



CRC SUGAR: STRATEGIC OBJECTIVES, OPERATION AND MANAGEMENT 1995-2000

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CRC FOR SUSTAINABLE SUGAR PRODUCTION: STRATEGIC OBJECTIVES, OPERATION AND MANAGEMENT 1995-2000

Industry Background

The sugar industry is a major contributor to the national economy, especially in the north-east where it underpins regional economic activity and employment in many coastal centres. Australia produces ~5 m t of raw sugar annually from ~38 m t of cane harvested from ~450,000 ha. Eighty-five percent of raw sugar is exported, and even during the current downturn in sugar prices, exports are worth c. \$1.2-1.3 b annually. For each dollar generated by the industry, a further \$1.55 of economic activity is generated in the wider economy.

Around 22,000 people are employed directly by the industry with c. 4-5 times that number in 'upstream' and 'downstream' sectors dependent on the industry. There are 7000 cane growers in Qld, NSW and the Ord, in NW Australia, most operating as family businesses (and so fitting the definition of 'Small to Medium Enterprises - SMEs'). There are 30 mills, around half proprietary-owned and the remainder grower-cooperatives. The industry provides basic regional infrastructure and generates wealth from areas where natural resources have limited alternative uses on a comparable scale.

The industry faces two major and sometimes competing challenges to its sustainability. Global competitive pressures dictate that the industry must innovate and achieve efficiencies to remain profitable. At the same time the industry's mainly coastal location (between environmentally sensitive areas of world heritage value - the Great Barrier Reef on one side, and wet tropics rainforests on the other - and adjacent to coastal streams and wetlands and other remnants of valued natural habitat) require that its practices be environmentally sustainable.

The need to mobilise industry R&D resources for a concerted effort to develop R&D solutions to these two major sustainability challenges contributed directly to the establishment of the Cooperative Research Centre for Sustainable Sugar Production (CRC Sugar).

1. CRC SUGAR STRATEGIC OBJECTIVES

The Centre addresses two issues of major economic, environmental and social importance to Australia: maintaining the international competitiveness of an industry of major national importance while protecting environmentally sensitive areas of world heritage value. Its outputs reflect 'public good' and 'direct industry benefit' elements.

Vision, Mission, Scope and Role

CRC Sugar's vision is for '*A profitable sugar industry enhancing the quality of its natural resource base and meeting the environmental expectations of an informed community*'.

The Centre's mission is '*To deliver outcomes based on collaborative, multi-disciplinary research and development that build the skills and technology for a competitive and environmentally responsible sugar industry*'.

CRC Sugar operates in an environment where industry R&D priorities across the value chain are well-defined at program and research strategy levels through a comprehensive process led by the Sugar Research & Development Corporation (SRDC) and involving all industry regions and sectors, the R&D providers and government. The most recent Sugar Industry R&D Demand cycle was completed in 1999.

CRC Sugar's strategic objectives and role are formulated jointly with industry and community stakeholders, in the context that the Centre deploys 15% of the total sugar industry R&D resources. The aim is to ensure that the Centre's Program is focussed on areas of comparative advantage where it can add value to the

other 85% of sugar industry R&D. The Centre's strategic objectives have been reviewed three times since its establishment: in 1995/96, in 1998, and in 1999.

On the most recent occasion, it was unanimously agreed by participants and stakeholders that the Centre should continue in a broadly similar form beyond 2002 and a bid for a CRC for the Australian Sugar Industry was submitted to the CRC Program on July 3, 2000. CRC Sugar's Stakeholders strongly endorsed the Centre's whole-of-industry focus, honest broker role, and participative approach with end-users.

The CRC Sugar Strategic Plan lists six Key Result Areas (KRAs) against which performance is benchmarked. The first three of these address the principal elements of sustainable agriculture: *Protecting the Environment*, *Sustaining Soil and Water Resources*, and *Enhancing Productivity* and together comprise the core focus of the Centre's research. The fourth KRA, *Education and Training*, is of particular relevance because of the historical lack of strong direct links between the sugar industry and the education sector.

The other two KRAs address less tangible but important challenges: to influence *Attitudes and Perceptions* by fostering as an honest broker informed debate on sustainability issues and delivering *Synergy from Collaboration* through a focus on 'value-adding' strategies.

At operational level, active involvement by stakeholders on the Board and through the Centre's consultative mechanisms (see later), together with the Centre's brokerage of projects with the SRDC, ensure that individual research projects are sharply focused on end-user needs and priorities.

2. QUALITY AND RELEVANCE OF THE RESEARCH PROGRAM

The Stage 1 Review stated that 'CRC Sugar is a major player in research and training in sustainable sugar production in Australia'. The Review noted that while the Centre's expenditure represents 15% of the aggregate industry R&D investment, papers reporting CRC research accounted for almost 40% of the papers at the most recent ASSCT conference, and that CRC Sugar postgraduate students represent at least 80% of those being trained in the industry.

