A COMPUTER BASED EXTENSION TOOL FOR AN ASSESSMENT OF DISTRICT RESOURCES

JL NEEN[1], QV MANN[1], KE DOMLEO[2] and DG MCARTHUR[3]

[1]*South African Sugar Association Experiment Station, Mount Edgecombe*
[2]*CG Smith Sugar Ltd, Noodsberg Mill, Dalton*
[3]*Union Co-operative Ltd, Dalton*

Abstract

An assessment of the agricultural resources of individual sugarcane farms in the Natal Midlands was performed by recording the factors rainfall, soil potential, frost hazard and a subjective rating of farm management ability. This information, together with farm production data for the three milling seasons 1991-92 to 1993-94, were entered into a computer spreadsheet package. Individual data were mapped and the weighted means were ranked and mapped, then used to derive norms, highlight trends and identify extension needs.

Introduction

The objectives of the project were to use available knowledge to quantify the production potential of land areas in the region into categories according to rainfall, soils, frost and management factors and to use the results to highlight trends, determine the influence of the different factors on yields and provide indicators for future extension programmes.

The agricultural advisors, agronomists, grower liaison officers and South African Sugar Association Experiment Station extension officers in the region have widespread knowledge and experience of the sugarcane growers and their farms. This includes a good understanding of the factors which influence the cane production potential of each farm and of the management capability of growers. The potential usefulness of this information is considerable. It was entered on a computer spreadsheet to assess the sugarcane farms in the Dalton and Noodsberg mill areas. This paper compares farm potential with actual yields, and both sets of data are used to identify trends and problem situations. It describes the method used and how it can be adapted to be used in other regions.

Method

The long term mean (LTM) rainfall was determined, the soils (in relation to their yield potential), frost hazard status and the standard of management were assessed for each farm.

The LTM rainfall for each farm was estimated, to the nearest 50 mm, from the records of about 60 farms with rainfall records. These data were then extrapolated to adjacent farms, and grouped into convenient categories for mapping and assessment. When the effects of the 1992/93 drought were examined, representative stations in each ward were selected and the rainfall figures recorded for four consecutive seasons. As the Midlands sugarcane crop is usually harvested between 22 and 24 months of age, a two season running mean was used to estimate the rain that fell on the crop in every ward during each milling season.

Soils, frost hazard and management standards on each farm were subjectively categorised on a scale of 0 to 5; with 0 being very poor (or highly likely, in the case of frost) and 5 being excellent (or no frost), categories 2 and 3 represented just below and just above average respectively. Soils rated 0 and 1 included the shallow, sandier soils, where the potential yield of sugarcane is low, and those rated 5 included the predominantly deep, humic soils with a high yield potential. The ranking of each farm in terms of the likely incidence and severity of frost was based on the experience of frosts in the region.

The assessment of management skills was more difficult. It was accepted that management has vital influence on the overall success of a farming enterprise. In addition, the strict confidentiality of each assessment had to be observed. The subjective ratings of management were based on the standards of cane husbandry practices such as weed control and cane nutrition, as observed by the authors.

To check the accuracy of the procedure, colour coded maps of the district were produced for each ranked factor excluding management. This highlighted possible errors in judgement and scoring, and provided an opportunity of correcting them.

Having established the ranking, the data was entered into the computer spreadsheets, for each quota and for each season.

With the database facility of the spreadsheet, it was possible to select weighted means of any desired set of data, depending on the established criteria. The sets were then studied to compare results within each ward, identify trends and determine the influence of one or more factors on yield or other aspects of production. Although the data for each season are kept separately, it is possible to select any item (e.g. tons cane per hectare) in order to make comparisons over several seasons. As new seasons' results become available, the data will be increasingly meaningful.

