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OUTLINING ECONOMIC MODULES FOR FARM MANAGEMENT INFORMATION SYSTEMS IN COSTA RICA

Report of a LEI-DLO mission to the
Veterinary School of the National University of Costa Rica

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CONTENTS

1. INTRODUCTION

This publication results from a mission of the Netherlands Agricultural Economics Research Institute (LEI-DLO) to the School of Veterinary Medicine at the National University of Costa Rica. The objectives of the LEI-DLO mission were to outline an economic module for a livestock management information system and to set a research agenda for future cooperation in data processing and development of decision support systems.

From 1986 onwards, the School of Veterinary Medicine of the National University of Costa Rica is conducting research to improve management of Costa Rican farmers by introducing computer programs. For this purpose, a management information system called VAMPP 1), which was developed for livestock farming in the Netherlands, has been adapted towards Costa Rican conditions (Baaijen and Pérez, 1995). Moreover, several new features were added to the program, such as the farm-splitting module. This module allows analyses of farm results within a farm (e.g., between breeds), between groups of farms, and even between nations. The system is now used by over 500 dairy farmers across all the Central American countries. Moreover, introduction of the VAMPP system to South American countries and African countries is being prepared.

Until now, data recording and data analysis are mainly restricted to technical aspects of dairy and pig farming 2). Supplementing these technical analyses with economic analyses can provide farmers with more specific information on areas for improvement of their farm enterprises. Moreover, it can provide useful statistics for evaluation of livestock farming on a national and international level.

LEI-DLO holds a long tradition of monitoring and analysing technical and economic farm results in the Netherlands. The institute provides statistics of Dutch agriculture to various national and international institutions, including the Dutch Government, European Union and FAO (Van Bruchem et al., 1995; Boone et al., 1996). Furthermore, LEI-DLO develops decision support systems to assist farmers in improving their farm management (Hennen, 1995).

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1) VAMPP = Veterinary Automated Management and Production control Program.
2) One exception is the pasture and nutrition module in VAMPP Dairy.

2. ECONOMIC MODULE FOR VAMPP 'CERDO'

The main purpose of the economic modules will be to generate additional information for farmers to support their decision making. Participation of farmers in the VAMPP program is voluntarily, meaning that the usefulness of additional information for the farmers must be balanced with their costs and efforts to collect the additional data. For the VAMPP research group, this places an upper bound on the extent of descriptive statistics that can be produced. To allow for the calculation of important key ratios and to allow for reliable group comparisons, some data recording is demanded. Above considerations have led to the decision to focus on an economic analysis rather than a financial analysis, i.e., to focus on returns and costs rather than on receipts and expenditures. The economic analysis evaluates the efficiency of livestock production on the farms 1). Because the research group at the School of Veterinary Medicine had already given much attention to program design and data base management, the LEI-DLO mission mainly focused on the definition and calculation of key figures. For the economic module of VAMPP 'cerdo', figures that will be calculated include gross returns, variable costs, fixed costs, net returns, break-even prices, gross margin, operating costs, and capital-generating capacity of the farm. In Appendix I, the relationships between these figures are shown. Because farmers have to assign all costs to either the reproduction or the fattening unit (but not both), the economic figures can be calculated for the farm as a whole, for the reproduction unit and for the fattening unit. Combined with technical figures on the average number of animals present in both the reproduction and fattening unit, economic figures can be calculated on an animal level. The remainder of this chapter will outline the economic module for the reproduction unit only, because there is an analogy with calculations in the fattening unit or the farm as a whole.

2.1 Average number of sows present

When calculating figures on a sow level, variables have to be divided by the average number of sows present in the analysis period and multiplied by 365/(#days in the analysis period). If data are available, economic modules must calculate moving averages on an analysis period of one year, in order to exclude bias due to small numbers or seasonal fluctuations.

Sows are included in the reproduction unit at first insemination. In Costa Rican pig farming, weaned sows that are selected for culling are often moved to the fattening unit. This means that, unlike in Dutch pig farming, less unproductive days are counted until the moment these sows leave the farm. To include the number of unproductive days because of late insemination of gilts, farmers have to enter a desired age of first insemination in the program. With correct data on birth dates, calculation of unproductive days using this desired age can give insight into the number of unproductive days because of late insemination of gilts.