The Review reported that the Centre 'has made excellent progress towards meeting its research objectives with almost all milestones having been met or exceeded and that the research is high quality and relevant to the needs of the sugar industry'. The Centre's 'whole-of-industry' approach was a 'major achievement' and the Centre's 'major role' was noted in

- coordinating research
- being an honest broker and thus allowing difficult issues to be tackled and
- participative research and development with end-users.

('Whole-of-industry' R&D was identified as a priority area in the recent 1999 Sugar Industry R&D Demand, an outcome due in part to the CRC's pioneering success in this area.)

Also noted was 'the emphasis on rural sociology, resource economics and participatory action research involving end-users' which contributed to approaches that 'greatly increase the readiness of end-users to approach and make substantial change.'

Another 'feature' of the Centre was the successful development and integration of biophysical modelling with economic modelling which 'has enabled the development of many reliable and outstanding decision support systems for end-users'. Specific achievements were listed for each of the Centre's three research programs.

In its response, the Board committed the Centre to continuing and enhancing the Centre's research excellence, and to delivering the benefits of its program to industry and community end-users, during the remaining term of the current Centre and beyond. The Board accepted, wholly or in part, all of the specific recommendations of the Stage 1 Review, the vast majority of which endorsed the future directions proposed by the Centre during the review.

The one recommendation raised by the Stage 1 Review that perhaps requires specific comment relates to the high proportion of refereed publications to date that have directly targeted sugar industry researchers. This has been part of a deliberate technology transfer strategy by the Centre to raise awareness and promote cultural change within the industry and its researchers, particularly in relation to environmental sustainability and whole-of-industry productivity issues. As a related component of that strategy, the CEO accepted an invitation to join the ASSCT Editorial Committee.

The Centre nonetheless acknowledges the potential applications of its work outside the sugar industry and the value of encouraging industry researchers to access information externally and internationally. There are at least 20 Centre publications planned or in press in international journals and many more will be forthcoming during the remaining life of this Centre.

Value of R&D Outputs

The relevance of the Centre's outputs to end-users was attested by the Stage 1 Review. The opportunities for gains from innovation are large in a high-GVP industry like sugar. The Centre's whole-of-industry research with the Mackay and Mossman industries indicate opportunities for 7-11% efficiency gains in cane supply to mills within existing harvesting, transport and milling constraints. Translated across the industry, productivity gains of this magnitude could translate to \$100-140 m revenue annually even at depressed sugar prices.

An independent benefit : cost analysis (BCA) of eight CRC Sugar Activities¹, based on conservative assumptions of sugar prices, adoption rates and estimates of benefits, indicated benefit : cost ratios ranging from 2 : 1 to 53 : 1 at a 5% discount rate, and internal rates of return from 12% - 84%. The net present value of the cane supply options work alone exceeded the aggregate (7-year) value of CRC Sugar's total R&D investment. Similarly positive outcomes were apparent from internal BCA of the Centre's R&D on supplemental irrigation, where sensitivity analyses showed investment criteria remained positive across a wide range of plausible scenarios².

The independent BCA analyses indicated that the return on investment was lower for environmental than production related projects². However, this outcome owes much to the difficulties of placing 'market value' on environmental outcomes – an area where the Centre has made progress through its own research³.

3. STRATEGY FOR UTILISATION AND COMMERCIALISATION OF RESEARCH OUTPUTS

The Centre's main role is an 'information broker', providing end-users with science-based information and assisting in its application to improve industry environmental, resource management and production practices. The Centre's technology transfer strategy takes into account that (i) the Centre has a diversity of stakeholders from the industry and the community, (ii) many of the issues addressed by the Centre's research are difficult and / or complex and require cultural change to facilitate implementation and (iii) the industry has in place extension networks where the CRC can add value rather than duplicate. The strategy comprises several complementary methods to technology transfer, each reflecting the nature of the technological innovation involved and tailored to the needs of the end-users.

Links to end-users

The Centre's industry stakeholders span the value chain, but primary emphasis is on growers and millers, and to a lesser extent agribusiness. All can be considered to be SMEs. Community-based stakeholders

¹ Agrtrans Research and eSYS Development (2000). *Economic Evaluation of Selected Research Activities of the CRC for Sustainable Sugar Production*. CRC Sugar Occasional Publication, August 2000. CRC for Sustainable Sugar Production: Townsville.

² Wegener, MK, Muchow, RC, Robertson, MJ and Inman-Bamber, NG (2000). Economic evaluation of investment in research: The use of supplementary irrigation in Australian sugar cane production: *Proceedings of the Australian Society of Sugar Cane Technologists Conference 22*: 178-186.