Table 1

Total hectares of cane and percentage cane areas in different long term rainfall categories

Rainfall Category	Total hectares of cane	Percentage cane area
< 850 mm	7 309	17
850 to 900 mm	15 568	37
900 to 950 mm	4 648	11
950 to 1 000 mm	6 066	14
1 000 to 1 100 mm	4 460	11
1 100 to 1 200 mm	3 628	9
> 1 200 mm	339	1
Mean LTA rainfall 903 mm	Total 42 019 ha	100 %

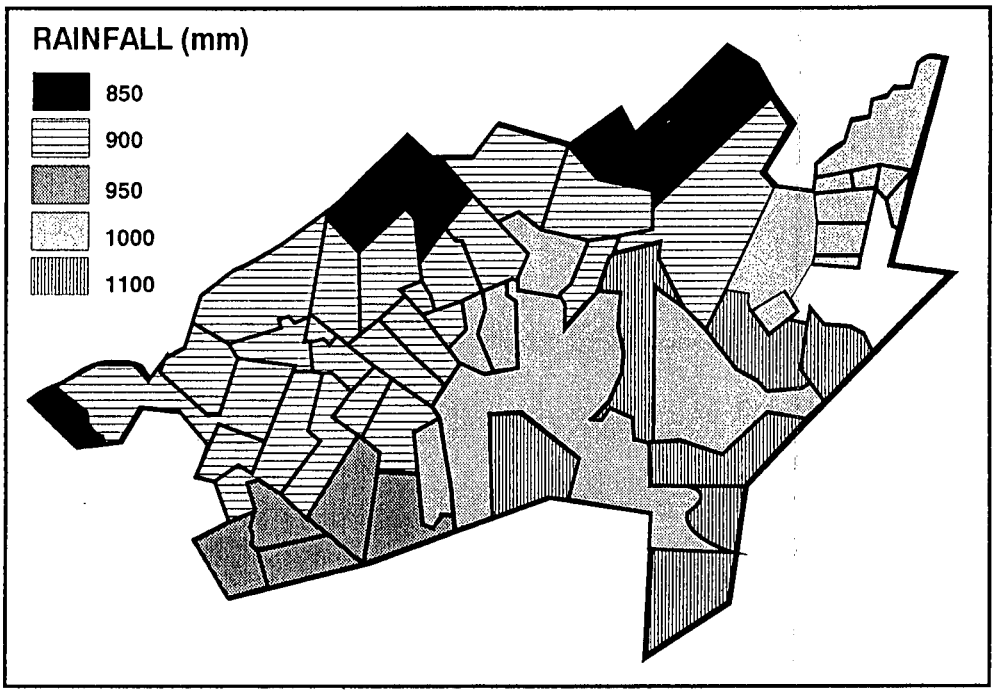

FIGURE 1 A map of portion of the Natal Midlands region showing farm boundaries, ward boundaries and estimated long term farm rainfall.

Results and Discussion

Of the current cane area in the region, 54% has a LTM rainfall of less than 900 mm, which is close to being marginal for rainfed sugarcane (Table 1). The weighted LTM rainfall for the cane area in the Midlands region is estimated at 903 mm.

Figure 1 represents a portion of the district showing a distinct rainfall pattern favouring the south and south eastern region.

Farm size in relation to sucrose production is shown in Table 2.

The frequency distribution of farm sizes coupled with cane production shows that there are 60 quota farms of less than 50 ha of cane (Table 2). Many of these small quota holders are recent entrants into sugarcane farming, and it is likely that most of these will require special extension assistance.

The distribution of the different soil categories and their respective cane production potentials are shown in Table 3.

Fifteen per cent of the cane area has excellent soils (rated 5) and a further 28% has good soils (rated 4). The average

Table 2

Number of farms, relative cane areas and cane production in the different farm size categories for the 1993/94 milling season

Farm size category (ha cane)	Number of farms	Cane area (ha)	Total tons cane
< 50 ha	60	1 687	35 676
50 to 100	48	3 683	68 537
100 to 150	42	4 917	96 900
150 to 200	37	6 532	137 012
200 to 250	23	5 084	103 952
250 to 300	17	4 653	100 441
300 to 400	16	5 615	127 223
400 to 500	10	4 283	78 972
> 500 ha	7	5 529	124 398

Table 3

Total and percentage cane area in different soil categories and ts/ha/annum during three milling seasons

