AN INTEGRATED APPROACH TO EVALUATION OF RESEARCH OPPORTUNITIES IN THE QUEENSLAND SUGAR

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Summary: Governments, as well as other funding agencies, expect research providers to become more accountable for research spending. An integrated approach to evaluate research opportunities in the Queensland sugar industry is described. The main components of this approach which include problem definition workshops, grower surveys, and cost-benefit analysis of individual projects are described. Computer software to assist industry personnel to carry out cost-benefit analysis of potential projects has been developed.

INTRODUCTION

Governments, as well as other research funding agencies, expect research providers to become more accountable for funds spent on research. They also want to see improvement in the effectiveness of research effort. A number of economic and non-economic techniques have been developed and used by research managers to set research priorities and to evaluate the impact of research. With the application of these techniques, the full dimensions of problems to be researched will be well defined and, with stakeholders participating in a multidisciplinary evaluation process, a more holistic view will be taken of the problem.

Economic techniques provide a systematic basis for evaluating benefits from alternative research opportunities in a cost-benefit framework and thus provide a transparent way of evaluating research since various parameters need to be specified, explicitly. Economic evaluation is of greatest utility for assessing applied research into clearly defined problems for which the impact, and industry context, are readily described. There are also a number of other, non-economic evaluation techniques, such as interdisciplinary workshops, that do not explore the economic dimensions of research, explicitly, but which provide a means of exchanging information among stakeholders to a research problem and allow consensus to be reached on the importance of individual research proposals.

This paper reports the development of an integrated process for the evaluation of research opportunities in the Queensland sugar industry. Economic evaluation was coupled with other participatory evaluation techniques in a case study into factors affecting the performance of ratoon cane in the Queensland sugar industry (McLeod 1995).

METHODS

A range of analytical techniques has been used to evaluate research investments in agriculture. Economic evaluation of such investments has mainly involved cost-benefit analysis although production function models and simulation studies have also been used. Non-economic techniques including peer review, precedence, congruence, problem definition workshops, and scoring approaches have also been tried.

As with the evaluation of other investments in agriculture and elsewhere, cost-benefit analysis has been applied to evaluate the economic merits of public investment in different research areas but the technique has not been used regularly in research management. This seems to be related to the fact that such evaluations are generally conducted by trained economists using specifically developed software. Furthermore, the economic benefits of some types of research are difficult to assess and, when combined with the need to use specific computer packages to undertake cost-benefit analysis, there has been limited adoption of the technique.

While cost-benefit analysis is of greatest utility when evaluating applied and developmental research projects for which the commercial impact of the research program can be identified, it is more difficult to estimate the economic returns to basic research because this "curiosity" type of research has the aim of providing fundamental gains in knowledge from which objectively oriented projects can progress. Peer review, workshop, and other non-economic techniques are best suited to evaluation of that type of research.

Participatory approaches to the evaluation of research, in which scientists from a range of scientific disciplines, as well as industry representatives, can be used to identify research required by an industry and to suggest the types of evaluation best suited to various types of research. Participatory techniques for the evaluation of research opportunities can be used to define research problems, to generate consensus about research priorities among industry stakeholders, and to structure research plans. Participatory workshops have been used by the Cooperative Research Centre for Tropical Pest Management to set the research agenda in a number of industries including tomatoes, rangelands, and cotton.

Research investment in Queensland sugar industry

Sugarcane is grown in Queensland from Rocky Point near the Queensland-New South Wales border to Mossman in far north Queensland. Over this large production area, various environmental conditions apply and different production methods are practised.

The Bureau of Sugar Experiment Stations (BSES) and Sugar Research Limited (SRI) are the main providers of research and extension services to the Queensland sugar industry. In recent years, the involvement of CSIRO, the universities, and the Queensland Department of Primary Industries in sugar industry research has increased with the availability of funding through the Sugar Research and Development Corporation. A newly established Cooperative Research Centre for Sustainable Sugar Production is likely to provide further coordination.

Cane breeding and varietal improvement has been a significant part of BSES research effort on behalf of the industry and it continues to provide a valuable return on investment in all regions. A recent economic evaluation of a project aimed at developing early-sugar varieties demonstrated an extremely high return from the research investment. Other research opportunities, related to actual production problems in each region, also exist.

Integrated approach to research evaluation

The identification of research, development and extension opportunities to improve the length and profitability of sugarcane crop cycles is a complex problem that has many technical and socio-economic dimensions. A generic approach, that uses a problem definition workshop to structure the broad scope to the research problem and to gain consensus on the action required to answer key research questions has been developed. Central to this approach is the idea that research problems should be adequately defined before specific research proposals are implemented and that the procedure should be participatory, should involve a multi-disciplinary group, and be iterative in order to maximise the chances of success. To identify major features of the sugarcane ratooning problem, a problem-definition workshop and grower survey was completed prior to conducting cost-benefit analysis of a number of research opportunities. Each of the components of this integrated approach to research evaluation are described.

