International Conference on Policy Modeling (Ecomod 2007)

SÃO PAULO

JUNE, 2007

Simulation of scenario for dairy production family farming in Minas Gerais State
(Contributed paper)

José Luiz Bellini Leite, bellini@cnpgl.embrapa.br
Analista – Embrapa Gado de Leite

Humberto Resende, resendeh@powerline.com.br
Ex-empregado da Embrapa Gado de Leite

Simulation of scenario for dairy production family farming in Minas Gerais State

1. Resume

It is presented the adaptation and the results of a bio-economic production model with emphasis in dairy production in Minas Gerais State. The model based on LEITE (2000 and 2005) offers flexibility to simulate scenarios for systems specialized in milk production, conjugated production of milk and meat and the land-animal husbanding and crop farming. Its objective function is to maximize the profit. The model was applied using information of 55 farms of the micro region of Juiz de Fora in the Minas Gerais State - Brazil. The results showed that, in comparison to the current economic results in the study region, the profit could be largely increased. It still showed that considering the capacity of the lands in the region, the milk cattle breeding would not have conditions to compete with agriculture mainly with the fruit growing.

Key-words: mathematical modeling, milk production; bio-economics systems; family farming.

1. Introduction

The productivity of the Brazilian milk properties is low when compared to the competitors including the countries of MERCOSUL. The competition intensification brought by the economic opening and by the over-valued of the Brazilian currency (Real) can eliminate the inefficient, what has corroborated by a vast literature information showing the trend of production concentration with the elimination of a great contingent of producers, mainly small and familiar producers.

The region of Zona da Mata has already been the most important milk producer of Minas Gerais being situated currently in the third position. Even with the recent retaken of the growth of the milk production it still is distant of the performance found in the more dynamic regions of Minas Gerais State. The agrarian structure of the region is characterized by small properties, many of them with familiar characteristics[1], therefore, with strong challenges for survival in a market where the producer is a price taker.

The first objective of this study is to determine the effects of technological change, better resources allocation and land-animal husbanding and crop farming in the profit of the family farming milk producer in the Juiz de Fora Region.

To reach the desired objective, a bioeconomic mathematical model of production system was adapted, having as base the work of LEITE (2000 and 2005). The model assumes that the milk producer is a prices taker, but has control of the variables of the production system (allocation of resources - corresponding to the size of the flock, amount of available lands,

---

[1] Characteristics of the familiar economy: a) direction of the works in the establishments exerted by the producers; b) average number of employees lesser or equal the man power of the family.

machines, equipments and installations; and technology (corresponding to the genetic group and its potential for milk production). Moreover, the producer would be apt to adopt procedures of land-animal husbanding and crop farming. Thus, four hypotheses are formulated: (i) Different technologies of current use can improve profit level of milk production systems; (ii) Different resources allocation can improve profit; (iii) land-animal husbanding and crop farming can improve profit of the considered farms of familiar economy; (iV) The combination of different technologies, resources allocation and land-animal husbanding and crop farming can improve the profit of the family farming milk production systems. The verification of the hypotheses was given by the simulation of the representative milk production system of the study region, using the mathematical model developed.

2. Methodology

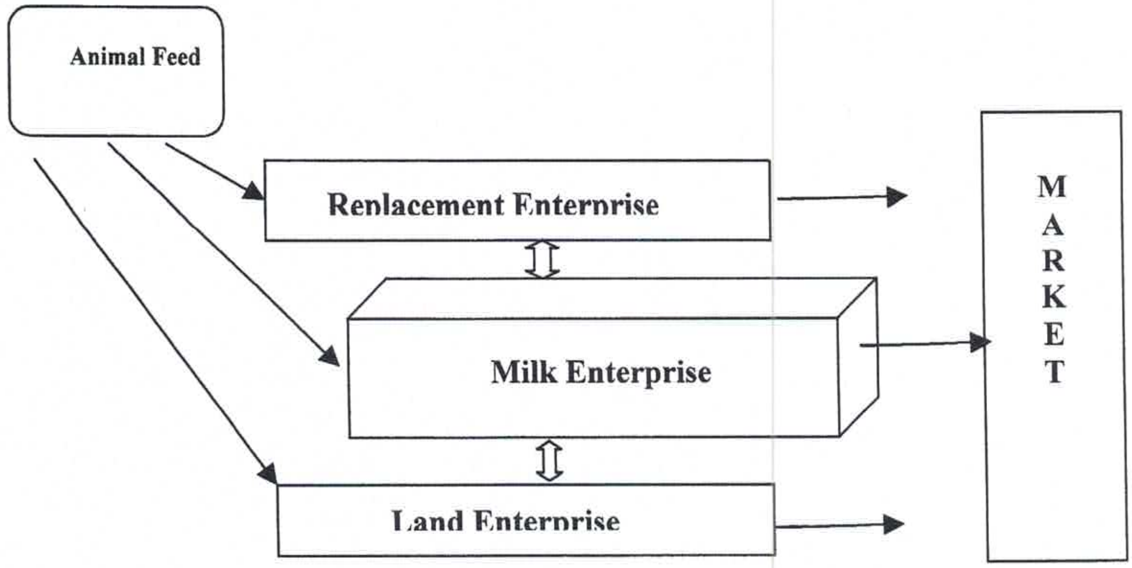
The mathematical model adapted from Leite (2000 and 2005) uses the software General Algebraic Modeling System (GAMS) and possesses the following assumptions:

(i) Producers are profit maximizers;
(ii) Available financial resource is equal to the farm inventory value;
(iii) Milk production system is composed by three enterprises (Milk, Replacement and Land);
(iv) Milk production as function of: (i) Technical parameters of the race/breding; environment; e fixed ratios of six nutrients;
(v) The supply of nutrients must be bigger that the demand from the animals;
(vi) Existence of hierarchy in the cows biological functions (fetus growth, maintenance and production).

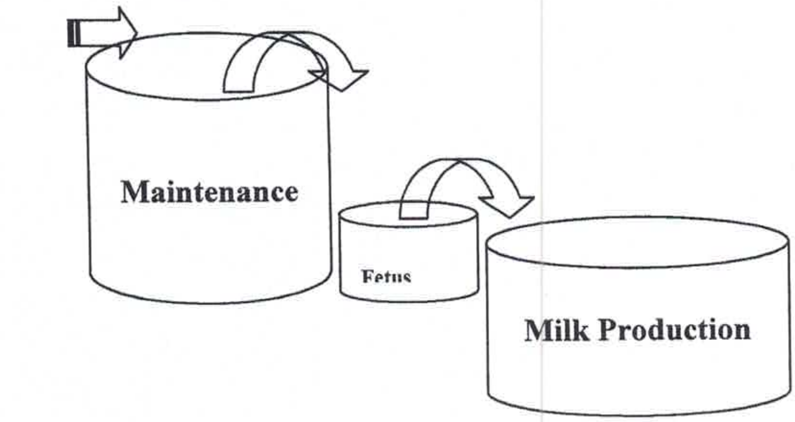
The model admits that a milk production system can be organized in three enterprises, namely: (i) <u>Replacement Enterprise</u> possess installations, equipment and all the animals in growth period. Purchase calves from the Milk Enterprise, animal feed from the Land Enterprise and from the market and sells the first born animals to the Milk Enterprise and to the market; (ii) <u>Milk Enterprise</u> possess installations, equipments and all the adult females in the milk production phase. Purchase animal feed from the Land Enterprise and in calf cows from the Replacement Enterprise and from the market. It sells milk to the market, calves to the Replacement Enterprise and culled animals to the market; (iii) <u>Land Enterprise</u> possess all the lands destined to the food production for family and feed production for animals. Sell its products to the Milk and Replacement Enterprises and also to the market. When the Land Enterprise sells its products to the market, it is characterized the farming-cattle integrated production. If not, it only produces feeds for the others two enterprise of the production system.