Soil category	Total ha cane (3 yr mean)	Per cent cane area	ts/ha/an 1991	ts/ha/an 1992	ts/ha/an 1993
0	2 138	5,2	4,94	4,6	2,01
1	4 905	11,9	5,58	5,31	2,34
2	6 781	16,5	5,44	5,23	2,25
3	9 902	24,1	6,15	6,3	3,25
4	11 298	27,5	5,93	6,56	2,85
5	6 092	14,8	6,98	7,53	3,62
Mean 3,05	Total 41 116	Total 100%	Mean 5,96	Mean 6,16	Mean 2,86

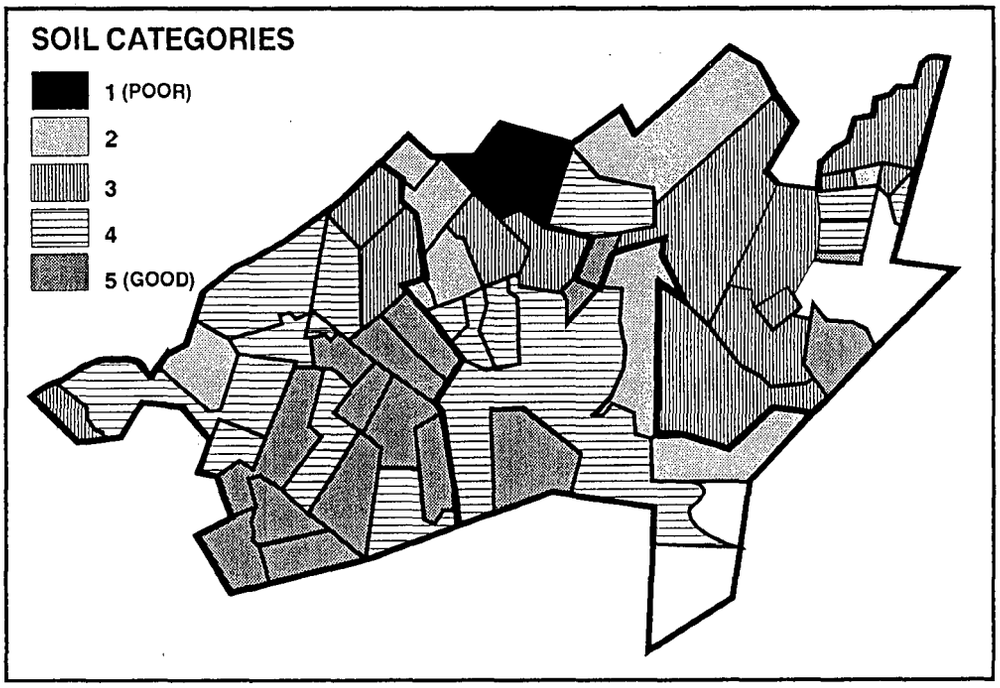

FIGURE 2 A map of portion of the Natal Midlands region showing different soil categories on farms.

rating for soils over the entire area is 3,05, which highlights the quality of the soils as one of the region's principle resources (Table 3).

This is further illustrated in Figure 2. It is noteworthy that farms with a high soil range usually have the higher rainfall.

The relationship between management proficiency and yield is presented in Table 4.

Although individual management ratings must remain confidential, the region has an overall management rating of 3,79 which is also regarded as good.

During the three milling seasons 1991-92 to 1993-94, which included a season of drought, the soils rated 3 (9 902 ha or 24% of the cane area) produced 5,24 tons sucrose/ha/annum with a seasonal rainfall of 806 mm (Tables 3 and 5). The rainfall was 90% of LTM. In a normal season 5,82 ts/ha/annum would be the projected potential of these soils at current levels of management efficiency and technology application.