³ Mallawaarachchi, T, Blamey, RK, Morrisson, MD, Johnson, AKL and Bennett, JW (in press). 'Community values for environmental protection in a cane farming catchment in Northern Australia: a choice modelling study.' *Journal of Environmental Management*.

include environmental managers (e.g. EPA, GBRMPA, QDPI Fisheries), environmental interest groups (e.g. Landcare, ICM/CCC, environmentalists), downstream industries (e.g. fishing, tourism) and policy makers in industry, financial services, and local and state government. The Centre recognises that end-users' objectives, expectations and perceptions often differ. Considerable emphasis is placed on the Centre's role as an honest broker, providing objective scientific information to all end-users.

The Centre's strong participative links to end-users at all levels of operation foster a strong output / outcomes focus. The industry is strongly represented among the Centre Parties and on the Board. Industry and community end-users are actively involved through the Centre consultative committee structures (the Advisory Committee (AC), Program Consultative Groups (PCGs), the 3.2 Industry Consultative Group, reference panels for scoping studies and short courses) and through direct participation in research.

Technology transfer methods and techniques

Participative research with end-users. The Centre has put emphasis on participative research and learning projects that actively engage end-users at all levels of the CRC's operations, and in all phases of the research from initial planning to evaluation and implementation of options in pilot studies. The experience has been that participative approaches are more effective than traditional extension approaches when dealing with complex issues, where different stakeholders may have different and even competing goals and expectations.

The participative approach has been assisted by the direct involvement as Parties of the five major milling companies (representing >95% of mills) and CANEGROWERS, who collectively second c. 7.0 FTSE to the Centre (\cong 29% of total in-kind). These staff have played a critical role in delivering the application of research outputs. In addition, the Centre has involved non-Party end-users in several studies.

Examples where the participative approach has proved valuable include alternative cane supply options analysis (millers, growers and marketers), yield forecasting (cane inspectors, mill management), on-farm management of acid sulfate soils (millers and growers, community and fishing interests), natural resource management decision-making (growers, millers, councils, community, environmental interests), re-use of effluents (growers, councils), limited use of supplemental irrigation (growers).

Economic analysis and decision support tools and approaches. An integral part of the Centre's strategy for applying information and facilitating beneficial change has been to integrate biophysical and economic information into frameworks useful to end-users. Operationally, this has been fostered through the Centre's Systems Analysis and Modelling Cross-Program. Biophysical models and other frameworks developed by the Centre enable extrapolation of experience (e.g. across regions and years) and allow complex interactions among factors (e.g. crop, soil and climate) to be understood and manipulated. Coupled with economic analyses and evaluation, the models enable scenarios to be examined and options evaluated in terms of economic costs, benefits, trade-offs and risks.

The wide range of modelling and other integrative tools (such as Cane supply options analyses; NRM Tools, CLAM, DamEa\$y, SUGARCO\$T, APSIM Sugarcane model, LUCID framework for nutritional information) is catalogued in the Annual Report (see Section 11, Performance Indicators). Economic analyses and research⁴ have focussed on (i) benefits of specific practices and options, (ii) regional resource use, (iii) whole of industry management issues and (iv) value of research outputs.

The value to end-users of these tools and approaches was favourably noted in the Stage 1 Report.

Links with BSES/CPPB extension network. The sugar industry has an established network of regionally located extension staff employed by the Bureau of Sugar Experiment Stations (BSES) and local Cane Protection and Productivity Boards (CPPBs). The extension officers are each responsible for providing advice to individual growers and millers in their area. The extension network is particularly well suited to the facilitation of continual diffusion of technology and knowledge on better crop, soil and water management practices to the wider grower and miller community. Information is made available to end-users at BSES

⁴ For more details, see *Applying Research Outputs – Economic Analysis & Evaluation*, Section 6, Applications of Research CRC Sugar Annual Report 1999-2000.

regional field days and shed meetings, through various extension resources materials and in response to direct requests.

CRC Sugar has built strong links with this network, through an aggregate 4.3 FTSE extension staff seconded to the CRC from BSES and CPPBs, who in turn provide leadership for Technology Transfer Cross Program activities within the Centre. The seconded extension staff provide the conduit for Centre research outputs into the network, and thence out to individual growers and millers. The aim has been to add value to the existing extension network in three main ways:

- provision to extension staff of publications, information sheets, poster displays, videos, kits and where relevant (e.g. Sodic Soils Toolkit) training in their use;
- provision of high-level training via 'train the trainer' short courses on key sustainability issues, targeting industry extension and advisory staff (see later); and
- expanding capacity in the environmental sustainability area, by employing a Technology Transfer Officer through the BSES to assist develop extension kits and techniques in that area.

The range of extension materials developed by the Centre spans the range of traditional (*Occasional Publications*, posters, information sheets, extension kits, videos) and WWW-based information packages in down-loadable pdf format. (A catalogue of the information sheets, extension kits, video is provided in the Annual Report (Section 6)).