<u>The model conceptions</u>

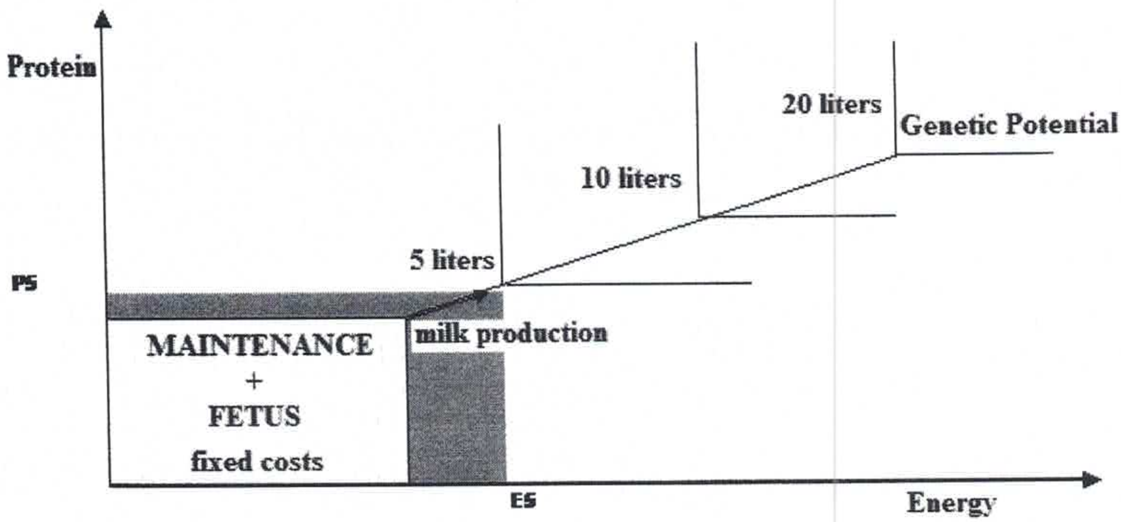
a) Systemic vision incorporating the possibility of the animal feed to be acquired on the market, the three enterprises, its relations and their products to be sold as animals, milk and agricultural products.



b) Existence of hierarchy in the main biological functions of the cows: maintenance; fetus growth and milk production. This way, nutrients coming from the ingested feed will only start to flow to the fetus when all the requirements of the maintenance are satisfied. In the same way, it will only bring nutrients to the milk production when the necessities of the fetus are completely satisfied. These ideas are shown below.



c) It also assumes that the milk production is function of the genetic potential of the animals and the availability of six nutrients: protein, energy, NDT, calcium, phosphorus, and potassium. It was considered, as the Cornell Net Carbohydrate and Protein System (CNCPS) that the milk production follows a linear standard until the limit determined for the genetic potential of the animal. In optimized systems, the necessities of the animals in production must be satisfied. Thus, considering the biological hierarchy of the animal, assumed here, and the necessity to satisfy the necessities of the animals in optimized systems, it is certain that the costs of destined feeding to the maintenance and the growth of the fetus are fixed costs. Considering only the two most important nutrients (protein and energy) we have the following schematically representation of the milk production, where P5 and E5, are the protein requirements and energy for production of 5 liters of milk and to supply the requirements for the maintenance and growth of the fetus.



There has been made the calculations of production costs and expected productivity of 31 technologies for production of foods for animals of the flock and 2 alternatives of food production for family (Embrapa Milk Cattle 2005). There has been also calculated the costs of production and expected productivity for land-animal husbanding and crop farming, considering fruits (two types of bananas, passion fruit, guava, tangerine, Tahiti lemon) and reforestation (eucalyptus). These alternatives of agricultural production had been used in the model for the simulations of land-animal husbanding and crop farming, for being considered adequate in agronomic terms for the study region.

The model also possesses the alternative of 21 feeds for animals and foods for the family that can be acquired in the market. With this, the model collates the possibility to produce in the farm and to purchase products from the market, considering the objective of maximizing the profit. It was calculated, also, the inventory of the property considering the capital expended with: a) lands, b) animal in the different categories and, c) facilities (machines, equipments and installations). The value of the inventory consists in restriction of the total to be invested when the model suggest a new optimized system. The model still considers:

(i) Complete system of milk and meat production that allows the land-animal husbanding and crop farming, in the case, fruit and reforestation. To simulate the milk production, the model considers the technical characteristics of Holsteins-Zebu crossbreed animals, because these are the most popular in the study region. However, others five races can be used (Brown-Swiss, Gir, Guzerat, Holstein and Jersey). A simulation with the Holstein race was conducted;

(ii) Nutritional characteristics; productivity by hectare, cost of production and/or price of market for each available feed for animals;

(iii) Lands characteristics of the study region: (i) mountain, hill, plan-and-dry; plan-and-humid. When acquiring lands, the model considers the ratios of each one of these classifications, reproducing the characteristics found in the region. When it chooses what it is going to be planted it considers the lands aptitude;

(iv) It considers that animals with different productivity have different prices. This problem is solved by considering an equation of price of the animals in function of the cow productivity, meat price, margin of milk-feeding cost ration (using a proxy milk price-corn price ration) and market interest.

(v) Farmers have an initial capacity to invest, which corresponds to the current endowment value (R$ 85,040, 57).

(vi) Three categories of cows are used in the Milk enterprise. Mature cows, lactating cows, and pregnant cows;

(vii) Six animal categories are used in the Replacement enterprise. They are classified by gender – heifer (female) and steer (male) – and by age (zero, one and two – year old). The farmers can invest in heifers and steers that are zero or one – year old.