Table 5

Mean ts/ha/annum, mean seasonal rainfall and long term rainfall representing the various soil categories

Soil category	Means ts/ha/an 1991 to 1994	Mean seasonal rain (mm) 1990 to 1993	Long term rainfall (mm)
0	3,89	715	818
1	4,42	714	817
2	4,31	747	849
3	5,24	806	896
4	5,01	816	961
5	6,03	802	965
	Mean 4,97	Mean 782 mm	Mean 903 mm

Table 4

Total and percentage cane areas in different management categories and ts/ha/annum during three milling seasons

Management category	Total ha cane −3 yr mean	Per cent cane area	ts/ha/an 1991	ts/ha/an 1992	ts/ha/an 1993
0	95	0,2	3,85	4,14	0,89
1	733	1,8	5,2	4,62	1,67
2	4 777	11,6	4,96	4,98	2,37
3	6 965	16,9	5,87	5,52	2,52
4	18 038	43,9	5,82	5,98	2,82
5	10 508	25,6	6,79	7,62	3,47
Mean 3,79	Total 41 116	Total 100%	Mean 5,96	Mean 6,16	Mean 2,86

The sucrose production in various rainfall zones is shown in Figure 3. It is noteworthy that in normal seasons the areas with the highest rainfall do not produce the greatest yields. However, this trend was not as apparent in the 1993-94 drought season. It is postulated that more cloud cover and mist in the areas of high rainfall, or lower temperatures associated with the mist at high altitudes, are possible reasons for this result.

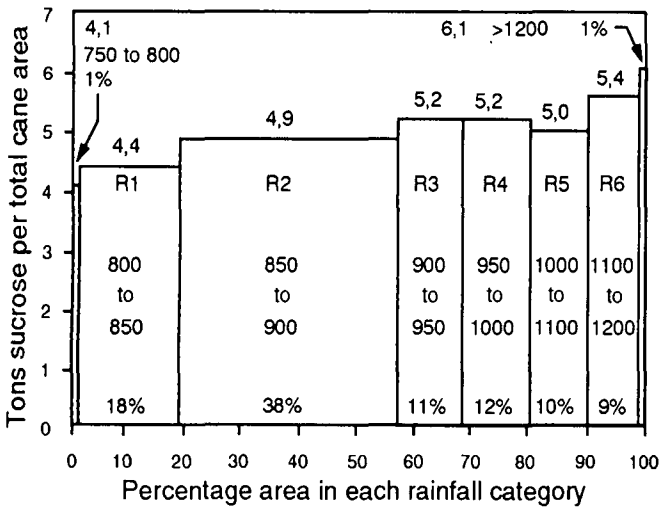

FIGURE 3 The effect of long term rainfall on sucrose production in the Natal Midlands during three milling seasons.

The influence of soils on sucrose yields during the three seasons 1991-92 to 1993-94 is shown in Figure 4.

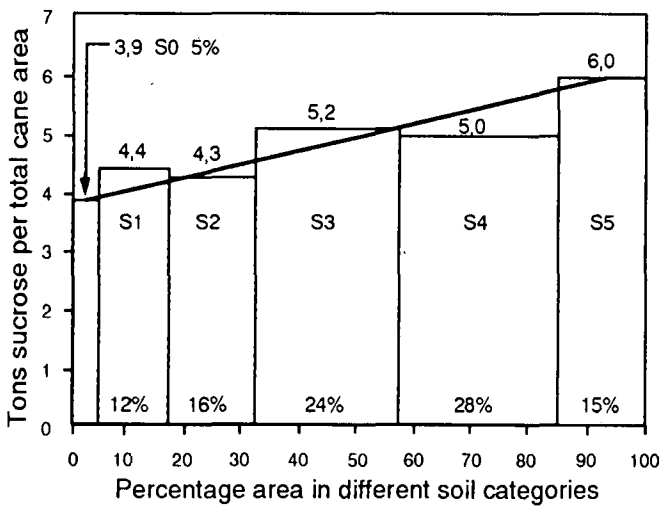

FIGURE 4 The effect of soil types on sucrose production in the Natal Midlands during three milling seasons.

(Footnote: the percentage land areas in each of the different soil categories is plotted on the X-axis of the graph).

The slope of the curve indicates the effect that soils have on production. It is also noteworthy that the dip in the production curve for category 4 soils is probably because most of the heavy red soils have been included in this group. As these soils have a high wilting point, the moisture from light rains which fell was less readily available to the crop than similar rains which fell on the loamy soils of categories 3 and 5.