The wider impact of these outputs is difficult to gauge quantitatively but is on-going. In the first six months that downloadable pdf information sheets were available via the Centre's website, more than 600 downloads were made by extension staff linked with the CRC.

Communications and presentations. All project plans are required to have in place a TT strategy developed in consultation with TT Cross Program Coordinators. Likewise, all CRC Sugar staff and students are encouraged to actively participate in fostering end user awareness of and application of their research outputs. Communications and presentations to stakeholders are an important component of this strategy. Key areas of focus are (i) presentations (at industry meetings, seminars, field days, shed meetings), (ii) articles in industry journals (e.g. *Australian Canegrower*, *Australian Sugarcane*, *Sunfish*), (iii) articles in regional newspapers and (iv) radio and television stories.

The Centre's Annual Reports provide a catalogue of the Centre's extensive activity in these areas. In the last five years, the number of communications and presentations by staff and students increased more than four-fold to >300 individual events in 1999/2000.

International links. The Australian sugar industry is a world-leader in the development and application of production and milling technology (although the latter is progressively being eroded as up-to-date capital-intensive milling infrastructure is developed in low-wage competitor countries). The main focus of the Centre's international links is to ensure awareness of and access to novel research approaches inside and outside the sugar industry. For example, lead staff maintain active links with sugar industries in South Africa (SASEX), Hawaii, southern USA, Brazil, Mauritius and UK, and with key research groups (e.g. University of California, Davis, Institute of Arable Crops, UK, USDA Salinity Laboratory, University of Pretoria).

Intellectual property management

IP is managed in accordance with its IP policy, the key elements of which are:

- A record of Centre IP is maintained in an IP Register. IP is held in trust for the CRC by the joint venture party(ies) hosting the research wherein IP is generated. Ownership of Centre IP is vested in the Centre Parties in proportion to their equity in the CRC.
- Background IP is identified as relevant, noted in the IP Register, and agreement for its use secured prior to the commencement of CRC research designed to build on it.

- Guidelines are issued to students on IP management as part of the agreement covering the conditions of their CRC awards. The CRC retains commercial ownership of IP emerging from student projects funded by the CRC, while copyright of theses is vested with students.
- All research outputs are considered for commercialisation potential before publication. Permission to publish is required, but in line with the CRC's role as an 'honest broker' of information, open publication and dissemination of information is generally encouraged.
- Recognition of the IP contributions of all contributing researchers is encouraged through multiple authorship of publications.
- Commercial-in-confidence requirements are observed where confidential industry data are sourced for use in CRC research. However, such requirements do not preclude the disclosure to joint venture Parties and research end-users of general conclusions emerging from CRC research.
- Joint venture Parties to the CRC are permitted to use Centre IP in their normal commercial operations within Australia. However, commercial use of IP in offshore operations requires CRC permission.

The broad thrust of the IP management strategy is to actively facilitate dissemination and use of research outputs in Australia, while retaining the option of realising the commercial value of specific IP suitable for capture and sale as a commercial product.

Commercial sale of IP

For the purposes of commercialising Centre IP, the Centre joint venture agreement provides for the establishment of a Party or other person as Commercial Agent to act on behalf of the joint venture Parties as a whole. The principles and procedures that would govern the role and function of the Commercial Agent are also codified in the agreement.

The Centre examined the option of commercially exploiting some of its computer-based decision support systems. It was concluded that commercialisation would hinder rather than hasten adoption rates, especially where end-users need education and encouragement to change. Further, the returns from commercial IP sales would not be sufficiently large to justify the diversion of resources from active promotion of adoption and the transaction costs incurred.

The Board has recognised that strategies are needed for more broadly applying research outputs from participative research, particularly ways to encourage end-users to work with the CRC to translate achievements to other regions. Experience to date has shown that fully participative approaches, while more effective in securing commercialisation objectives, are time-consuming and resource-intensive. Current belief is that future research should focus on participative case studies in one or two mill regions or catchments, and rely on additional mechanisms to secure wider application of outputs.

4. EDUCATION AND TRAINING

As noted by the Stage 1 Review, CRC Sugar is the major higher-level education provider for the sugar industry. Specific education goals are to enhance the industry's scientific capacity in sustainability of production, and to improve industry practice by promoting awareness of and fostering use scientific information on sustainability issues. The two main strategies to achieve these goals are postgraduate training, and provision of continuing education on key sustainability issues targeted at industry extension and advisory personnel. Opportunities are also provided for generic skills enhancement for researchers and students.

Postgraduate training

The main aim of the postgraduate program is a pool of competent researchers with the skills and industry experience needed to sustain the flow of new ideas and promote industry innovation. Formal scientific training is being provided at Ph D, Masters and Honours levels in a range of disciplines mainly through JCU, UQ and CQU. The program is attracting capable trainee scientists into the sugar industry, and providing further professional development for people already in the workforce.

