Decision Support Systems for Small Scale Agroindustrial Investment Promotion in Rural Areas[1]

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ABSTRACT

A series of decision support systems (DSS's), developed as part of a government program to promote the implementation of small scale agroindustrial projects in rural areas, is described. The DSS's constitute an alternative to the use of printed agroindustrial profiles to disseminate information on technical and economic aspects of such projects. Users have access to information on the potential projects and can evaluate their feasibility considering their own data and relevant assumptions. Information is presented in hypertext and graphical formats, and in conventional data tables. The hypertext files provide descriptions concerning the technological processes, related legislation and potential markets, while graphical images present plant floor plans and 3-D views of facilities and equipment lay-out. Data is available on several items, including technical coefficients, equipment costs, raw material and other input costs, interest rates, other loan conditions, and product mixes and prices. They can be easily changed by the user, so as to better reflect specific conditions. Economic-engineering models allow the computation of standard financial evaluation indicators. Sensitivity analysis is also performed. Results can be either displayed on screen, saved or printed. 15 systems have been developed, covering a wide array of agroindustrial projects. Usability tests were performed with a sample of potential users. Results were extremely favorable, confirming the initial hypothesis of the potential of the proposed approach as an effective means to promote agroindustrial investments.

Keywords: Decision Support Systems, Agroindustrial Projects, Project Profiles

INTRODUCTION

Agroindustrial projects are frequently promoted by governments and development agencies as strategic components of rural development programs. In fact, as pointed out by Austin (1992), a considerable share of international aid flows in the 80's and early 90's was directed to investments in agroprocessing projects. Informal consultations with development experts suggest that these trends are even more prevalent today.

The reasons for such an interest in agroindustries as major forces in rural development efforts are associated with the potential benefits generated by investments in the sector. It is known that the multiplier effects of agroindustrial investments are amongst the highest, when compared with other economic sectors. By aggregating value to agricultural products, agroindustrial processing contributes to the creation of employment opportunities both before and after the farm gate, thereby reducing the serious problem of rural migration, which is so common in less developed economies. Moreover, agroprocessing technologies contribute to the improvement of quality of raw materials and final products. Better quality, in turn, promotes improved health and nutrition and yields access to more demanding markets, both

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locally and internationally. Other important benefit is the availability of simple, small scale technologies, making a wide array of processing alternatives accessible to small investors.

In Brazil, the Ministry of Agriculture[4] has established a major effort to promote agroindustrial investments by groups of small farmers – the "Pronaf Agroindustria" Program (Ministerio da Agricultura e do Abastecimento, 1998). Its main objective is "...to contribute to the improvement of living conditions in rural areas, by fostering and supporting the integration of family farm associations to the agribusiness economy". The program offers credit lines for investments in new agroindustrial plants. Training and technological support and information systems to support planting, processing and marketing decisions are also provided.

In order to present potential investors with basic information on technologies, as well as on costs and benefits of alternative enterprises, the so called "agroindustrial profiles" are usually prepared by governments and development agencies. These publications briefly describe the enterprise, including information on the processing technology, the needed equipment and buildings, labor requirements, potential markets and cost-benefit issues. As part of its support actions, the "Pronaf – Agroindustria" Program originally planned the development of a series of such profiles.

Yet, one critical difficulty with the "profile" approach is the static characteristic of the information they convey. In fact, for a country with marked regional differences as Brazil, in is not reasonable to assume that input costs, product prices, product mixes and other key agroindustrial project hypotheses would hold true nationwide. Furthermore, with the historic inflation problems of the country, there would be a non negligible risk that relative and absolute prices could change, thus drastically reducing the usefulness of the provided financial information.

To circumvent these perceived shortcomings, a computer based alternative to the traditional "profile" has been suggested by the authors - the "interactive agroindustrial profile" (Silva et al., 1998). The interactive profile concept entails the development of decision support systems (DSS's), containing all descriptive information of the agroindustrial projects, plus economic-engineering models that allow users to adjust project assumptions so as to reflect their specific conditions.