The model assumes that, to maximize the profit, the family farming producer has control over the choice variables of the three enterprises that composes the production system. The model, using as objective-function the present value of the profit of one year of the production system, organizes the mathematical representation of the problem faced by the producer, in the following:

Net Present Value

$$Max\ NPV_b = M\,\pi_b + R\pi_b + L\pi_b - DesFam \tag{1}$$

Where:

NPV_b = Net present value;

$M\pi_b$ = Milk Enterprise Profit;

$R\pi_b$ = Replacement Enterprise Profit;

$L\pi_b$ = Land Enterprise Profit;

Desfam = Expenditures of the family with subsistence.

The Subscript "b" represents the considered genetic group. The present value deducts future profits and expenditures to a discounted rate "d".

Milk Enterprise Profit.

$$\underset{mbreed,qcm}{M\pi_b} = pmilk * qm_b[mbreed_b, qcm_b] + pbeef * qbeefM_b(qcm_b, culling_b) + \sum_{s=1}^{2} pcalves_s$$
$$* calvesM_{b,s}[qcp_b] - m\cos t_b\{f\cos tM_b(feedLM_{b,f}[n\sup M_{b,N}], feedmktM_{b,f}$$
$$[n\sup M_{b,N}]) + c\cos tM_b[invcowM_b, invLandM_b, invfacM_b, i_R] + lab\cos tM_b[qcm] +$$
$$vet\cos tM_b + o\cos tM_b + rep\cos tM_b[qcm_b, cul_b]\} \quad (2)$$

Where:

Pmilk = milk price;

qm b = quantity of milk produced;

mbreed b = average milk produced;

qcm b = herd size.

pbeef = price of beef;

qbeefMb = quantity of beef produced;

culling b = culling rate,

pcalves = price of calves,

calvesMbs = quantity of calves produced. The subscript s equal 1 represents female calves and s equal 2 represents male calves.

qcp b = pregnant cows;

mcost b = total cost in Milk enterprise;

fcostM b = the feed cost;

feedLM b,f = feed bought from the Land enterprise;

feedmktM b,N = feeds bought from market,

nsupM b,f = nutrient supplied in breed 'b' using feed 'f';

ccostM b = capital cost;

invcowM b = investment in cows;

invLandMb = investment in land. The land bought in Milk enterprise is to construct the facilities and it is fixed and equal to one hectare;

invfacM b = investment in facilities;

i R = interest rate;

labcostM b = Labor cost;

vetcostM b = Medical veterinary cost;

ocostM b = Other cost. It considers milk transportation, taxes, fuel and energy.

repcostM b = cost to replace a culled cow.

Milk Production Function

$$\underset{mbreed,qcm}{qm_b} = Max\{Min((n\sup M_N[feedM_{b,f}] - nother_{b,N,st}[cw_b, cphs_{st}, env]) / milk3_{b,N}[mbreed_b, qcm_b, env]), gp_b)\} \quad (3)$$

Where:

nother b,N,st = nutrients required to other cow physiological stages;

cw b = cow lived weight;

cphs st = cow physiological stages (body maintenance and fetus growth);

env = the environment conditions (temperature, humidity, wind etc);

milk 3 b,N = fixed proportion of nutrients required to produce one liter of milk;

gp b = genetic potential to produce milk.

The quantity of milk produced (qm $_b$) is the "maximum" genetically possible production for each breed 'b', constrained by the level of nutrient available. Since no substitutability between nutrients is assumed, milk production is limited by the scarcer available nutrient. The available nutrient supplied is equal to the total nutrient supplied (nsupM $_{b,N}$) from available feed (feedM $_{b,f}$), minus the required nutrients for other cows' physiological stages (nother $_{b,N,st}$). The required nutrients for other cows' physiological stages are functions of the cow weight (cw $_b$) and the cow physiological stages (cphs $_{st}$ – maintenance and pregnant) and the environment (env). The animal requirements are estimated using the Cornell Net Carbohydrate and Protein System.