CRC Sugar supports students through Postgraduate Awards, which provide a stipend at the APA(l) rate and travel and research support. Augmentative support is provided for part-time postgraduate study by researchers already in employment, and as supplementary support for students with partial external funding.

Postgraduate training focuses on topics of priority industry need, and as noted by the Stage 1 Review, student projects are closely integrated into research activities. Particular emphasis has been placed on training to meet emerging industry needs in the social sciences (rural sociology, technology transfer, human geography) and economics (12 students).

Most students are jointly supervised by one or more associate supervisors from an industry or non-university party. Most are also doing their research off-campus, and more than half are located with a non-university Party remote from their host university. These arrangements provide 'real-world' experience for the students, and while they present new challenges, they provide the students access to a wider range of expertise and research infrastructure. As noted by the Stage 1 Review, 25% of research papers in 1999/2000 had at least one student author.

Thirty-six students have now received CRC Sugar support, exceeding the original target (22-24). Of these, ten are researchers already in employment, and two are CRC Sugar staff. Half of the students have now completed the research phase of their studies. Of these, several have submitted their theses and four have had degrees awarded. Three Awardees discontinued their studies after enrolling.

Several students have received awards for outstanding performance: Ms Tracy Henderson (Australian Institute for Agricultural Science and Technology Young Professional of the Year for 2000); Ms Jo-Anne Cavanagh (AMSA Student Travel Prize (\$4,000) April 1998; Marine Pollution and Eco-toxicology Hong Kong Conference Registration Scholarship, June 1998, and US Society for Environmental Toxicological and Chemistry Award (\$US10,000), in May 1998); Mr Gurmit Singh (W Kerr Award, Australian Society of Sugar Cane Technologists, April 1999); and Mr T Balakrishnan (a member of the project team that received the RiverCare 2000 Gold Award for Primary Industry, December 1998).

Short Courses

'Train the Trainer' short courses provide up-to-date scientific information including outputs from the Centre's research activities. Target participants are the extension and technical advisory personnel responsible for advising sugar industry and community agencies on sustainability issues.

Course topics and broad format are based on a needs-analysis survey of more than a hundred groups, including the BSES Extension Service, CPPBs, milling companies, agribusiness, ICMs, LANDCARE, local and state government agencies, environmental groups and environmental management agencies. A reference panel that includes end-user members helps shape the course outline. Courses are intensive, with the individual components prepared and presented by specialists. All course papers are peer-reviewed before being collated into a course manual published by the Centre.

Four presentations have been made to ~100 participants, including almost all BSES extension staff, of the short course *Sustainable Nutrient Management in Sugar Production*. Course evaluations by the participants were very positive. The BSES extension service is now using the information provided through the course in an SRDC-funded extension project outside the CRC that will deliver improved fertiliser management practices to individual growers across the regions. Pivot Ltd is using the course manual for its in-house training program, while the Australian College of Tropical Agriculture has incorporated key information into its diploma level courses.

In follow-up evaluations 3-15 months after the *Sustainable Nutrient Management* short courses, participants reported they were using most of the information provided to them 'regularly' or 'very regularly' in their work.

Presentations of the short course *Environmental Management for Sustainable Sugar Production* have been made to ~80 participants in Townsville, in Brisbane and in Mackay. The course focuses on the main environmental issues that need to be managed by the industry, and 'best practice' options based on current understanding. Course participants included BSES and state government extension staff, technical staff from CPPBs, fertiliser companies and agribusiness, and agricultural college teaching staff. As was the case for previous short courses, participant evaluations were very positive. Another short course is planned on *Sustainable Irrigation Management*.

CRC Sugar also sponsors / co-sponsors specialist workshop courses for sugar industry researchers e.g. nutrient cycling/trash management (1996), optimising nutrient management (1997, 1998), basics of modelling (1998), soil characterisation (1998), analyses of productivity data (1999), sodic soils (four presentations to ~90 extension staff), economics and farm management (1999), rural sociology (1999) and irrigation modelling and extension (1999).

To date, more than 400 participants have been trained through the Centre's 'train the trainer' short courses or attended specialist workshops.

Skills Enhancement

CRC Sugar sponsors staff and student attendance at external technical workshops to enhance their knowledge in their respective disciplinary areas and to present information on their own work to others. Several staff and students (e.g. Paul Nelson, Fiona Robertson, Bernard Schroeder, Thilak Mallawaarachchi, Karen Vella, Roger Lawes, Russ Muchow, Graham Kingston) have been sponsored to present their work at international conferences.

