

**BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA**

**FINAL REPORT – SRDC PROJECT BS182S
AN INTEGRATED DECISION SUPPORT SYSTEM
(DSS) TO IMPROVE THE UTILISATION
OF PRODUCTIVITY DATA BY EXTENSION,
RESEARCH AND PRODUCTIVITY PROGRAMS**

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ABSTRACT

Utilising previous research outcomes, a software application titled SUGARSCAPE was developed to provide extension, research and productivity staff within the Australian sugar industry a means of collating block and farm productivity data.

The original concept was to assist extension, research and productivity staff with the production of productivity reports through a suitably designed software application. The application designed by this project increased the scope of previously available productivity report options, and also included a spatial reporting component. Over a period of three years a software application was developed and trialed by a user group. This ensured the end result was derived by the needs of the industry. Towards the end of the project Bureau of Sugar Experiment Stations (BSES) extension staff participated in training sessions using the software application on their own computers; feedback was documented on evaluation forms and will be used as guidelines for further research. To date the software has been received enthusiastically. To assist users a user manual and on-line help documentation have been created and will be distributed with the software application.

With the exception of one objective, all project objectives were met. Most of the recommendations for further research have already been undertaken through another Sugar Research and Development Corporation (SRDC) project titled 'Facilitate the accessibility of productivity data by sugarcane farm managers through the SUGARSCAPE productivity software application.' This project will be completed by July 2001.

1.0 PROJECT SUMMARY

Australian sugar mills during their harvesting season generate immense amounts of productivity data. As well as for remuneration purposes this data can be also be utilised internally for research and extension activities. There are conventional software applications such as Microsoft Excel and Access, which can assist users with generating data summaries however, this is labour-intensive and time consuming for the average computer user. Hence a concept evolved to create a software application unique to the Australian sugar industry for the generation of productivity reports.

SUGARSCAPE was the name given to the software application designed to collate productivity data and produce easily comprehensible reports for growers, millers, extension, research and productivity staff. The application is an integration of Microsoft Excel, Access, Visual Basic and ESRI's MapObjects.

SUGARSCAPE provides a means of producing tabled, graphical and mapped productivity reports on a selected number of parameters such as cane and soil type, district or zone, a certain sugar price, a certain block size, a specific crop class and over a specific season or range of seasons.

Unlike previous versions of the software this application has been designed with the flexibility of accepting block or farm productivity data from either Queensland or New South Wales mill areas. However the majority of the popular reports are available for users with block data. Even so this application has the capability of benchmarking across mill areas if required.

Throughout the duration of the project the software application was introduced to user groups and feedback from these meetings and training sessions ensured the final functionality of the program. The final version of the software is packaged with extensive on-line documentation and a user manual.

Further research is already planned to extend the integration of this application with other farm block recording software encouraging the ongoing development of SUGARSCAPE.

2.0 PROJECT BACKGROUND

Widespread interest created by the outcome of Project BS51S 'Improved utilisation of productivity data through planned extension programs' and BS128S 'Enhanced productivity information to improve extension programs and research data' has resulted in the need to broaden the scope of the productivity software currently available to extension, research and productivity staff.

BS51S developed software to analyse productivity data and produce reports. BS128S broadened the scope of the program by including additional parameters such as soil type and harvesting systems.