Replacement Enterprise Profit.

$$R\pi_{\underset{qcr}{}b} = pheif_b * qheifRM_b + pbeef * qbeefR_b(dgainh_b, dgains_b, qcR_b) + \sum_{s=1}^{2} pcalves_s *$$
$$calvesR_{b,s}[heif2f_b] - r\cos t_b\{f\cos tR_b[feedLR_{b,f}[n\sup R_{b,N}], feedmktR_{b,f}[n\sup R_{b,N}]]$$
$$+ c\cos tR_b[invcowR_b, invfacR_b, invLandR_b, i_R] + lab\cos tR_b[qcR_b] + vet\cos tR_b +$$
$$o\cos tR_b\} \qquad (4)$$

Where:

$R\pi_b$ = Replacement enterprise profit;

pheif b = price of heifers;

qheifRM b = quantity of heifers sold to Milk enterprise;

qbeefR b is = quantity of beef produced;

dgainh b = daily gain for heifers;

dgains b =daily gain for steers. The daily gains for heifers and for steers are calculated using the formulas adopted in the Cornell System.

qcR b = herd size in Replacement enterprise;

calvesR b,s = quantity of calves produced where subscript 's' equals to 1 for female and 2 for male;

heif2f b = quantity of second-year heifers;

$rcost_b$ = total cost in Replacement enterprise;

$fcostR_b$ = feed cost in Replacement enterprise;

$feedLR_{b,f}$ = quantity of feeds bought from Land enterprise;

$nsupR_{b,N,}$ = nutrient supplied in Replacement enterprise;

$feedmktR_{b,f}$ = quantity of feed bought from market;

$ccostR_b$ = capital cost;

$invcowR_b$ = investment in cows;

$invfacR_b$ = investment in facilities;

invLandR b = investment in land. The land bought in Replacement enterprise is to construct the facilities and is assumed fixed and equal to one hectare.

labcostR b = labor cost;

vetcostR b = medical veterinary cost;

ocostR b = other cost. It includes milk transportation, taxes, fuel and energy.

Land Enterprise Profit.

$$L\pi_{\substack{b \\ feed}} = \sum_{f=1}^{31}\{(feedLM_{b,f} + feedLR_{b,f})*tr\cos t_f + \sum_{f=1}^{10} (feedLMkt_f)*fpricemkt_f$$

$$-\sum_{f=1}^{41}\sum_{l=1}^{4} (feedL_{b,f,l} + feedLfam_{f,l})*p\cos t_f\} \qquad (5)$$

Where:

feedLM b,f = demand of the ME for the food 'f';

feedLR b,f = demand of the RE for the food 'f';

feedLMkt f = food 'f' produced by the LE and sold by the Market;

feedLfam f,l = demand of the family for the food 'f', produced in the land type 'l';

fpricemkt f = Market price of the food 'f';

trcost f = costs of transference the food "f" produced by LE to the ME and RE;

feedL b,f,l = total amount of the food 'f' produced by LE in the land type 'l';

pcost f = production cost of the food 'f'.

The total feed production is constrained by the land available and its characteristics. Since the Land enterprise cannot sell products to the market, the amount produced should be equal to the amount demanded. The transfer cost is equal to the production cost for feed 'f', and consequently its profit is equal to zero. This result is consistent with the assumption that the Land enterprise is a subsidiary to the other two enterprises. In addition, it is consistent with observations of milk production in Brazil where there are few examples of dairy producers selling feeds to the market. However, when LE receives the authorization to commercialize products in the market, the model is apt to compare alternatives with the milk production and land-animal husbanding and crop farming.

Family subsistence expenditures.

$$DESFAM = \sum_{p=1}^{2} (consum_p * Mprice_p + consum_p * Trcust_p)$$

Where:

Desfam = family expenditures with food (p);

consum p = food consumption of the family;

Mprice p = food price in the market;

Trcustp = food production cost.

The expenditures of the family with food can be of two origins. Expenditures with food acquired in the market and expenditures with the food production in the owned farm. This conception allows comparing the alternatives to produce in the property versus buying in the market considering the cost of opportunity of this decision.

The mathematical model was finished using software General Algebraic Modeling System (GAMS). The model has ample applications that could be useful in future researches of simulation and optimization of milk production systems and land-animal husbanding and crop farming.

The work hypothesis and accomplished simulations

The four hypotheses of the work were: (a) different technology of the current adopted can increase the profit (technical efficiency); (b) different allocation of resources of the current existing one can raise the profit (allocate efficiency); (c) land-animal husbanding and crop farming can improve the profit (diversification versus specialization) and (d) the combination and/or set of the hypotheses above can improve the profit.

The following simulations were accomplished considering a representative farm of the 55 properties in the region of Juiz De Fora - MG, according to Zoccal et al (2004).

(i) Current milk production System (Simulation 1). It reproduces the conditions found currently in the milk production systems in the study region. This simulation has as objective to know the current economic situation of the representative farm and to validate the model.