2.2 Calculating with inflation

Costa Rican inflation is 15 to 20% each year. This means that for instance veterinary and feed costs paid at the beginning of a year may differ considerably from those paid at

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1) Analysis of, for instance, future perspectives of farms is limited by missing data entities, such as alternative income sources, family expenditures, tax payments, and solvency rates.

the end of the same year and in the following years, independent of the health status of the farm. Therefore, all costs are converted into US dollars ($) when they occur (regardless of whether they are actually paid). Interest costs of animals and feed reserves, will be based on the average exchange rate between the start and the end of the analysis period. The effect of inflation on interest costs of buildings and machineries is discussed below. The final gross margin figure will be displayed in both US dollars and colons 1) according to the exchange rate at the end of the analysis period.

2.3 Gross margin

An important figure for farm comparisons is the gross margin figure. The gross margin equals the gross returns minus the variable costs. It is a straightforward translation of technical production figures into economic importance, given a more or less fixed production environment with available labour, buildings and machineries. The gross margin figure aims to support operational and tactic decision making in order to improve productive and economic efficiency of converting variable inputs in outputs.

2.4 Gross returns

Gross returns on a sow farm consist of sales of piglets, sales of culled sows, and sales of culled boars.

2.4.1 Sales of piglets

In Costa Rica, hardly any piglets are sold, which means that no market price of piglets exists. To allow for a separate evaluation of the reproduction unit and the fattening unit of Costa Rican pig farms a standard piglet price could be calculated using the method of the 'Landelijk Biggenprijzenschema' (National Piglet Price Scheme) in the Netherlands. This method aims at a fair allocation (between reproduction and fattening) of profits and losses generated in a standardized, well-managed, farrow-to-finish unit. The allocation is done by calculating per animal the costs of labour plus 35% of the replacement costs (depreciation and interest) of buildings and machineries, for both the reproduction and the fattening unit. The ratio between the costs in the reproduction unit and the fattening unit determines the ratio of allocation of profits or losses. In the Netherlands, the allocation currently is 57% for the reproduction versus 43% for the fattening unit. This means that 57% of the profits (losses) generated from farrowing to finishing pigs is added to (subtracted from) the standard break-even price of piglets.

The piglet price is determined at a weight of 25 kg. Within the range of 22 to 29 kg, prices of Dutch piglets are adjusted per kg difference with the break-even price of '1 kg of piglet' (exclusive of piglet price and sale costs). This adjustment is calculated as follows: one kg of piglet above 25 kgs equals a two-day reduction in the fattening period and a 2 kgs reduction in concentrate supply (below 25 kgs equals a two-day increase and a 2 kgs increase). The standard fattening period from 25 to 113 kgs equals 121 days. A reduction in fattening period of two days results in a reduction of 2/122 * the total costs per fattening pig sold (except for the costs of the piglet and sale costs). If the weight of piglets exceeds the range of 22 to 29 kg, similar calculations can be made but a smaller reduction in the fattening period will be more appropriate because of the high growth rate of elder piglets.

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1) In August 1996, 1,000 Costa Rican colons equaled 4.8 US dollars (=8 Dutch guilders).

2.4.2 Sales of culled animals

In Costa Rica, sows and boars that are not sufficiently productive are not necessarily sold right away, but are often transferred to the fattening unit to increase their weight before slaughtering. This means that part of the unproductive days of the sows are effected in the fattening unit (whereas in the Netherlands all are effected in the reproduction unit and lower the farrowing index figure). In case boars and sows are not sold right away, a market price for those animals has to be defined to include in the 'post' 'Sales of culled animals'. Farmers have to enter into the program the estimated market value of the animal when transferring it to the fattening unit.

2.5 Variable costs

Variable costs include costs of replacement animals (sows and boars), feeding costs of sows and piglets, veterinary costs, insemination costs, interests on animals, costs of bedding, water and electricity, and other variable costs. Costs of replacement animals consist of prices paid for replacement animals or estimated values of fattening pigs that are transferred as gilts or boars to the reproduction unit. The economic module will have an (optional) separate recording of feeding costs for sows and piglets.

