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BIOECONOMIC MODEL FOR DECISION-MAKING ON FATTENING BEEF-CATTLE

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Abstract

Profitability and competitiveness of agricultural systems it is closely related with the technology used. Economic and financial appraisal of investments on pasture improvements, facilities, feed and management plans, etc. are often required in order to make decisions. A bio-economic simulation model was developed in order to support decision making on beef-cattle grazing fattening. The aim of the model is to show the relationship between the technological alternative analysed in physical terms as well as financial and economic. By this way it is possible to asset and relate the bio-economic impact of the different animal and pasture management alternative technologies. Results show that the model could be used to support decision making when using stocking rates between 0.8 and 2.5 heads/ha.

Keywords: Models, bio-economic, production systems, livestock, decision support.

Introduction

Decision making at farm level is a complex, dynamic and evolutionary process. Good information is a key element in order to analyse and make more well-informed decisions (Mc Grann , 1991; Mc Grann *et al* 1999). Therefore, information as other resources need to be managed in order to become usefull. A Bioeconomic model for decision-making on beef-cattle grazing fattening was developed in Uruguay with the objective of: i. Formulate a computer model that can be used for researchers, technical advisers and farmers in order to evaluate and plan different productive alternatives for grazing livestock beef-cattle fattening as well as to quantify the effects that this alternative promotes; ii. Offer a tool that allows users to do an economic and financial analysis of the different alternatives, supporting the user in the identification of options that produce increments in efficiency and income and decrease risk; iii. Demonstrate that nowadays the computer and information science are a very useful technology to support the tasks of planning, implementation and control of different alternatives of production and research; iv. Indicate the advantages of model experimentation, before developing field trials, with the purpose of exploring a very wide spectrum of possibilities that allow to orient and to identify relevant products for research.

Material and Methods

Using a spreadsheet (MS. Excel 97 SR-2) and spreadsheet compiler (Visual Baler, Ver 2.0) a Windows environment bioeconomic model was developed on the basis of an older DOS Model (Cardozo and Ferreira 1994). The developed model, should be useful to support decisions related to beef-cattle fattening activity in Uruguay range lands.

The model is mechanistic, deterministic and dynamic and is being integrated by two modules:

2.1) **A biological model** that simulates the growth of the bullocks in grazing systems, validated by the results of analytical research developed by INIA. The models simulate the growth of the bullocks based on: a)initial weight b)age c)final expected weight of the animal, d)availability, e)digestibility f)growth of pastures.

The end weight (slaughter weight) is the result of the addition of the monthly gains or losses generated by the model on the initial weight. The cycles of production start when the animal purchase or initial fattening and end at the final or slaughter weight.

The main inputs necessary to run the models are:

a) Initial herbage availability at the beginning of the grazing and its growth rate in terms of dry matter per month and per hectare;

b) Monthly values of herbage digestibility;

c) Grazing starting month;

d) Stocking rate;

e) Initial weight;

f) Age of the animal (months) at the beginning of the cycle;

g) Slaughter weight or end weight;

The main outputs are:

a) Evolution of the pasture availability during the cycle;

b) Average animal daily gain during the cycle;

c) Meat production during the cycle in Kg per hectare;

d) Average livestock during the cycle in beef-cattle units;

e) Efficiency of herbage utilization (EUF)

f) Efficiency in the conversion of herbage to meat(ECF).

g) Total Efficiency (EUF)*(ECF)=ECC

2.2) **an economic and financial analysis model**.

On the basis of the data generated by the biological model, calculate Gross Margin, Net Income and equilibrium prices as well as a sensitivity analysis are calculated using the variations in the bullock prices purchase per kilogram and the production costs.

The costs are organised in a format of direct and indirect costs and in monetary and non- monetary.

It is possible to realise economic and financial analysis.

The financial analysis per activity is used for inventory changes and sells that generate rent or gross income. In this case the costs are the operational expenses and include the financial expenses for capital operation interest and debts. The financial analyses do not include the opportunity costs of the land and the capital investments on the activity. The expense for payment of interest in the case of mortgage of the land is included like a financial expense. The information about financial expenses and incomes are generated through the preparation of the financial states of the firm for the operative year.

The economic analyses include the opportunity cost of the resources used in the production process and the operation costs. The opportunity cost of the land is considered like the rate of return that should be necessary to pay for the land in a similar production system. The opportunity cost of the capital is the rate of return being expected for the capital investment in a activity with similar risk to the analysed. To avoid and prepare the double account, the financial expenses and the payment of interest associated to debts or mortgages of the land, are not included in the economic costs.

The main inputs are related with the costs. The organisation for the input of the costs is:

I) Direct monetary costs of the activity.