Opportunities are also provided for staff and students to attend more generic skills enhancement courses and workshops, run by the Centre or out-sourced to other training providers. Nine postdocs and students have now attended the CRC Leadership and Career Development Course, developed by the University of Melbourne Business School, a presentation of which the Centre co-sponsored in Townsville with four other northern CRCs. Two postgraduate students, Ms Karen Vella and Ms Judy Skilton were sponsored by CRC Sugar to attend last year's *Women in Science* conference in Melbourne.

Twenty staff and students have attended intensive two-day media skills training workshops and ten a specialist scientific presentation skills course. Several staff and students have attended training workshops on postgraduate supervision.

5. COLLABORATIVE ARRANGEMENTS

CRC Sugar adds value to sugar industry R&D by promoting cooperation among its joint venture Parties and participative research with industry and community end-users. The Centre's work in network development and institutional bridging was noted as a case study in the Mercer-Stocker Report on CRCs⁵.

CRC Sugar staff and students are drawn from 13 diverse organisations, and located at some 25 sites stretching 2500 km along the eastern coast of Australia. The challenge has been to link the different organisations, cultures and staff into a cooperative network that operates coherently. We have implemented various arrangements to meet this challenge and deliver the benefits of scientific research to the nation's nearly 7000 canegrowers and 30 sugar mills along the eastern coast of Australia and in the Ord River Irrigation Area in Western Australia.

Arrangements for Fostering Linkages

Enhanced Communications Infrastructure. The Centre employs a Communications Officer and IT Specialist support staff and maintains enhanced communications facilities, the main elements of which are:

- A high performance, high capacity network server providing email and data sharing services to Centre staff located with the Parties.
- A public web page [at <http://www-sugar.jcu.edu.au>] to service industry and general community information interests about CRC Sugar, its work and its staff.
- A web-based Intranet capacity to enable interactive staff access to internal information and to help streamline research management and administration functions.
- Room-based video-conferencing equipment at Centre HQ, complemented with PC based video-links located in Brisbane, Meringa, and Bundaberg.

⁵ *Case Study: CRC for Sustainable Sugar Production*. p. 29. In 'Review of greater commercialisation and self-funding in the CRC Program'. D Mercer & J Stocker. DIST: Canberra, May 1998.

- Weekly internal email newsletter *Short & Sweet* for staff and students and monthly external email newsletter *CRC Sugar News* targeting >200 end-users.
- WWW-based data-sharing facilities: *Research Tools- Weather Station Data* (up-to-date weather records from field sites), *Soils of the Sugarlands* (comprehensive metadata on soils information), and *Sugarbag* (local and international experimental records of crop growth).

Organisational Structures. All of CRC Sugar's management and committee structures are multi-party in composition and operate to facilitate collaboration at all levels throughout the Centre. Other organisational features that foster collaboration include:

- CRC Sugar's three cross-programs – *Systems Analysis and Modelling*, *Technology Transfer* and *Education* – deliver through the three research programs.
- The Annual Program Planning Meeting in March enables a comprehensive review of the year's work and planning of future initiatives.
- All three research programs contain a mix of disciplinary skills. Virtually all CRC Sugar R&D Activities now involve staff from two or more Parties. Experiments are located at private farms, research stations, universities and milling companies, with different teams sometimes sharing the same experimental sites and facilities.
- Interactive workshop courses are held to promote interdisciplinary understanding among researchers. This past year, workshops were held on sociology and economics.
- A CRC-funded modelling scientist is a conjoint appointment with the Australian Production Systems Research Unit to facilitate collaboration on crop-soil-water modelling.

External Research Links. Comprehensive catalogues of the Centre's external research links at local, national and international level are provided in the Centre's Annual Reports (Section 3, *Synergy through Collaboration*).

Cooperative Links with Other CRCs. CRC Sugar has a diversity of active links with other CRCs to achieve R&D aims and promote CRC Program objectives (see catalogue of Links with Other CRCs, Section 3, 1999/2000 Annual Report). Foremost among these are research links (e.g. joint student project with CRC Reef, joint workshop with CRC Reef on water quality issues, forthcoming joint conference on downstream effects of land-based activities), active participation with other CRCs in wider promotional activities (e.g. with other northern CRCs in federal and state parliamentary briefings, sponsorship of the BHERT/CRC career development course) and an active role in the CRC Association (representation of the agricultural sector, sector brochures, triumphs of technology transfer). These links have been facilitated by co-location with several other CRCs, notably CRC Reef, in Townsville.

Links with end users. These were discussed above. Suffice to say all current end-user Parties have remained with the Centre. In addition, joint projects / collaborative links have been established with other end-user groups such as Maryborough Sugar, the Burdekin industry, Tully Sugar, Pivot Ltd, Australian College of Tropical Agriculture, Bundaberg On-Farm Water Storage Users Group, North and South Burdekin Water Boards, NSW ASSMAC and Maryborough Council.

