A PROPOSED FRAMEWORK FOR OPERATIONAL CROP FORECASTS IN THE SOUTH AFRICAN SUGAR INDUSTRY

CN BEZUIDENHOUT

South African Sugar Association Experiment Station, Private Bag X02, Mount Edgecombe, 4300, South Africa

Introduction

The are a number of benefits for the South African sugar industry when crop forecasts are used to assist management in decision making. Growth models are to a greater extent being used to assist with crop forecasts (e.g. Supit, 1997; CLIMAG, 1999; de Jager *et al*., 1998). Studies at the University of Natal (Lumsden *et al*., 1999) highlighted the potential benefits of a model-based crop forecast system. Similar forecasts by the Experiment Station (Bezuidenhout and Singels, 2000) have also shown the ability to deliver regular forecasts for various combinations of soil, climate and management parameters for the industry. Ahmadi *et al*. (2000) noted that the incorporation of forecasts and other agronomic decisions under a suitable management portfolio would lead to improved control of various aspects of crop production and harvesting systems. Modellers, who are often remote from areas of management, must take steps to disseminate information at the right time and in the right format.

A survey was conducted by questionnaire in which stake holders in the agricultural, milling and services sectors were given the opportunity to state their requirements. This paper summarises the results of this survey by proposing an operational crop forecast framework that will address issues such as forecast frequency, timing, accuracy, geographical resolution, information transfer media and the integration of forecasts with management decisions.

System requirements

Forty-nine stakeholders participated in the survey, and Table 1 reflects their representation among stakeholder groups. Some participants relate to more than one group.

Participants were asked how they utilise crop forecasts. Forecasts, referred to in general terms, are used for submitting estimates to Mill Group Boards (MGBs) and hauliers, adjusting fertiliser applications, supplying advice on predicted growing conditions, predicting potential pest and disease problems, determining the length of the milling season, assisting with financial planning and enabling the planning of sugar marketing and sales strategies.

The industry's need for crop forecasts for the approaching milling season starts in September, increases towards February and then remains high during the milling season. Forecasts prior to the growing season (September to December) should be interpreted with caution due to uncertain climate outlooks. The majority of stakeholders require an updated forecast on the first day of every month in order to synchronise with MGB activities. Monthly updates are achievable with models like CaneSim (Singels *et al*., 1998) given that adequate human and computing resources are available.

Uncertainties about the climate outlook and limitations within the model, and uncertainties in model input, all affect the accuracy of a forecast. The uncertainty of a forecast therefore needs to be quantified (e.g. by confidence intervals) and stakeholders must establish the suitability of the forecast to support their decisions.

Table 1 gives the resolutions at which participants would like to obtain a forecast. It is evident that a large proportion of stakeholders have an interest in forecasts on farm, climatic zone or mill area scale. A farm-based forecast requires the processing of large amounts of management and weather data, which is not feasible given current resources at SASEX. Forecasts for a mill area might not capture the diverse agroclimatic conditions that exist. Homogeneous climatic zones therefore appear to be a realistic forecast resolution. A statistical approach can be followed in which typical agroclimatic practices within each climatic zone are modelled. Stakeholders could then obtain results for average fields under specific agroclimatic conditions, or they could synthesise forecasts for larger areas based on the proportional contributions of fields.

It is proposed that all RV related crop properties (Murray, 2000) be forecast because of the diverse interests among stakeholders. Stakeholders could benchmark the performance of this season's crop against that of the previous season, a well-watered crop, or the previous ratoon crop. It is therefore proposed that cane yield, sucrose yield, fibre content and non-sucrose content be expressed by indices and managed by an interactive database. This will enable stakeholder-specific comparisons, graphs and maps to be made.

Participants indicated that e-mail, which unfortunately is limited when delivering large quantities of information, would be the most convenient method of information transfer. A combination of e-mail, web pages and stand-alone PC software is proposed. E-mail could be used to supply summarised results while web pages could host more detailed information. The database, which can be downloaded via the web pages, should be linked to a PC-based decision support program (DSP) and could answer customised 'what if?' questions. Figure 1 illustrates the proposed framework for delivering crop forecasts to the industry.