(ii) Different technologies can improve the profit (Simulation 2). Production System of Simulation 1, admitting changing productivity of the cows in lactation (from 7.9 to 10 l/cow/day[2] and reduction of the calve interval from 18 to 15 months); and (Simulation 4) changing from crossbreed Holstein-Zebu animals to Holstein being able to reach up to 19.21 l/cow/day.

(iii) Resources allocation can improve the profit (Simulation 3). Keeping productivity of the cows in 7.9 l/cow/day and varying herd size and composition.

(iv) New technologies and resources allocation, simultaneously can improve the profit. (Simulation 5). Allowing variation in the resources reallocation (size of land, herd size and composition) and in the productivity of lactating cows.

(v) In Simulation 6 the model is set free to reorganize the property as a whole, considering as a restriction the farm endowment value for investments. Beyond

---

2 Average productivity of the cattle races according to Martinez (2000).

reformulating all the milk production system it is allowed land-animal husbanding and crop farming with reforestation and fruit production.

3. Results and discussion

The complete model algorithm is available for others researches. For the studies of family farming the simulation results are showed below.

1) Current milk production System (Simulation 1). It reproduces the conditions found currently in the milk production systems in the study region.

TABLE 1. Family farming average characteristics in the Juiz de Fora Region*.

Variables	Milk production system characteristics
Endowment value (R$)	85.040,57
Mature cows (heads)	18
Lactating cows in (heads)	12
Cow productivity (liters/cow/day)	7.9
Growing animals (diverse categories)	21
Lands (ha)	39.8
Major breed	Crossbred Holstein-Zebu
Major feed	Pasture of Brachiaria Decumbens

*There were 55 farms on that studies (region of Juiz de Fora – MG).

(i) Simulation 1 represents the current situation of the family farming milk production systems in the Juiz de Fora region. The milk production system is organized with crossbred animals Holstein-Zebu with average productivity of 7,9 l/cow/day. The basic feeding is pastures of Brachiaria Decumbens pasture. The net profit of the milk production is R$ 249,68 and the internal rate of Return is 3,52%. In the current conditions exists a strong economic incentive for this producer to leave the business considering as opportunity cost the minimum wage. This affirmation gains force when because the families possesses 4,4 people in average, what leaves an *per capta* profit equal to R$ 56,72.

In next table is shown the results of the others simulations with the objective of verifying the study hypothesis.

TABLE 2. Results of the Simulations.

Variables	Simul. 1	Simul. 2	Simul. 3	Simul. 4	Simul. 5	Simul. 6
Total capital invested (R$)	85.040,57	85.040,57	85.040,57	85.040,57	85.040,57	85.040,57
Mature Cows (heads).	18	18	30	15	50	18
Lactating cows (heads).	12	14	24	13	40	14
Cow productivity (l/cow/day)	7.9	10.12	7.9	19.2	10.12	10.12
Growing cows (heads).	21	21	0	0	0	21
Land (ha)	39.8	39.8	39.8	39.8	4.77	39.8
Land-animal husb. crop farming	Não	não	não	Não	não	sim
Breed choice	HZ*	HZ	HZ	Holandês	HZ	HZ

Major feed	Pasture	Pasture	Pasture	Pasture	Pasture	Pasture
Annual milk production (liters)	28.911	44.447	74.682	77.037	123.620	44.447
Daily production (liters)	79	122	205	211	338	122
Production cost (R$/l)	0.38	0.29	0.29	0.24	0.29	0.33
Net Profit (R$/year)	2.996,18	6.749,46	19.244,10	21.531.92	32.298,71	256.598.19
Monthly net profit (R$/month)	249,68	562,46	1.603,68	1.794,33	2.691,56	21.383,18
ROI (%/year)	3.52	7.94	22.6	25.32	37.98	201.74
Price Received by producer (R$)	0,50	0,50	0,50	0,50	0,50	0,50

Source: Data from the simulation process.

(ii) Simulation 2 represents the increase of the cow productivity and reduction of calves' interval. The productivity passes from 7.9 to 10.12 l/cow/day and the calves' interval from 18 to 15 months. This simulation shows an profit growth of 125.27%. The production cost decreases by 23.68% and the return on investment (ROI) increase by 7.94%. These results indicate that the hypothesis of different technology can improve the profit was verified.