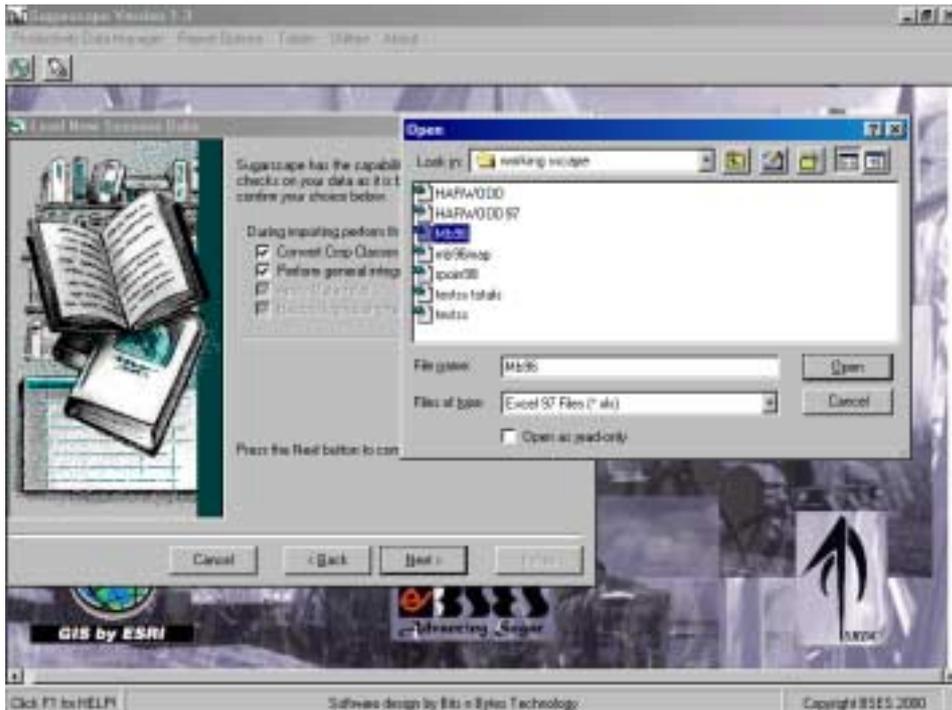
The major role of an extension officer is to advise growers on their cropping needs. It is therefore essential that extension staff be provided with the necessary tools for collating productivity data into a comprehensible format. With the conclusion of BS128S 'Enhanced productivity information to improve extension programs and research data' a software application called 'PRODIV' was developed. This software has the ability to produce reports comparing block data over a full crop cycle by variety, zone and soil type. As the technology becomes available, many sugar mills are increasing the scope of the block data recorded. It would be advantageous to extension, research and productivity staff to use these data as the basis of reports on productivity as they become available.

The software application designed through this project can be characterised as an integrated Decision Support System (DSS). An integrated software application is the union of several highly specialised applications. In this instance the integration is between Microsoft Access, Excel, Visual Basic and ESRI's MapObjects. Although any one of these applications may be excellent in its particular function, users often need to combine different types of information from different sources. Using the relational qualities of Access, the statistical and graphical capabilities of Excel, and the geographic mapping capabilities of MapObjects under one object-orientated Visual Basic interface, users are provided with a flexible but powerful tool for report development.

3.0 ACHIEVEMENT OF PROJECT OBJECTIVES

- *Develop a software package that has the capability of accessing raw data from mill databases, and manipulates these data to produce easily interpreted productivity data.*

SUGARSCAPE was the title given to the software application written to access mill data and enable the user to produce summarised reports from this data. Data can be imported as block data - an individual record for each block or farm data - summarised data for each farm. Appendix A, SUGARSCAPE user guide defines the required data formats. The SUGARSCAPE application accepts an Excel file in a pre-defined format. Where necessary a text file can be imported into Excel before loading into SUGARSCAPE. The application includes a Load Season wizard to assist the user with loading new data. During the load procedure SUGARSCAPE checks the data integrity, and if any problems are encountered copies the rows of data which are causing the error to a report which can be printed by the user for interpretation. After a successful load the user receives a confirmation message and a prompt to enter the district or zone information for their mill area.



Screen Dump 1: Loading New Seasons Data into SUGARSCAPE

SUGARSCAPE was designed to allow the user to choose from many different report options. The report options form shown on the previous page allows the user to query the data by seasons, district, grower number, variety, soil type, cane type (burnt or green) along with sugar price, harvesting and levies cost, % supply and block size. Once the user has selected the query options a report can be produced.

Screen Dump 2: The report options form

Reports are classified loosely as graphical, tabled or mapped. Graphical report options include CCS Charts, Relative District CCS, Variety x Crop Class Bar Charts, Productivity x Crop Class Bar Charts, Histogram, District Productivity Comparison Chart and Time of harvest reports for block data and District Tonnes Sugar/ha for farm data.