In cooperation with the Brazilian Ministry of Agriculture, 15 interactive profiles were developed for the "Pronaf Agroindustria" Program, covering the following small scale agroindustrial projects: cheese production, cashew-nuts processing, poultry slaughter, hog slaughter and processing, brown sugar, sugarcane brandy distillery, fruit pulp, soybean meal and oil, milk cooling centers, diversified milk processing, goat milk cheese, manioc flour (two plant sizes), banana drying and minimally processed vegetables. A different system is being developed for each of the alternative projects. The general structure of these DSS's , which were named "SAAFI-Agro" (Portuguese acronym for "Decision Support System for Financial Evaluation of Agroindustrial Projects") is discussed next.

MATERIALS AND METHODS

Two related objectives are sought. One is the provision of an user friendly environment for the dissemination of agroindustrial technologies to potential investors. As such, descriptive and visual information should be available, warranting straightforward consultation. A second objective is the provision of interactive cost-benefit information, in the form of direct access to tables containing all basic data on project investments, costs, revenues and financing conditions, so that the provided figures can be readily changed by users. Once the desired changes are performed, the system should automatically compute investments, costs, revenues and cash flows. These figures in turn should be automatically considered in the computation of financial indicators, such as the internal rate of return, net present value, pay-

[4] The project was transferred to the Ministry of Agrarian Development (MDA) in late 1999.

back period and break even point. Finally, a sensitivity analysis, and an evaluation of the effects of under capacity utilization (learning curve analysis) should be conducted.

The systems were developed for the Windows 95/98 environment, with the Delphi 3 programming language. A traditional prototyping methodology (Turban and Aronson, 1998), was followed in the DSS's development.

RESULTS AND DISCUSSION

The same basic structure was followed for all of the developed DSS's. An opening screen (Figure 1), offers access to a pull-down menu, by means of which consultation to a standard project can be made. Optionally, users can create new projects, by modifying the assumptions and data of the standard project, or retrieve previous modifications, saved from prior utilization of the system.

Figure 1. Opening Screen of the DSS for the Banana Drying Agroindustrial Plant

Once a consultation option is made, users can access the descriptive and visual information, the cost-benefit information or the financial evaluation results.

Descriptive and Visual Information

Descriptive information is mainly composed by a hypertext file presenting a characterization of the technical aspects of the enterprise. Information is offered on the processing steps, the raw materials needed, the necessary equipment, labor needs, building specifications, legislation, waste treatment processes and equipments, and quality assurance systems, among others. In order to facilitate the consultation, most technical terms are linked to explanation boxes.

Complementing the technical texts, processing flow charts, plant floor plans and 3-D plant views (Figure 2) are visually displayed.

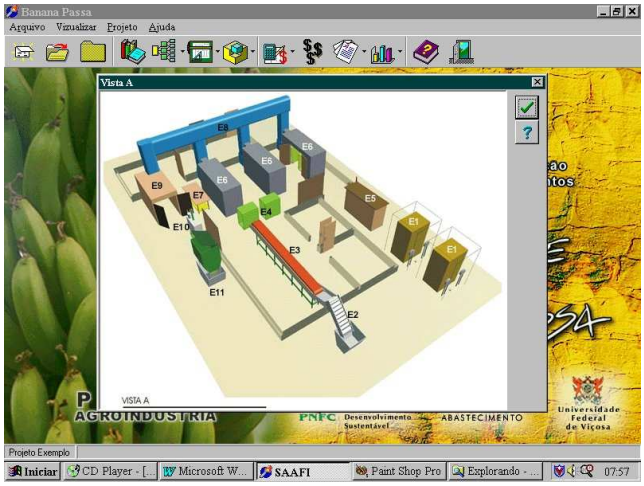

Figure 2: 3D View of the agroindustrial plant (banana drying)

Print-outs of all texts and drawings can be easily obtained.

It should be noted that all descriptive and visual information provided correspond to a given plant size. This information set can not be altered by users, for it reflects technological standards and scale of operations considered appropriate for the purposes and target beneficiaries of the “Pronaf-Agroindustria” Program. On the other hand, changes can be performed in the cost-benefit modules.

