concludes that because of the nature of the productive environment and the management and nutritional constraints faced by producers in developing countries there will be relatively little adoption of rbST in the next two decades in these countries. It may eventually become widespread as

management, nutrition infrastructure and herd genetics improve and the price of rbST declines when its patents expire.

In developed countries MOET has been used for a number of years although it is still not fully refined. Its potential gains for the dairy industries of these countries are described only briefly in chapter 3 which focuses primarily on the use of MOET in developing countries. MOET's uses in advancing the rate of genetic gain through its inclusion in breeding programs or as a component of open nucleus breeding herds are outlined. However, it is concluded the use of MOET in breeding programs may be of considerable value in the longer term but this will have little effect on milk production from developing countries during the next decade. A model of the expected economic value of the technique in providing a continuous supply of F1 crossbred cows as a means of sustaining higher milk yields in developing countries is described in some detail. The model, which incorporates the main factors determining whether the production of an F1 calf through MOET, or an F2 calf through natural service, will be more profitable, was used to analyse the relative profitability of MOET and natural service under varying assumptions about those factors. The results suggest that the use of MOET to produce an F1 female calf has the potential to be profitable under relatively favourable conditions but that it is unlikely to be profitable for the majority of producers in developing countries during the foreseeable future.

A brief analysis of the world dairy industry during the past two decades is presented in chapter 4 and the projected effects of rbST and MOET on world dairy markets are discussed in detail. The approach taken by Jarvis and Atanu Saha to estimate these effects is the derivation of simple projections using the past rates of growth of milk production and consumption to project future growth rates. Trends in production for each of the countries included in the analysis were estimated by regressing past annual production on an exponential trend and using the estimated trend to estimate production to 2000 and 2010 using 1988 as a base year. A similar approach was used in estimating consumption trends which with regional income elasticities were used to estimate the milk consumption in each country to 2000 and 2010. The production surpluses and deficits for each country were summed to estimate the regional and world position in each of those years. The projections are based on the explicit assumption that governments will regulate to maintain constant real milk prices.

Irrespective of whether future levels of production and consumption are modelled on trend data from 1961–1988 or more recent data from 1980–1988, the adoption of rbST and MOET is projected to lead to large world surpluses in 2000 and 2010. Where the more recent trend data is used, these surpluses are so large that it is conceivable that the world milk market

would exist only as a series of arrangements between surplus countries unable to market product commercially and deficit countries without the means to pay for imports. Although the author acknowledges that the projections are too crude to determine whether adoption of rbST and MOET will cause significant market disruption, they do not support those who argue that the output changes caused by rbST could be absorbed without undue adjustment cost.

In summary, the author observes that the adoption of these two technologies will increase the returns to good management and to scale, thus resulting in a dairy industry with fewer larger herds, fewer more productive cows and fewer more skilled farmers. In the United States the total benefits of adopting rbST to producers who can profitably adopt, as well as to domestic consumers, will outweigh the costs imposed by declining prices on smaller less profitable dairy farms, but the industry adjustments which will be required in response will be large. In the absence of the identification of a threat to human health he believes that most other developed countries will approve its adoption to preserve their competitive position. MOET is not likely to become a general practice in developed countries because it is only marginally cost effective, although its impact on world dairy production is likely to increase as its use becomes more economical.

In the developing world the use of rbST will not be profitable in the medium term and MOET is unlikely to make a great contribution to improving herd genetics during the next decade. More evidence is required to determine whether it is economic to use the technique to produce F1 crossbred cows. The timing of the adoption of these two technologies in those countries will depend on the rate at which other technological changes, which are a prerequisite for the profitable use of rbST and MOET, are made.

The value of this book lies more in the discussion of the issues involved than in the projections which are made. The methodology used is not a rigorous econometric attempt to model the interactions of government policy, price and supply. Rather, simple projections are made which are based on assumptions which might well be challenged. The experience of the United States is drawn on heavily to predict the response of the dairy industries in other developed countries to rbST. Following the BSE scare in Britain, the European Union may be considerably more reluctant to approve the use of rbST than is assumed in this study, particularly as member countries are trying to reduce dairy surpluses rather than increase production. For major dairy exporters such as New Zealand the risk of damaging trade relations with the European Union and the lower likelihood of achieving economic gains in grass-fed systems have meant that there is no industry pressure to license rbST. More importantly, the author

acknowledges that the assumption of constant real milk prices as a consequence of government support in the future is increasingly unlikely after the Uruguay Round. This book presents an interesting attempt to evaluate these technologies and their impacts on world dairy production and consumption using a range of secondary data, but gives little more than an indication that their impact may disrupt international dairy markets during the next two decades.