Tabled reports include Variety Performance x District Table, Variety Performance by a Grower Group, Farm Vs Zone Performance Table, an Annual Block Summary and Farm Ranking Table for block data and Top Producers Sugar/ha and Farm Ranking Table for farm data. If soil data is available Soil Type Performance Summary and Productivity Performance of a Soil Type will also be available at a block level.

SUGARSCAPE has an integrated mapping component which provides users with a Geographic Information System (GIS) viewer without the cost of purchasing specialised GIS software. SUGARSCAPE maps allow users to view standard ArcView .shp (shape) files and use standard mapping tools such as spatial select, pan, zoom etc to manipulate the farm or district map to their liking. For those users who have little experience with GIS technology, SUGARSCAPE also automates a farm or district map. The automatic map feature produces a farm or district map that contains a series of layers including Net Return, Sugar, Cane t/ha, and CCS.

A definition of each report and an example are included in Appendix B.

- *Utilise the relational database structure created in BS128S 'Enhanced Productivity information to improve extension programs and research data' as the knowledge base for an integrated object-orientated decision support system.*

The Access table designed in BS128S was used to model the SUGARSCAPE database. SUGARSCAPE has also included tables for the eventual recording of irrigation, pest, rainfall, and disease data. Below is the entity relationship diagram of the SUGARSCAPE database.

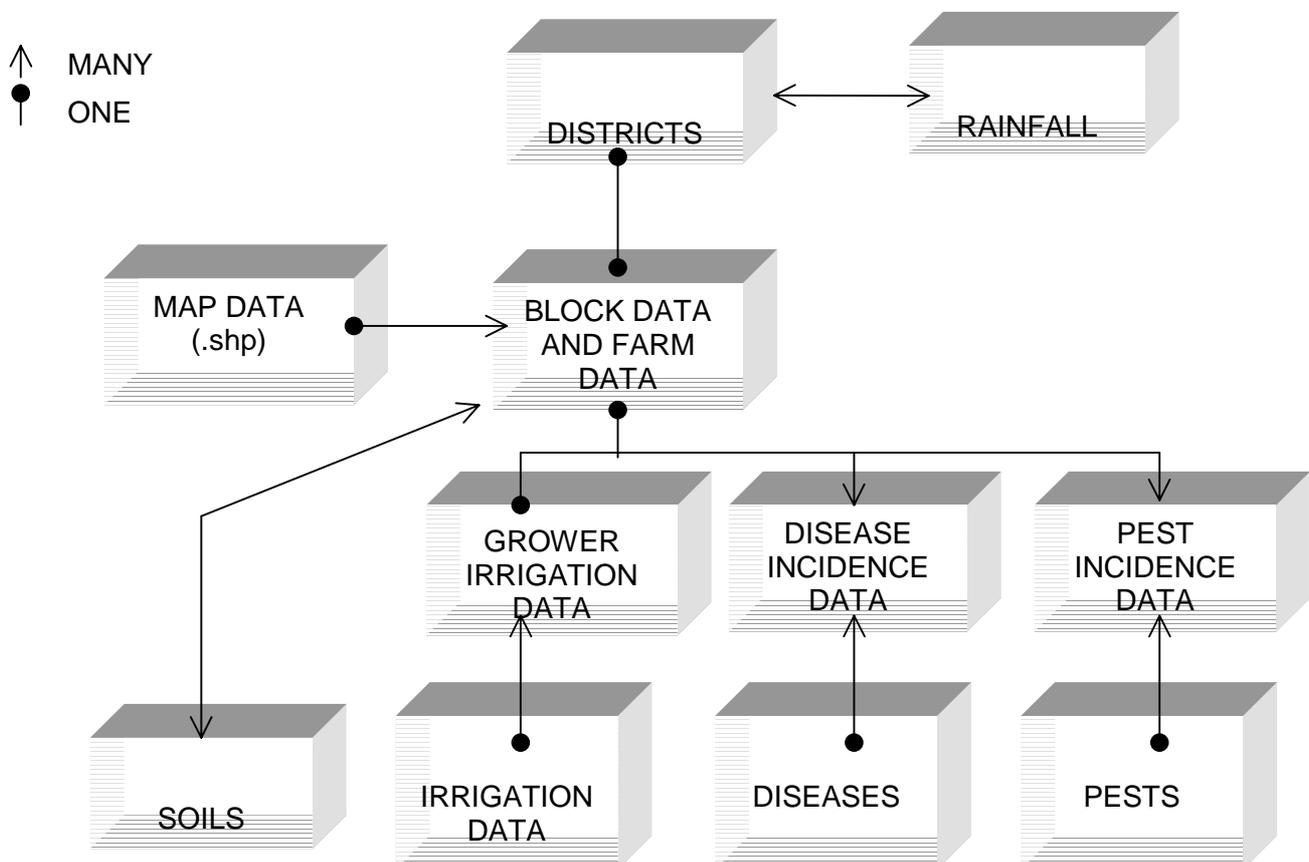
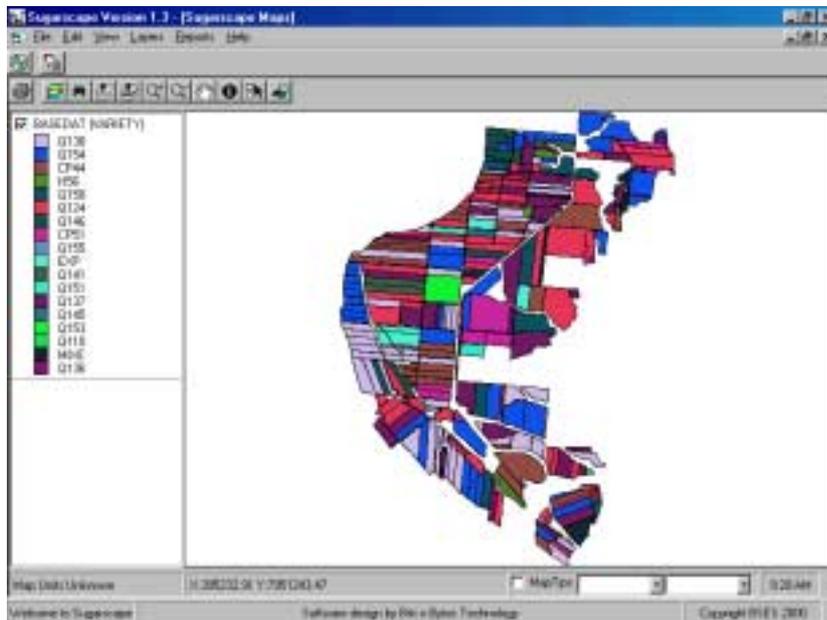