2.6 Net returns

Net returns are calculated by subtracting fixed costs from the gross margin. The 'net returns' figure supports strategic decision making of the farmer, i.e., decisions to quit farming or decisions on large investments (farm renovation, farm expansion).

2.7 Fixed costs

The fixed costs consist of costs of depreciation, maintenance and interest on buildings and machineries, labour costs and other fixed costs.

2.7.1 Depreciation costs of buildings and machineries

Buildings and machineries will be depreciated on a fixed percentage of their replacement costs. Replacement costs increase due to inflation or due to other technologies and requirements. With a yearly (overall) inflation rate of 20% and a 5% depreciation per year, depreciation costs of a 1,000,000 colons facility built in year t, equals (5% of 1,100,000 1) =) 55,000 colons in year t and (5% of 1,320,000 2) =) 66,000 colons in year t+1. If the assumption of 0% inflation in US dollars is made, calculation of total depreciation can be done much simpler by multiplying the age of a facility with 5% and with the replacement value of a facility (at the time of construction). Farmers only need to enter the types of buildings that they have and the years in which they were built. The program then assigns replacement values to these buildings, expressed in US dollars, calculates the depreciation costs in dollars and consequently displays this value in dollars as well as colons (based on the current exchange rate at the end of the period). If inflation in US dollars exists, or if the replacement value of a facility increases (e.g., due to other technologies or requirements), the simpler method will (slightly) underestimate depreciation costs. Depreciation percentages of buildings and machineries cannot be changed by the farmers.

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1) The average value of the facility in year t = 1,000,000 + 0.5*20%*1,000,000.
2) The average value of the facility in year t+1= 1,200,000 + 0.5*20%*1,200,000.

2.7.2 Interest costs on buildings and machineries

Interest costs are a fixed percentage of the average book value of buildings and machineries in a certain year. The book value of assets equals the replacement value of assets minus the sum of depreciations in previous years. Because of inflation the nominal book value of assets may increase over time. In the example above, the book value of the facility in year t equals 1,100,000 colons 1). The depreciation in year t equals 55,000 colons. Therefore, the book value in year t+1 equals (1,320,000 - 55,000=) 1,265,000 colons. Using the assumption of 0% inflation in US dollars as was done with calculating depreciation costs, the book value can be calculated by subtracting all yearly depreciations from the current replacement value of the asset (since in dollars the nominal replacement value is fairly constant in time). The book value to be used for the interest calculation is defined by the average book value in the analysis year, i.e., the sum of the book values on January 1st and December 31st, divided by two.

An even simpler way of calculating interest costs, and which Dutch extension services tend to use for cost-price prognoses, is to assume that, during its productive lifetime, the average book value of a facility or machinery equals 50% of the replacement value (at the time of construction).

The interest rate used to calculate the interest costs must be adjusted for inflation. The nominal interest rate overestimates the real interest costs for the farmer, because the opportunity costs of lending money to a bank (instead of buying buildings and machineries) is far less than the nominal interest rate. For instance, if a farmer lends 100,000 colons to a bank in year t, the saving account will amount to 100,000 * (1+ nominal interest rate) in year t+1. However, due to inflation, the actual value of this total amount of colons has decreased with a factor 1 / (1+inflation rate). Consequently, the real interest rate can be calculated with the following formula 2):

real interest rate = (1+nominal interest rate) / (1+inflation rate) -100%

Instead of a real interest rate on equity capital, a nominal interest rate must be paid on money that was borrowed from a bank, i.e., borrowed capital. Therefore, the total interest costs on buildings and machineries depend on the solvency of a farm and can be calculated using a simple balance sheet approach (table 2.1).