Problem definition workshop: Growers from the four main canegrowing regions use quite different production methods and production trends in each were considered at a problem- definition workshop that also identified issues affecting crop performance throughout the sugarcane crop cycle. The workshop was used to specify the range of survey, technical input, and economic evaluations required to answer the most pertinent research questions about the management of ratoon cane. The workshop was used to gather information and to gain consensus on the most fruitful options for technical and socio-economic research. Participants at the workshop suggested that a survey of growers, collation of technical information, and cost-benefit analysis should be used to investigate research and development

opportunities associated with crop management, canegrub control, water management and improved harvesting techniques.

Grower survey: Growers in one mill area from each of the four regions (Tully, Pioneer, Proserpine, and Maryborough) were surveyed to collect production data, to provide background information on the adoption of new technology, and to gauge their attitudes on crop-cycle research and other crop management issues. Varietal improvement was the most frequently-nominated option to improve performance of ratoon cane by the 60 growers interviewed.

Cost-benefit analysis: Cost-benefit analysis was used to assess, systematically, the economic impact of research, development and extension opportunities nominated by workshop participants. Many of these opportunities are currently being investigated by sugar industry researchers and they were ranked using the cost-benefit procedure. Cost-benefit analysis is used to determine industry benefits emanating from the adoption of new technology and these gains may accrue to users (canegrowers) through increased yields from the current input mix or the same yield from reduced inputs, decreased cost of inputs, or improved product quality which result in the value of output increasing without any increase in production costs. The milling sector of the Queensland sugar industry is also likely to benefit from technological improvement in canegrowing. Mill profits may be increased by increasing mill efficiency, or by decreasing processing costs, while mills also benefit indirectly from increased cane yields that increase mill throughput.

RESULTS AND DISCUSSION

Thirteen projects nominated by participants at the workshop or identified by the grower survey as opportunities to improve ratoon sugarcane performance were ranked according to their expected impact on the industry. Net present value, benefit cost ratio, and internal rate of return are commonly used in investment analysis to identify attractive projects and a standard cost-benefit summary sheet was developed to allow a consistent presentation of results and to permit easy comparison among potential projects. Results were also presented graphically in a format that clearly indicates projects with the greatest potential to generate industry benefits. Similar graphical techniques have been used by other authors to report on industrial research options and CSIRO recently adopted this approach to illustrate results from priority-setting activities.

Using these techniques, new varieties, improved methods of placing canegrub insecticide, and improved efficiency in irrigation were identified as research opportunities that would generate the highest returns for the industry.

The sugar industry was divided into four agronomically similar production areas (north, Burdekin, central, and south) to account for the differences that new technology may have on canegrowers across the industry. In each of these areas, the market potential, or maximum level and rate of adoption of new technology, largely determined the magnitude of industry benefits resulting from the commercialisation and implementation of research. Widespread adoption of new varieties is the reason for such a favourable return from that project.

There is considerable uncertainty surrounding the research, development and extension process and to incorporate this, a parameter indicating "probability of success" was built into the cost-benefit procedure. Projects with a **high** probability of success involve applied and developmental types of research. Typically, these projects have short delays before adoption because developed processes or products are being tested with a specific application in mind. Many of the extension-type projects evaluated such as improving irrigation efficiency and better insecticide placement were assumed to have a high probability of success. This is perhaps the most critical of all the variables included in the cost-benefit analysis procedure and therefore the chances of success at each stage of the research process should be assessed with some rigour.

Project costs are the planned annual expenditures on research and support staff, materials and other costs, such as some contribution towards the on-going overhead costs of the research organisation, over

the life of the project. The most significant costs relate to the number of professional staff. In this project, to simplify research costs, all costs other than research staff salaries were considered to be proportional to the number of staff engaged on a project. The professional staff cost, including overheads such as maintenance, vehicles, support staff, and other project expenses, were estimated from research organisation records but precision in the estimation of project costs is not as critical to the validity of the evaluation as attention to project benefits since rate of adoption, extent of user gain, and probability of success have such a significant effect on the estimate of benefits.

To assist users with a limited economic background to evaluate projects with cost-benefit analysis, computer software (*SET for Windows*) was developed as part of the final phase of the integrated approach to research project evaluation in the sugar industry. The software

uses a menu system and dialog boxes to structure the analysis and on-line help to provide industry statistical information as well as summary sheet and graphical displays to present results and a database to store results from previous evaluations. Ths software has provided a means of disseminating productivity and economic information collected during the project and has been used to provide researchers and policy-makers in the sugar industry with a cost-benefit analysis framework that was both theoretically sound and user-friendly. Such a system will help researchers and managers focus on factors inflfuencing the success of research projects and thus help to set priorities in research management.

REFERENCES

1. McLeod, R.S., 1995. Research investment analysis: An integrated approach to evaluation of research opportunities in the Queensland sugar industry, Unpublished PhD thesis, The University of Queensland.