Cost-Benefit Information

Before a project’s cash flow can be calculated, a cumbersome process for estimating investments, costs and revenues must be performed. Data must be gathered on the items that compose each of these categories, and the appropriate tables must be built. In addition, several aggregation steps must be taken, before the needed information for financial evaluation can obtained. The developed DSS’s greatly simplify this process, by providing access to all relevant tables and by automating the aggregation steps and other necessary computations.

The cost-benefit components are organized in four main groups of data tables: fixed investment and working capital estimation, cost estimation, revenue estimation and financing alternatives. The first group contains figures on costs of equipment and other fixed investment items, such as land, vehicles, buildings (civil work) and others. The second one lists all input and raw materials needed, as well as other fixed and variable cost items such as labor, energy, depreciation, taxes, etc. Revenue estimation is performed by establishing a product mix and a set of selling prices. The financing schema combines information on interest rates, grace period, repayment schedules and others. Figure 3 illustrates the presentation format utilized.

Figure 3. Presentation format for the financial data tables

As shown in Figure 3, users can readily change the quantitative data, so as to adapt the project to their specific areas or conditions. Alternatively, these changes can be made as a way to assess the impact of key financial assumptions on the project profitability (what-if analysis).

After the intended changes are made, it is then possible to access the financial analysis information component.

Financial Analysis

Besides presenting the project's cash flow and the standard financial evaluation indicators - net present value, internal rate of return, pay -back period and break-even point – , the financial analysis component presents graphs with cost breakdowns, break-even charts, sensitivity analysis spiderplots (Figure 4) and "learning curve" charts.

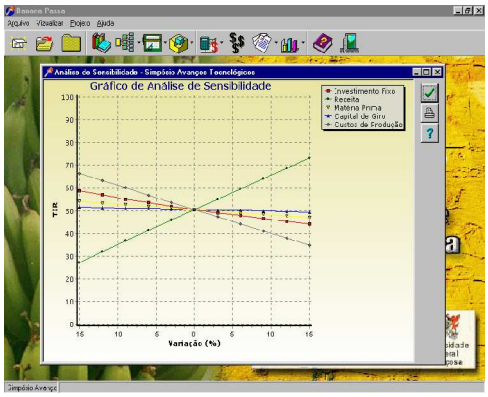

Figure 4. Sensitivity Analysis Spiderplot

The spiderplots (Eschenbach, 1992) show the effects of altering key project assumptions on variables such as investments, costs and revenues. The learning curve chart depicts the effects of running the agroindustrial plant below full capacity during one, two or three years of operation. (Figure 5)

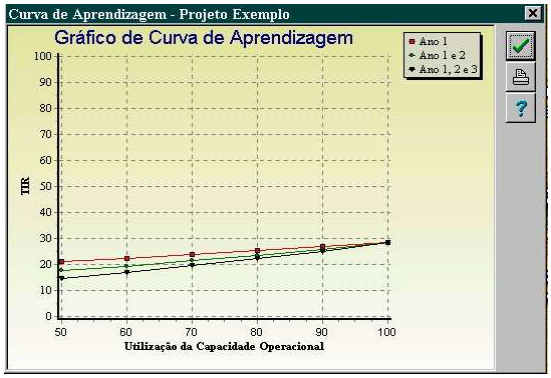

Figure 5. "Learning Curve" Chart

Concluding the utilization of the system, a complete print-out can be provided, in a format that contains all the necessary information for presentation of the project to a financing agency.

CONCLUSIONS

The DSS's already developed have been demonstrated and discussed with Ministry officials, development experts, academics and potential users in several occasions. Reactions were always very favorable, both to the proposed concept and to its implementation. There is a general agreement that the DSS's constitute an innovative and substantial enhancement to the usefulness of the traditional project profile.

Moreover, usability tests were performed by a group of potential users. Average scores in a 1 to 5 scale were maximum for the attributes "usefulness for the intended purpose", "user friendliness" and " recommendation to potential users". Scores for attributes related to the quality of the information provided averaged 3.8.

Farmer groups, extension agents and potential investors in general will be able to download the DSS's from a web site in the Brazilian Ministry of Agrarian Development. Interested readers may also obtain copies by contacting the authors, who are preparing a demonstrative English version of one of the interactive profiles.

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