6. RESOURCES AND BUDGET

Cash and in-kind receipts and the deployment of these resources over the first five years are shown in the 1999/2000 Annual Report.

There have been no significant expenditure deviations from the Commonwealth Agreement apart from those due to slippage in staff and student recruitment in years 1 and 2. This was dealt with through the changes agreed with the Commonwealth following the Second Year Review. The changes, which also affected the timing of the Commonwealth Grant, brought forward some work and addressed emerging priorities in the wet tropics and environmental TT.

Approximately equal levels of resources have been applied to the three scientific key result areas, Environmental Protection, Sustainable Management of the Resource Base, and Enhancing Productivity. Because sustainable soil and water management contributes to both environmental sustainability and crop productivity, the resources of Centre have been fairly evenly divided between environmental protection and production related outcomes.

The Centre's budget is approved annually by the Board, and Parties advised of the maximum approved cash expenditure for their Activities for that year. Unspent cash funds are re-deployed on an annual basis. Over the life of the Centre, the Board has moved to progressively reduce the aggregate unspent funds held by the Parties, with additional funds now only advanced when funds held by Parties are depleted.

The Board's policy has been to use the majority of Commonwealth Grant to employ new staff and students to encourage development of new research capacity for the industry. An aggregate salary (plus on-costs) : operating ratio of 2 : 1 has been maintained for new staff and students through the life of the Centre.

The SRDC funds support SRDC-approved projects. To assist align research with both SRDC and CRC objectives, preliminary proposals are reviewed by a joint CRC-SRDC board subcommittee. As far as practicable, SRDC funds are used as a 'glue' to foster collaboration between seconded staff from CRC Parties. As processes have been streamlined, the SRDC funds have become more akin to additional cash income.

In addition to the SRDC commitment under the Commonwealth Agreement, CRC staff attract additional funding from SRDC (e.g. cane supply scheduling, ripeners, pesticides), LWRRDC, NHT and industry.

As Centre Agent, JCU maintains the joint venture trust account, with payments dispersed to Parties as instructed by the CEO on behalf of the Board. As Centre Host, JCU provides access to administrative services (mainly HR services for Secretariat staff, procurement of goods and services and travel). The Centre maintains its own commercial financial management system to enable effective financial monitoring and reporting to the Board (quarterly financial reports) and the CRC Program.

Program Leaders are required to confirm in their respective reports to MC and the Board, that Party in-kind commitments are being met in their areas of responsibility, or alternatively to alert the CEO, and the Board, of any discrepancies. Throughout the life of the Centre, aggregate Party commitments (FTSEs and in-kind) have been honoured. In particular, industry end-user commitments have been broadly maintained notwithstanding extremely difficult economic circumstances (in year 5, average sugar prices were ~30% of those when the Centre started).

Annual Auditor's Reports in each of the five years have clearly stated that proper accounting standards and controls have been exercised by management and no substantial qualifications have been raised. The Commonwealth Grant has been used only for the CRC Program of Activity and capital and IP are vested as per the Centre Agreement.

Forward projections indicate a balanced budget to June 30, 2002. Forward commitments provide for sufficient funding for all students on Postgraduate Awards to complete their studies within their requisite time periods, inclusive of some slippage in their progress. Provision is also made, in the event that the Centre is not re-funded, for the Secretariat to continue during the period July 1 – September 30, 2002, to ensure reporting, technology transfer and communications objectives are met.

An Activity Plan is a prerequisite for all Centre projects. Plans are broadly modelled on the SRDC approach, and comprise sections on Aims, Personnel (FTSEs) and Organisations, Industry Significance, Research Plan, Technology Transfer Plan, Collaborative Links, an indicative annual Budget and Milestones for Research, Technology Transfer and Communications against which progress is reported. Plans are maintained, updated and reported against, via a database with interactive access available through the WWW, a process that has been progressively streamlined with time.

Activity Plans form the basis of formal Activity Agreements between the Centre and Parties, again based on the SRDC model. Under the Agreements, responsibility for approving expenditure rests with the Activity leader, or with the relevant program leader where deviations from approved expenditure are contemplated.

Likewise, students in receipt of a CRC Sugar Postgraduate Award and their supervisors are required to sign a Student Agreement which identifies the rights and responsibilities of those concerned. Apart from IP considerations, the conditions attached to the Postgraduate Awards are the same as those attaching to the APA (I) Awards.

7. MANAGEMENT STRUCTURE

Consistent with the broad CRC model, CRC Sugar comprises parties from three sectors: the industry itself, the public R&D sector, and the Universities. The 13 Parties to the CRC provide in-kind commitment in the form of seconded staff with the complementary strengths and experience needed to tackle sustainability issues. These skills are augmented by the appointment of new staff and by the recruitment of postgraduate students, using the cash and project funds provided by the CRC program, and SRDC, respectively.