Figure 4 Sugarscape Entity Relationship Diagram

- *Enhance available report options with geographic mapping facilities utilising the flexibility and efficiency of an integrated software application.*



Screen Dump 3: SUGARSCAPE Maps

ESRI's MapObjects is the software component that has been integrated with Visual Basic to produce the SUGARSCAPE mapping component. The mapping component allows users to investigate the spatial distribution of productivity data hence providing another tool for data analysis.

- *Assist extension and productivity staff with the collation of productivity reports by including a report wizard within the application.*

This objective was abandoned in the later stages of the project. Coding for this objective was started and eventually abandoned because the process involved a large amount of system resources affecting the overall stability of the software application. MicroSoft technical support was consulted on the issue and agreed the programming method being used (Object Linking and Embedding or OLE) and the problems being experienced was a known problem with Visual Basic, and could not suggest a possible alternative to solve the problem at the time. In theory the idea of the report wizard should have been technically possible, however adequate system resources required to open and run Excel, Word, Access and Visual Basic simultaneously were not available at the time. Hence, the objective was abandoned and the time associated with the objective was allocated to finalising the archive, import and export utilities for the application, and the general running of the application. The exclusion of the report wizard in no way changed the reporting scope of the application, as all reports are available individually.

- *Evaluate the effective use of an integrated object-orientated decision support system by extension and research staff.*

After each training session users were asked to complete an evaluation form. The questions and results were as follows:

Program functionality

<i>Please comment on the functionality of the following areas. (% response) (1 being the highest and 5 the lowest)</i>	1	2	3	4	5
Did you find the program easy to navigate?	20	40	20	20	-
Did you find it easy to load data into the program?	-	40	60	-	-
Did you find error messages were appropriate?	60	20	-	20	-
Did you find on-line help useful?	20	40	40	-	-
Did you find it easy to load the software onto your computer?	40	40	-	-	-

Usefulness of output

<i>Please rate the usefulness of the reports produced by SUGARSCAPE (1 being the highest and 5 the lowest)</i>	1	2	3	4	5
Graphical					
CCS	60	20	-	-	-
Relative District CCS	60	20	-	-	-
Variety x Crop Class Bar Chart	60	20	-	-	-
Productivity x Crop Class Bar Chart	60	20	-	-	-
Histogram	60	20	-	-	-
District Tonnes Sugar/ha	60	20	-	-	-
District Productivity Comparisons	60	20	-	-	-
Tabled					
Variety Performance by District	60	20	-	-	-
Variety Performance by a Grower Group	60	20	-	-	-
Farm vs Zone Performance	60	20	-	-	-
Farm History Table	60	20	-	-	-
Farm Ranking Table	60	20	-	-	-
Top Producers Sugar/ha	60	20	-	-	-
Soil Performance Summary	60	20	-	-	-
Productivity Performance of a Soil Type	60	20	-	-	-
Individual Farm Performance	60	20	-	-	-
Mapped					
Automatic District/Farm Map	80	20	-	-	-

Additional Comments:

'Very powerful tool and very comprehensive with enormous potential but not the kind of thing that you can pick up straight away. You would need to use it a lot to get conversant with it.'

'Course needs to run over a whole day, mapping section is complex.'

What would you use SUGARSCAPE for? (circle answer)

To assist with annual productivity reports.	Yes 100%	No -
To produce individual grower reports on an ad-hoc basis.	Yes 100%	No -
To export grower data for research purposes.	Yes 100%	No -
For producing simple farm and district maps.	Yes 80%	No -

Under what conditions if any, would you adopt SUGARSCAPE as a reporting, decision-making tool for your area? eg availability of support, training, maintenance.

*'Training & tech support vital' ; 'Need some availability of support if possible' ;
'If mill data was available in a suitable format, support, maintenance and ongoing training' ; 'If other farm inputs could be incorporated eg fert, water, herbicide.'*

4.0 PROJECT METHODOLOGY

The duration of the project was three years with the application development technique being primarily top-down. This technique involved dividing the application into independent modules for ease of understanding and design. In the first stage of development, feedback was collected from the target user group which comprised extension, research and productivity staff throughout Queensland and New South Wales. Meetings were held in all extension areas discuss the current use of productivity software; access to mill data; access to mapped data; reporting needs; proposed software application scope; compatibility with other in-house software; and confidentiality of data. To confirm the desired outputs of the application a questionnaire enclosing examples of productivity reports was sent to each user in the target group.

Using the information collected from the centre visits and the questionnaire a requirements definition for the proposed software application was compiled. The requirements definition was a technical document defining the system scope, functional description and decomposition, data model, data flow and data dictionary. The hardware and software requirements were detailed along with alternative and proposed solutions. Examples of proposed interfaces were also outlined. This document provided a technical reference during prototype development. The architecture of the application was then documented in the System Specification. With the system documentation completed coding of individual modules was started. By December 1998 the first prototype of the application was completed and training sessions were held in a selected number of areas. These sessions provided valuable feedback on the usefulness of outputs, and feedback from these sessions was used to append, redesign and alter report options before the release of the application. On the completion of the coding the software was tested using a fictional set of productivity data. The testing phase provided

a means of ensuring the report outputs were providing valid indicators of productivity performance.

The user and on-line documentation was then developed for packaging with the application. The user documentation defines the required data format for loading new data into SUGARSCAPE. It also provides the user with step-by-step instructions on producing a report. On completion of the application a number of training sessions were held in extension areas. The application was received enthusiastically and installation of the software ran smoothly. A number of small run-time errors were discovered and have since been resolved.