GLEN GREER

Agricultural and Economics Research Unit
Lincoln University

Introduction to Practical Linear Programming, by David Pannell. Published by John Wiley and Sons, 1997, hardcover, pp. 333, ISBN 0-471-51789-5.

David Pannell has been a major player in mathematical programming, for a number of years, as one of the team in Western Australia, who developed the MIDAS family of whole farm models. This effort involved working with a variety of people from different disciplines. The outcome was a modelling system that is widely accepted as a good representation of reality in the West Australian wheat belt, both agronomically and economically. The need to explain linear programming to a variety of people from different disciplines has influenced him in writing a book on linear programming that makes the technique accessible to non-specialists.

He particularly notes that this is the first book on linear programming to include 'no coverage at all of the simplex algorithm'. Traditionalists may argue that this approach is like Hamlet without the Prince of Denmark. They will ask how such a complex technique can be approached and mastered except through the established mathematical route. Pannell reminds readers of Hirshfield's (1990) remark that 'desktop computers have brought a whole new class of analysts to the LP community. . . . These people are familiar with LP but do not want to become experts.' This book is for them. Even an experienced user will find that there is plenty to learn from it and indeed that they do not much miss 'Hamlet'. The story goes with a swing without the gloomy Dane soliloquising everywhere.

The layout of the book is straightforward. It begins with five chapters that lead the reader through the basics of linear programming then passes on to more advanced techniques. There is a useful summary of key points at the end of each chapter. The first chapter describes the typical structure of a linear programming problem and its application. In the second chapter, there

is a careful exposition of the graphical solution approach. This chapter is thorough and clear and anyone working through it carefully will have a good intuitive grasp of linear programming. This basis should enable them to understand what is happening when a model is solved. The third chapter progresses to the specifics of matrix construction in a helpful way that stresses the importance of thinking clearly about the units used, a frequent cause of grief. The description of a strategy for matrix building should save the beginner a lot of confusion. The fourth chapter consists of a careful explanation of the output from linear programming and its interpretation. Finally chapter five concludes the introductory part of the book with a set of examples. The hundred pages of the first five chapters are a clear and concise introduction to linear programming that certainly does not suffer from the lack of mathematical complexity.

The remaining two hundred pages of the book take the reader deeper into linear programming. Chapters deal with negative coefficients and transfer rows, non-linear relationships, integer variables and expositions of multiperiod and multiregional models. A chapter of examples reinforces this material. The final six chapters cover the interpretation of range and sensitivity analysis, the representation of risk and uncertainty and chapters on 'Some complications', including unboundedness, and 'Debugging your model'. Both of these are very helpful expositions for the struggling modeller.

The book therefore deals with some sophisticated issues without leaving linear programming. The author assumes that the target audience of this book need go no further into mathematical programming. These readers will benefit by learning that a non-linear relationship can be represented in linear programming. They will also see that it is possible to handle at least the simpler integer problems by manually seeking the best integer solution near the continuous optimal. Similarly, the treatment of risk and uncertainty shows the use of linear relationships to cast light on these areas.

The final chapter of the book discusses some practical issues with a good summary of the strengths and weaknesses of linear programming. Three particular weaknesses cited are the high information requirement, the dangers of misuse and the resources needed to maintain a model. Pannell quotes the maintenance needs of a large model as being half a person each year for a 400 column by 300 row model. This is a daunting amount of time and effort and reinforces the need to get all the benefits possible from the modelling system as a store of data and focus of research.

The maintenance problem indicates that the non-mathematical approach of this book does have some disadvantages. Explicitly mathematical systems such as GAMS (referred to in chapter 11), allow much more efficient data storage and management than are possible in a matrix format. In GAMS the

user begins by writing the mathematical equations and never explicitly draws up a matrix at all. Such systems also provide a choice of solvers for non-linear and integer problems. Desktop programs have brought basic linear programming to a new audience. Similarly, more sophisticated approaches allow experienced practitioners to advance to what were once unmanageable areas of analysis. It is only fair to say the extra possibilities may also allow the novice to flounder into a bottomless swamp of over-sophisticated analysis.

This book is intended for novices and they should exhaust its possibilities before trying to go further. What is in this book will take them a long way. It covers a large part of all the analysis that they will do with linear programming. Besides the text, the book also contains a helpful disk of linear programming software to work through the examples. The book is an excellent introduction to linear programming, that most practitioners of the art could read with profit. I shall certainly keep it close at hand in future.

Nigel Hall

Australian Bureau of Agricultural and Resource Economics

References

- Hirshfield, D.S. 1990, 'Some thoughts on math programming practice in the '90s', *Interfaces*, vol. 20, no. 4, pp. 158–65.
GAMS 1988, *GAMS*, The Scientific Press, Redwood City, California.