Table 2.1 A simple balance sheet

Assets		Liabilities	
Total assets	100,000 colons	Equity capital Borrowed capital	80,000 colons 20,000 colons
Total assets	100,000 colons	Total liabilities	100,000 colons

'Total assets' equals the accumulated (book) values of all farm assets, such as land, buildings, animals and machineries. The amount of borrowed capital can be deduced from the actual amount of interest paid, divided by the nominal interest rate. The amount of equity capital then can be calculated by subtracting borrowed capital from the total liabilities (or total assets). Interest costs on equity capital can be calculated by multiplying the real interest rate with the amount of equity capital. Finally, total interest costs on build-

1) Depreciation starts in the year following the construction of the facility. Therefore, the book values equals the average replacement value in that year.

2) As an example, a nominal interest rate of 30% and an inflation rate of 20% results in a real interest rate of (1+0.3)/(1+0.2)-1 = 8.33%.

ings and machineries equals the sum of the interest paid and the interest costs on equity capital.

2.8 Operating costs

In Costa Rica, labour productivity is relatively low compared to the Netherlands 1) and varies considerably between farms. To improve the net returns of a farm, reducing labour costs may be worthwhile. However, labour costs cannot be evaluated separately because labour can (partly) be substituted by buildings and machineries. Therefore, operating costs (being the sum of labour costs and interest costs, maintenance costs and depreciation costs of buildings and machineries) are compared between farms.

2.9 Break-even prices

An important figure for farmers is the break-even price 2). It tells the farmer which sale price will cover its total costs. Usually this figure is expressed in units of production, e.g. the break-even price per piglet. The break-even price equals the sum of variable and fixed costs. Typically break-even prices per piglet exceed sale prices per piglet, meaning that the owner's input of farm labour and management, and assets are not fully rewarded.

2.10 Capital generating capacity of the farm

The gross capital generating capacity of the farm (gross CGC) equals the net returns plus depreciation costs plus unpaid farm labour of the farm owner (or his family). Adding the calculated interest costs of the farm results in the net capital generating capacity (net CGC) of the farm. CGC reveals the contribution of the farm to changes in capital that can be used for tax payments, new investments, principal payments, family expenditures, and savings. With a solvency rate of 100%, the CGC equals the net CGC and can be seen as an upper bound. CGC equals the gross CGC at a solvency rate of 0% which places a lower bound to the capital that is generated by the farm. The CGC figures give some insight into the future perspectives of a farm. However, as mentioned before, to draw accurate conclusions on the future developments of Costa Rican farms, additional financial data are required.

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1) On a farrow-to-finish farm with 115-sows, visited in a field trip, 4 full-time labourers were employed, whereas in the Netherlands such a farm would typically employ somewhat less than two full-time labourers.

2) Also referred to as cost price.

3. ECONOMIC MODULE FOR VAMPP 'LECHE'

The economic module for dairy farming (VAMPP' leche') will not be discussed in detail because of the analogy with the economic module for pigs (VAMPP' cerdo'). Important differences between pig farming and dairy farming are the costs of land use and milk production permits. Costs of land use differ from costs of other production factors, because they do not include depreciation costs. Normal land use will not decrease the quality of land. This means that the interest costs of land use are based on the actual market value of land instead of a (depreciated) book value.

Costa Rican milk production permits (actually, permits to deliver milk to the Dos Piños dairy cooperation) are high-priced compared to Dutch milk quota (4,000 colons versus 800 colons per kg milk). This high price can be explained by the higher milk price and the market security provided by Dos Piños. In the Netherlands, milk quota may no longer exist in a few decades. Therefore, milk quota are depreciated with 7% each year. It is unclear what the perspectives are for the Dos Piños milk production permits and, therefore, no indication can be given on the number of years to depreciate these permits. Interest costs of land use and milk production permits can be calculated with the same balance sheet approach as was explained in the section 'interest costs on buildings and machineries'. Both the costs of land use and the cost of milk production permits are part of the fixed costs of dairy farming.

4. FUTURE COOPERATION

One of the objectives of the LEI-DLO mission was to set a research agenda for future cooperation in data processing and development of decision support systems. As an introduction to the work of LEI-DLO, a seminar was given on 'information management in Dutch livestock farming', in which the features of the GLOBAL-DETECTOR system of LEI-DLO were explained. In another session, a software demonstration of GLOBAL-DETECTOR was given. These two sessions were followed by discussions with staff members of the School of Veterinary Medicine. This has resulted in a research agenda, which will serve as a basis for writing specific research proposals.