(iii) Simulation 3 considers resources allocation, keeping the amount of land and the productivity of the animals. The model substitutes the growth animals for lactating cows. This informs that considering the production costs and the beef price (equal or less than R$60.00) the best decision for the family farmer would be to increase milk production. This change provided to an increment of the profit of 542.29% in relation to current situation showed in simulation 1. The production cost reduced while the ROI growths 619,32%. These results indicate that the hypothesis of better allocation of resources can improve the profit, were verified.

(iv) Simulation 4 considers the hypothesis of different technology can improve the profit and simulates the production system with Holstein cows. The model assumes that the producer has ability and knowledge to deal with the specialized cows. The monthly profit jumps to R$ 1.794,33 with ROI of 25.32%. The cow productivity is 19.2 l/cow/day. The number of cows is reduced to half, in relation to simulation 3, because of the biggest value of the cows. In relation to simulation 3, the best result of the system, the profit has increased by 11.89%.

(v) Simulation 5 for the hypothesis of different technologies and new allocations of resources can improve the profit, therefore two concomitant changes. The number of cows in lactation increases substantially reaching the amount of 50 animals. The chosen cow productivity is the limit of the genetic potential of the Holstein-Zebu cows. The economic results are better than the previous ones with 37.98% of ROI. The model indicates a specialized milk production system increasing the volume of milk produced. The land was tremendously reduced to 4.77 (ha) representing an 88% decrease. This was possible due to an increase in land productivity. When the model optimizes the system it uses feeds with high productivity from available Embrapa Dairy Cattle technologies. The resources expended previously in the land purchase, as well as the resources in growing animals were redirected to increase the number of cows. This result indicates that the resources allocation on the milk production system must prioritize increasing of lactating cows and their productivities.

(vi) Simulation 6 considers the original milk production incorporating the possibility of land-animal husbanding and crop farming. It notably demonstrates that the milk production cannot concur with agriculture, notably fruit production. The rearranged production system considers the areas of mountain for the production of eucalyptus, the hill and the plan-and-dry for guava production. Milk production uses the area of plan-and-humid. In it, the model indicates *Setaria sphacelata* to feed animals and purchase the other animal feed required in the Market. The values are extremely high, however the loss of 30% of the production of guava was considered. The model assumes that all production will be commercialized.

4. Final comments and conclusion.

The milk producers of the Juiz de Fora Region, included in this work, possess characteristics of family farming. The simulations showed that with the current productive systems exists a strong economic incentive to: (i) modify the standard of milk production, adopting more productive technologies and promote new allocations of the available resources, notably increasing the number of lactating cows, their productivity and the land productivity; (ii) Change business from milk production to fruit crop. Considering the land characteristics and aptitudes in the Juiz de For a Region, it was evident that the milk production would not be able to compete with fruit crop; (iii) to migrate to the city, selling the farm.

The land-animal husbanding and crop farming is a reality of the Brazilian country properties, notably of the family economy. The land-animal husbanding and crop farming, many of them with facilities of difficult reversion, indicates a necessity to use available resources in a rational and intensive form. These results are consistent with BARHAM et al. (1994), whose central argument is that the irreversibility of some types of investments is fundamental in the evaluation of the yield of the properties.

Considering the work results, some questions that are beyond the target of this work, need answers: (i) Why is there a continuity and recent increase of the milk production in the Juiz de Fora region? (ii) What is the power directing this milk production retaken? (iii) Why the low cow and land productivity persist? (iv) Why does not exist a race for fruits production?

5. References.

BARHAM, B. L., CHAVAS, J. P. and KLEMME, R.M. "Low Capital Dairy Strategies in Wisconsin: Lessons From a New Approach to Measure Profitability." Department of Agricultural Economics, University of Wisconsin. Staff paper no 381(October 1994).

Embrapa Gado de Leite 2005. http://www.cnpgl.embrapa.br/precos/custos2.php.

General Algebraic Modeling System. GAMS Corporation.