5.0 DISCUSSION OF RESULTS

With the exception of objective four all expected outcomes have been achieved.

The SUGARSCAPE application was the evolution of previous software designed to provide extension, research and productivity staff with access to productivity data. The software was designed to run on a standard IBM-PC with Windows 95/98 and Microsoft Office 97/2000.

SUGARSCAPE allows users to produce reports using block or farm data in a variety of formats. Appendix B details the available report options. To provide flexibility and individuality of outputs, SUGARSCAPE produces all of its reports as an Excel spreadsheet or chart. Once a user has created a report all they need do is save the file under another file name to change the format of the report.

The most desired component of the application was the inclusion of a GIS mapping component. Most growers relate favourably to a map of their own farm. With SUGARSCAPE maps an extension officer can easily produce a multi-layered map of a specific farm, representing a growers return, sugar, cane(t/ha) and ccs.

Several utilities have been included within SUGARSCAPE to allow it to integrate with other standard software applications. An export facility for a grower or farm has been included allowing extension staff to extract productivity data for further analysis. Map data can also be saved as a standard .shp file. Other standard utilities include season backup; archive and delete.

The final training sessions held using SUGARSCAPE were well received although most users commented the course was too short and they needed more time to digest the extent of the application particularly the mapping component. Users also indicated that it would be useful for training and support to be a continual process and not just a one-off occurrence.

A continuing problem is the varying format of productivity data received from each mill. Unfortunately as there are currently no standards in place throughout the sugar industry for productivity data this is going to continue to be an on-going problem for

any party designing industry-wide software. SUGARSCAPE cannot anticipate every variation in data format.

5.1 Assessment of the likely impact for the Sugar Industry in Australia and elsewhere and where possible the cost and potential benefit to the Australian Sugar Industry and future research needs

If adopted and supported by a large proportion of the industry as a standard reporting system the application would assist the evolution of an industry-wide productivity data standard. As the application has been designed for the entire industry, it is possible to benchmark across mill areas.

The application was relatively inexpensive to create and with on-going support has the potential to become a dynamic collection-point for not only productivity data but also farm inputs such as fertiliser, irrigation, and pests. Eventually the boundaries between block recording applications and industry-wide applications such as SUGARSCAPE will fade and an all-encompassing application will emerge which can assist not only researchers but also growers at an individual level.

6.0 PROJECT TECHNOLOGY

The SUGARSCAPE software application was developed to assist the extension, research and productivity staff and sugar mills within the Australian sugar industry. Therefore, no intellectual property issues arise.

6.1 Recommendations on the activities or other steps to further develop, disseminate or exploit the Project Technology

SRDC project BS248S titled '*Facilitate the accessibility of productivity data by sugarcane farm managers through the SUGARSCAPE productivity software application*' will continue the development of the SUGARSCAPE application. The objectives of this project have been directly derived from the recommendations for further research project BS182S. They are as follows

- Extend the SUGARSCAPE productivity software application by developing a utility to export the productivity and spatial data of an individual sugarcane grower to a file that can be imported into the CANEMAN software application and other industry software applications.
- Extend the CANEMAN software application to include an import utility which will allow users to import their entire seasonal records and spatial data in one procedure.
- Increase the validity of block recording data for the individual cane farm manager whilst decreasing time allocated to data input each season by an individual farmer.

- Promote the standardisation of productivity data throughout the Australian sugar industry to facilitate benchmarking across mill areas.
- Provide ongoing maintenance and support for the SUGARSCAPE application ensuring the software application remains a viable tool for users.

As well as those objectives listed above, training users also list the following as recommendations for further research.

- Integrate existing report options with pest, disease, rainfall and irrigation data.
- Actively seek on-going funding to continue the development of the database application as the industry dictates.

APPENDIX A

SUMMARY OF REPORT OUTPUT

APPENDIX B
SUGARSCAPE EVALUATION

APPENDIX C
CD AND USER MANUAL
(ATTACHED)