4.1 Agenda for future cooperation on monitoring and analysis of data

I PROGRAM DESIGN

A Economic farm data

A0 System development

* Monitoring/analysis system in VAMPP
  (prototypes, in execution)
* Phase 1: pigs/dairy
  Phase 2: group fattening pigs / bovine

A1 Validation of management information systems

* At user level (informal)
  - Acceptance and satisfaction
  - Adaptation to variation in farm management (user reports)
* Data quality (formal analysis by qualified personnel,
  - System errors
  - capture/storage/processing
  - test in lab (with standard farm data set)
  - registration errors
  - quality control mechanisms
  - operational errors
  - checking with farm records and documents, etc.
  - outlier tests
  - independent farm study to compare with VAMPP database
  - compare with data quality assurance of LEI-DLO

A2 Database analysis

* Descriptive statistics on a national level
  - Strata of farm types, intensities, management variants, breeds, etc (see DELAR, etc)
  - To be used for policy/user reference
  - Development of standard reports, etc.
* Development of farm specific standards for use in farm analysis
  - To develop a protocol for analysis
  - To improve economic sustainability
* Development of models for sensitivity analysis of input/output relations for different farm types
* Development of knowledge based systems for generation of farm advice

* Conduct a national survey to estimate frequency and distribution of farming systems
  - To draw representative samples of farms from the VAMPP database

A3 System development
* Adaptation of tools such as GLOBAL-DETECTOR
  - Sensitivity analysis
  - Knowledge acquisition (training of experts)
  - National reports

A4 Final evaluation
* additional data requirements
* user involvement
* impact

B Environmental farm data

BO System development
* Monitoring/analysis system in VAMPP
* Nutrient balances linked with economic data recording

B1 Data collection
* Definition of standards for farm in and output factors
  - Calibration or measurement

B2 Data analysis
* Validation of data quality
* Descriptive analysis
* Generation of knowledge for advice system

B3 System development
* Reports on farm level
* Development of knowledge based systems for generation of farm advice
  - Reasoning with uncertain and qualitative data

B4 Final evaluation
* Additional data requirements
  - User involvement
  - Impact

II PROJECT FORMULATION

* Partners
  - UNA/LEI-DLO/branch organizations
* Cooperation
  - SAIL
  - Central American livestock reactivation program

III FUNDRAISING

* This project could probably be financed by the Covenant for Sustainable Development between Costa Rica and the Netherlands.

5. CONCLUDING REMARKS

In meetings with staff members of the School of Veterinary Medicine, the current version of the VAMPP software has been demonstrated and further software developments and implementation of VAMPP have been discussed.

5.1 Decentralized use of VAMPP

The objective of the VAMPP project is to create a user-friendly management tool with low computer requirements that can be used decentrally (on-farm or in an advisor's office). For this, many efforts have been made in developing a robust program with an efficient data base structure. Almost 2000 internal data consistency checks were built into the program to ensure correct data entry. If editing of previously stored data occurs, the program makes sure that all related data (average values or heritage data) are updated as well. With the exception of the UNA's pilot projects, all services to the farmers are privatized. Some of the larger farms have now their own computers, but most farmers are attended by veterinarians, farmer organizations, or service bureaus. Typically, the farm data are updated once per month, just before the visit of the herd health veterinarian. During his visit, the monitoring technician analyses the primary herd parameters to see whether there are problems with the animals. Diagnostic tests can be executed with VAMPP when required, and the technician will refer to the veterinarian or nutritionist according to the type of problems found. The farmer receives attention lists including forms for routine data collection, an abstract of primary production and health parameters and, if applicable, the results of the diagnostic tests. Additional reports can be requested by the farmer or veterinarian. The output of VAMPP appears to be effective for increasing farmers' livestock management skills and for enhancing the effectiveness of veterinary services.