II) Direct non-monetary costs of the activity.

III) Indirect monetary costs of the activity.

IV) Indirect non-monetary costs of the activity.

In relation with the sensitivity analysis it is necessary to indicate:

a) The increment or decrement in the production cost (in monetary units) per head that the user like to consider. Do not consider the cost of purchase;

b) The increment or decrement in the expected value per kilogram of live weight of the bullocks at the end of the cycle.

The main outputs are:

a) Detailed budget with income and costs asociated with the activity;

b) Summary of income, costs and gross margin;

c) Summary of gain and losses of the activity;

d) Analysis of equilibrium prices;

e) Analysis of gains;

f) Analysis of the different sources of income (production or market);

g) Sensitivity analysis of the effective costs of producction.

Results and Discussion

The model has been validated with experimental data in different sites and years. To validate the model, the Average Error Percentage (AEP): $(\Sigma(y-x)/n)*(100/\mu)$ and the Average Error Standart Deviation (AESD): $\sqrt{(\Sigma(y-x)^2-\Sigma(y-x)^2/n)/n-1}$ was used (Silva, J., 1983) (Table 1). The model simulates more accurate values when the stocking rate is between 0.8 to 2.5 heads/ha. The forecast power decrease at high stocking rates, such as 3.75 heads/ha.

Figure 1 shows, real and simulated data for 1.5 stoking rate. Results show that the model predict in a reasonable way animal growth when using stoking rates between 0.8 to 2.5 heads/ha.

Therefore, the model, in the range of values that was validated, represents a good tool to estimate animal growth and the financial and economic benefits associated to each analysed feed and management plan. Using the model a wider amount of plans can be evaluated in order to support decision making at farm level. Further research need to be done in order to improve model accuracy in a wider range of stocking rate values.

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Table 1 - Model Validation, showing the AEP and AESD values.

I. PASTURE IMPROVEMENT LOW ZONE SOILS(T.Y TRES)	AEP	AESD
1,50 Head/Ha. Year 1 . Continuous grazing	-0.08	2.61
1,50 Head/Ha. Year 2 . Continuous grazing	-0.01	3.51
2,00 Head/Ha. Year 1 . Continuous grazing	-2.70	3.84
2,50 Head/Ha. Year 1 . Continuous grazing	1.90	2.95
2,50 Head/Ha. Year 2 . Continuous grazing	5.53	6.58
3,75 Head/Ha. Year 2 . Continuous grazing	7.15	8.94
II. PASTURE SEEDING LOW ZONE SOILS (T.Y TRES)		
1,02 Head/Ha. Year 3 . Continuous grazing	2.75	5.19
III. NATURAL PASTURE DEEP BASALTIC SOIL(TBO)		
0,8 Head/Yea/Ha. Continuous grazing	2.41	4.59

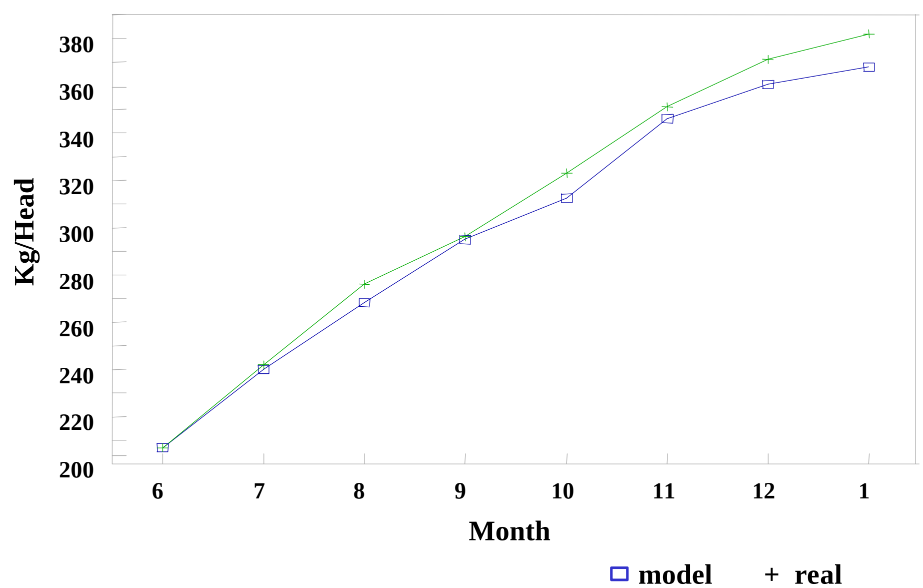

Figure 1 – Evolution of observed (+) and estimated ( ) live weight gain of grazing cattle.