The effects of management on sucrose production are shown in Figure 5. It is clear that management influences production as much as do rainfall or soils, and possibly more so.

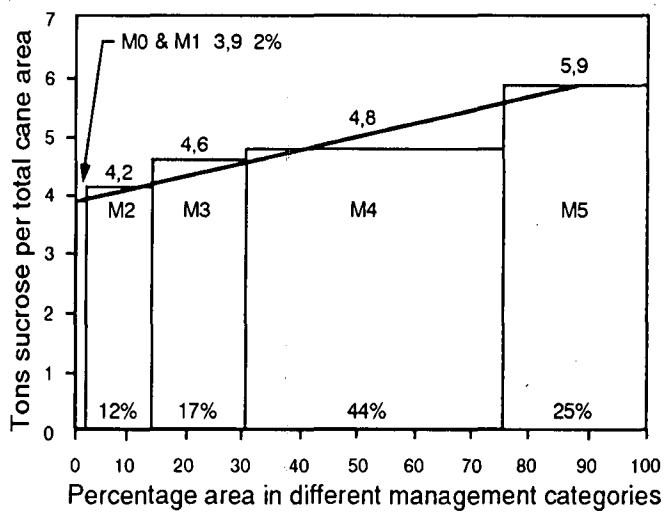

FIGURE 5 The effect of management on sucrose production in the Natal Midlands during three milling seasons.

The 1993-94 crop was subjected to two consecutive years of drought conditions, together with serious widespread frost damage during the first season. Production of the whole region dropped to 47% of the average sucrose production for the previous two seasons.

The effect of the drought and the influence of the frost varied considerably between wards. This is illustrated in Table 6, where production figures for two contrasting groupings of wards are presented.

Table 6

The effects of drought and frost on two contrasting groups of wards

Wards badly affected by drought and frost

Ward number	ts/ha/an 1993	Rain on the 24 mth crop (mm)	Percentage of LTA rain
10	3,25	1 094	60
12	1,0	968	60
13	1,62	986	58
16	2,23	1 088	64
	Mean 2,02	Mean 1 034 mm	Mean 60,5 %

Wards less affected by drought and frost

6	3,09	1 230	76
7	3,47	1 197	71
8	4,33	1 249	65
9	3,66	1 424	76
	Mean 3,64	Mean 1 275 mm	Mean 72 %

In those wards where drought and frost were most severe (wards 10, 12, 13 and 16), production dropped to 34% of the mean of the previous two years. This was from a rainfall of 1 034 mm or 60% of normal. In wards 6, 7, 8 and 9, production dropped to 63% of the previous two years, but the rainfall was 1 284 mm, or 74% of normal, and the frost was less severe.

The above examples show how norms can be obtained which can validate, refine or be compared with existing norms obtained from FRS data or those derived from crop modelling. All this information can be used to facilitate strategic decision making. For example, a mill group may improve its cane quality by calling for deliveries from poor soils, frost affected or drought stressed areas of the district before the cane starts to deteriorate. This would assist mill group boards to determine which growers should be given priority for additional early cane deliveries, and the likely tonnages which might be involved.

The implications of this method of farm assessments are far reaching. For example, if an individual grower performs below the norm established for his set of resources, his management must be questioned. Conversely, growers performing above the norms may be managing their farms better. This could be of use to extension officers. In effect, the project is a continuing situation survey; allowing more accurate targeting of appropriate extension messages to specific grower groups based on well collated facts.

Conclusions

This method of conducting farm assessments is not a replacement of quantitative information collection such as the mapping of soils, climate and land types. Nor does it replace the various uses of GIS, but it is rather an attempt to collate, quantify, and use data which is available at farm and ward levels. As the information was also relatively easy and quick to obtain, the method described should be of interest to other mills personnel and extension staff where it can be adapted to accommodate any set of information and data, and applied to identify factors and problems which limit cane production. Management practices which can be applied to overcome them and bring about improved productivity will also be more clearly identified.