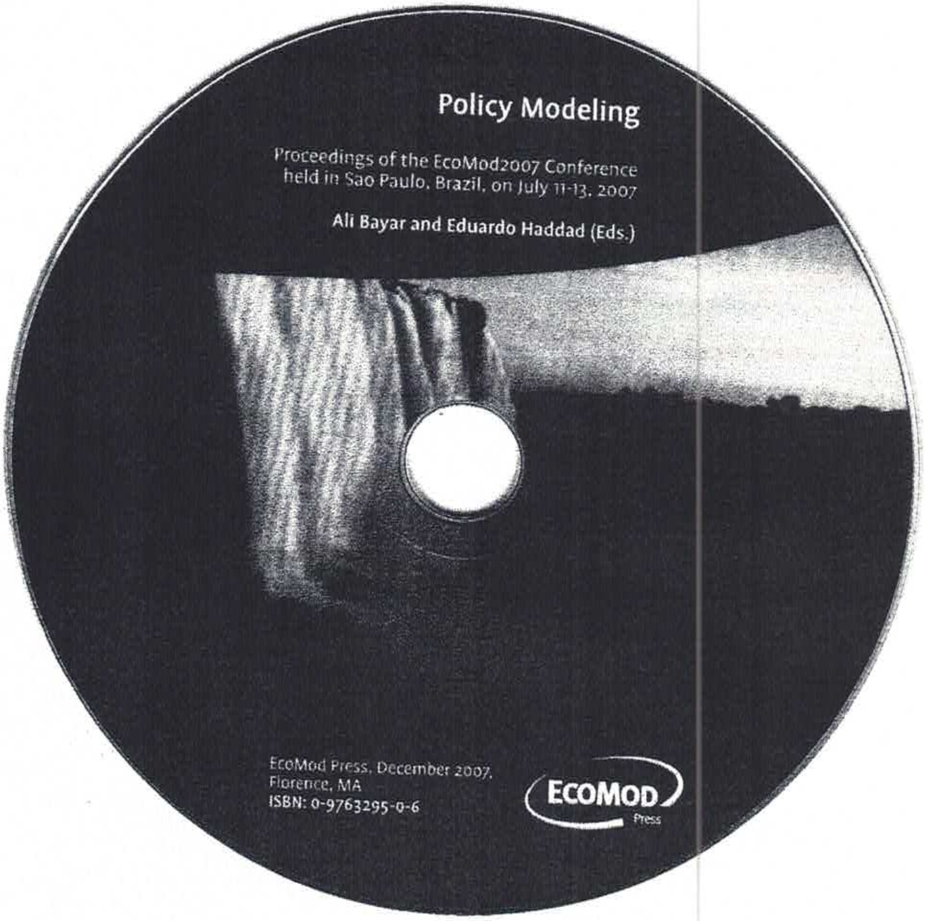
LEITE, J.L.B. The effects of alternative breed technology and resource allocation on the structure of brazilian milk production. Stillwater: Oklahoma State University, 2000. (Tese Doutorado).

LEITE, J. L. B. Metodologia de modelagem para Sistemas de Produção de Leite. In: CONGRESSO DA SOBER. INSTITUIÇÕES, EFICIÊNCIA, GESTÃO E CONTRATOS NO SISTEMA AGROINDUSTRIAL. v.43. 2005, Anais. Artigos Completos. Ribeirão Preto/SP. SOBER, 2005. 15p. 1CD.

Martinez, M. L. Melhoramento Genético do Zebu leiteiro com ênfase in capacidade de transmissão predita. Embrapa Gado de Leite. 2000.(mimeo).

ZOCCAL, R.; SOUZA, A. D.; GOMES, A. T.; LEITE, J. L. B. Produção de leite na agricultura familiar. In: XLII CONGRESSO BRASILEIRO DE ECONOMIA E SOCIOLOGIA RURAL. 42. 2004, Cuiabá, Anais... Cuiabá: SOBER, 2004, p 413.

UNIVERSIDADE DE CORNELL. Net Carbohydrate and Protein System, versão 4.0.23.


Policy Modeling
Proceedings of the EcoMod2007 Conference held in Sao Paulo, Brazil, on July 11-13, 2007
Ali Bayar and Eduardo Haddad (Eds.)
EcoMod Press, December 2007, Florence, MA
ISBN: 0-9763295-0-6
ECOMOD Press

Policy Modeling

Proceedings of the EcoMod 2007 Conference held in Sao Paulo, Brazil, on July 11-13, 2007
EcoMod Press, December 2007, Florence, MA – ISBN: 0-9763295-0-6
Editors: Ali Bayar and Eduardo Haddad

Program Papers

Local Organising Committee

Eduardo Haddad, and FIPE (Chair), Ali Bayar, Carlos Roberto A
Ana Barufi, José Luiz Bellini Leite, Rosana Curzel, Marcelo Dias I
Frédéric Dramais, Joaquim Guilhoto, Theresa Leary, Carmensita R
Raul C. dos Santos, Gervasio dos Santos, Raul A. dos Sant

Next conference

EcoMod2008 - International Conference on Policy Modelin
Berlin, Germany, July 2-4, 2008

Contact us at office@ecomod.net
Last modified: Decembre 5, 2007