5.2 Centralized use of VAMPP

Data of individual farms easily can be aggregated in a central data base and thus can be used to generate regional or national information (when the VAMPP program becomes the regional or national standard and information of nonusers can be gathered). To enhance farm analysis, a so-called farm-splitting module was developed to allow for within - farms and between - farms analysis. Especially in case this module is used, the value of an efficient data base structure becomes apparent.

5.3 Recommendations for further development in the VAMPP project

5.3.1 Put more effort in developing the pig module

It can be concluded from the demonstration of the pig module that the concept of the dairy module can also be applied for the pig module. However, the current version of the pig module is inconsistent and instable, meaning that a lot of work has to be done on programming and testing of the module.

5.3.2 Increase participation of users in the software development process

Now that VAMPP 'leche' includes most of the general concepts of dairy farm management, future system developments will be directed towards 'tailor-made' modules or key figures for specific groups of farmers. Further, if the number of options of a management information system increases, it requires a more advanced user-interface. Both developments require a more intensive participation of users in the software development process. However, it is recommended to postpone user participation until the prototyping phase, for two reasons: 1) before most farmers can make a judgment of the use of certain key figures or modules, they usually have to be confronted with it; otherwise, farmers tend to be too conservative in evaluating the usefulness of additional options; 2) if farmers are involved in the development process too soon, they may become discouraged by the errors in the pre-prototyping versions of the software. A computer adoption study in the Netherlands concludes that negative experiences of farmers with a computer program last long (KIS-Vleesvarkens, 1996). At the School of Veterinary Medicine, sufficient understanding of farming practices is available to be able to postpone user participation until the prototyping phase.

5.3.3 Emphasize farm-economic aspects

Obtaining a reasonable family income is the primary goal of most farmers. Therefore, farm management support and, thus, farm management information systems, must include economic figures. Cash expenses, cash returns, and technical production figures are imperfect measures of farm income, farm profitability and the relative economic position of a farm. An economic farm analysis shows the economic importance of the various production figures and evaluates the financial and marketing skills of a farmer. It is a crucial element for farm advice on operational decisions (e.g., fertilizer use), tactic decisions (e.g., choice of feed supplier), and strategic decisions (farm expansion).

This mission of LEI-DLO is a first step towards inclusion of economic figures in the VAMPP program. For further development of economic modules, and for the production of solid economic reports, hiring an economist at the School of Veterinary Medicine should be considered.

5.3.4 Make more use of available data

The VAMPP system is now used by more than 500 dairy farmers across all Central American countries. This means that large amounts of data have been collected that can be used for several purposes. First, individual farm analysis can be extended by calculating *farm-adjusted standards* (De Haan, 1991). *Farm-adjusted standards adjust farm results for* structural differences between farms and, therefore, allow for more accurate farm comparisons. Second, descriptive statistics on a regional, national or international level can be used for research guidance, competitiveness studies and policy support.

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APPENDIX

Appendix I Economic figures for VAMPP sows

Gross returns
* Sales of piglets or transfer prices to the fattening unit
* Sales of sows or transfer prices to the fattening unit
* Sales of boars or transfer prices to the fattening unit
* Balance differences (growth of animals)

Variable costs
* Purchases of gilts or transfer prices of fattening pigs to the reproduction unit
* Purchases of boars or transfer prices of fattening pigs to the reproduction unit
* Feeding costs of sows
* Feeding costs of piglets
* Veterinary costs
* Insemination and boar costs
* Interest costs of animals
* Costs of straw bedding, water, electricity, etc.

Fixed costs
* Operating costs
  - Depreciation costs of buildings and machineries
  - Maintenance costs of buildings and machineries
  - Interest cost of buildings and machineries
  - Labour costs
* Other fixed costs (e.g., manure transportation)

Gross margin equals the gross returns minus variable costs

Net returns equal gross returns minus variable and fixed costs

Break-even price for piglets equals the sum of variable and fixed costs divided by the number of piglets sold on the farm

Gross capital generating capacity of the farm equals net returns plus depreciation costs plus unpaid farm labour of the farm *owner* ('s family). Adding the interest costs of the farm results in the **net capital generating capacity** of the farm.