Emphasis in recruitment has been on filling gaps in available skills, for example in economics, modelling, mathematical analysis, spatial analysis and social science. One third of the new staff and 40% of the students are women. Several staff and students are overseas-trained.

Our staff and students are dispersed at numerous locations along the coast from Mossman in the north down to Harwood in NSW. Largest groupings are in Brisbane and in Townsville, with smaller groups in regional centres like Mackay, Bundaberg and Rockhampton. Necessarily, the Centre operates as a distributed network, with the Internet and email playing a crucial role in facilitating our operations.

The Board is responsible for Centre policy, strategic objectives, budget approval and oversight of management. The Board has an independent Chair and a minority of research provider members (2 millers, 2 growers, 1 SRDC, Chair, CEO, 4 research providers). Board meetings are held quarterly and are always well attended. Management Committee meets at 7-8 week intervals with meetings always well attended. Advisory Committee and PCGs meet twice annually, and are well attended. Agenda papers are provided and minutes circulated for all Board, Management Committee, AC, and PCG meetings.

Management and staffing arrangements have been relatively stable, particularly at program leadership and MC level. There have been only two changes to Specified Personnel, one involving leadership of the SAM Cross-Program, and the other, the leadership of input from CQU.

8. PERFORMANCE EVALUATION

Performance evaluation is achieved at several levels throughout the Centre, using mechanisms relevant to the level of operation and timeframe.

At the highest level, the Centre undertakes its own external annual review process. In the first three years, the Centre conducted annual meetings at program level in which staff and students reported on their work. Eminent scientists from outside the CRC were invited to attend and report on quality and relevance of the work. More recently, the Centre has conducted four-day Annual Review and Planning Meetings at which staff and students give oral presentations and posters on their work from the preceding year, and discuss implications and priorities for the future. Each year, a panel of three eminent scientists, with expertise spanning the three research program areas, is invited to attend and participate in the meeting, and provide their evaluation and recommendations for improvement to staff and students. The Centre Visitor, Chairman and usually several Board and consultative committee members also attend and participate in the ARPM.

Performance is monitored annually against, and the Centre's Performance Indicators are framed around the six KRAs in the Strategic Plan. Performance against Milestones and Performance Indicators is reported to the Board and to the CRC Program in the Centre Annual Report.

As an input into the above process, all students and scientists seconded for more than 20% of time to the Centre, from the CEO down, are expected to agree an annual workplan with their immediate supervisor, identify major objectives and likely time commitments, milestones and performance indicators for the coming year and report against them annually via the internal web page. Initial compliance levels were low

especially from organisations not used to formal annual assessment processes, but participation continues to grow over time.

All staff report annually on their key achievements, presentations and communications, interactions with stakeholders and key outputs such as publications, decision support aids etc. Initially reports were made via the program leader. More recently, reporting has moved to direct reporting through an internal web page 'annual report postbox'.

The Board scrutinises senior management performance at its quarterly meetings. The CEO, Executive Officer and Program Leaders are each required to provide a written quarterly report to the Board, reporting achievements against major milestones during the previous quarter and, by exception, alerting the Board to any issues of significance. In addition, the CEO meets formally with the Chairman once annually to review the CEO's performance against workplan milestones and performance indicators, and to agree on new milestones and performance indicators for the coming year.

At Management level, the Program Leaders are required to provide the CEO with a written program report prior to each MC meeting, identifying key achievements, raising operational issues and alerting the CEO to any issues of concern. Reports are circulated to all MC members and discussed at MC meetings.

Mechanisms to improve research quality include PCG and peer evaluation of research proposals at workshops and project meetings, and formal peer assessment of scientific publications. For the latter, existing mechanisms within the Parties are used as far as possible. In their absence, and for CRC Sugar *Occasional Publications*, the Centre (CEO and/or Program Leader) arranges for peer review prior to publication. In some cases (e.g. Short Course Manuals, Activity Papers), a consultant scientific editor is employed who arranges peer review. Most CRC-SRDC projects include a mid-term peer review.

The Centre's consultative mechanisms (Advisory Committee, PCGs) and active participation of end-users in Centre activities also provide opportunity for performance assessment from the end-user perspective, especially the relevance of the research. Applications of research, as well as effectiveness of stakeholder links are also discussed in these forums. PCGs report to the CEO following each ARPM.

Additional Information

This paper provides an overview only of CRC Sugar's first five years. More detailed information on CRC Sugar's achievements is available through the Centre's *Annual Reports* 1995/1996 to 1999/2000. In particular, the Annual Reports should be consulted for catalogued details of achievements in *Commercialisation of outputs* (Section 6), *Education and training* (Section 5), *Presentations and communications* (Section 9) and *Collaborative links* (Section 3), and also progress over time in *Performance Indicators* (Section 11).