Discussion and conclusion

Crop forecasts support a wide range of decisions and therefore require flexibility. The first forecast should be issued on 1 September, followed by a monthly update. Reporting forecast un-

Table 1. Summary of feedback received from questionnaire with regard to preferred spatial forecast resolution.

Stakeholder group	Number of participants	Proportion of participants requiring this forecast resolution					
		Field	Farm	Climatic zone	Mill area	Region	National
Growers	30	36%	80%	66%	83%	30%	20%
Millers	12	8%	58%	66%	92%	17%	17%
Marketing	2	0%	50%	0%	100%	50%	50%
Transport	5	0%	60%	20%	100%	0%	0%
Export	2	0%	50%	0%	100%	50%	50%
Overall	49	10%	24%	22%	30%	8%	6%

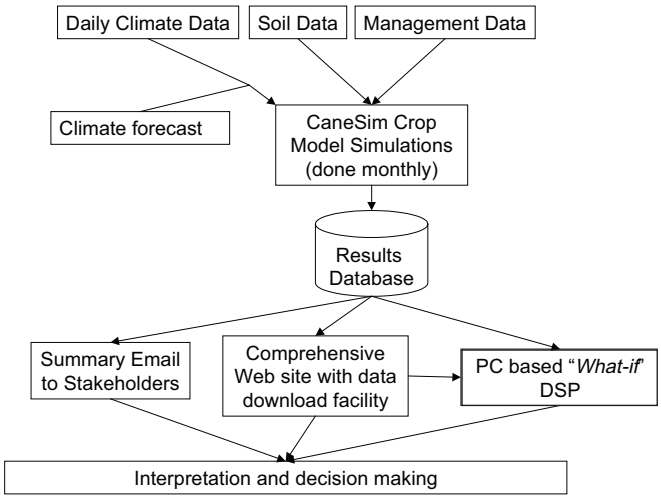

Figure 1. Flowchart of proposed crop forecast framework.

certainty is essential and stakeholders should assess the adequacy to interpret results. Forecasts on homogeneous climatic zones should provide efficient information for most stakeholders. A DSP is required to extrapolate results to larger areas. A database facility should enable flexibility and the presentation of graphs and maps. It is proposed that the bulk of forecast results be Internet-based.

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REFERENCES

Ahmadi, R, Baier, GJ and Shipley, DJ (2000). Improvement of cane quality at Ubombo Sugar. *Proc S Afr Sug Technol Ass* - Farming for RV Workshop, held at Mt Edgecombe, 13 June 2000. 7 pp.

Bezuidenhout, CN and Singels, S (2000). Climatic cane yield estimates for the year 2000. Series of Internal Reports of the SASA Experiment Station, Mt Edgecombe, Mar/May/June/Aug/Sept 2000.

CLIMAG (1999). Sugar first with across industry approach. IN: Newsletter of the Climate Variability in Agriculture R&D Program (CVAP), Issue 2, July 1999, ISSN: 1441-7987. Available at: http://www.cvap.gov.au/climag2.htm. Accessed {21/11/2000}.

de Jager, JM, Potgieter, AB and van den Berg, WJ (1998). Framework for forecasting the extent and severity of drought in maize in the Free State Province of South Africa. *Agricultural Systems* 57: 351-365.

Lumsden, TG, Schulze, RE, Lecler, NL and Schmidt, EJ (1999). An assessment of the potential for sugarcane yield forecasting using seasonal rainfall forecasts and crop yield models. Report to SASA Experiment Station, Mt Edgecombe, Dec 1999, 94 pp.

Murray, TJ (2000). The derivation of the RV formula for cane payment. *Proc S Afr Sug Technol Ass* - Farming for RV Workshop, held at Mt Edgecombe, 13 June 2000.

Singels, A, Kennedy, AJ and Bezuidenhout, CN (1998). IRRICANE: A simple computerised irrigation scheduling method for sugarcane. *Proc S Afr Sug Technol Ass* 72: 117-122.

Supit, I (1997). Predicting national wheat yields using crop simulation and trend models. *Agricultural and Forest Meteorology* 88: 199-214.